CMBEBiH 2015

1st Conference on Medical and Biological Engineering in Bosnia and Herzegovina

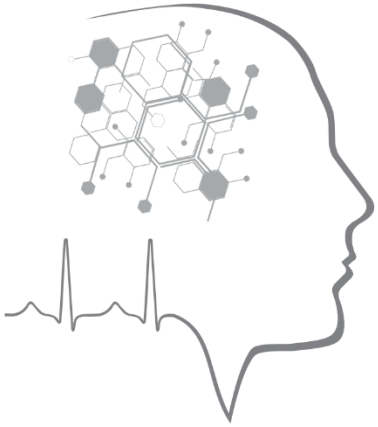
Expand your horizons through biomedical engineering

PROGRAM & ABSTRACT BOOK

March 13-15, 2015
Sarajevo, Bosnia and Herzegovina

1st Conference on Medical and Biological Engineering in Bosnia and Herzegovina

Expand your horizons through biomedical engineering



CMBEBiH 2015

PROGRAM & ABSTRACT BOOK

March 13-15, 2015

Sarajevo, Bosnia and Herzegovina

CONTENTS

WELCOME

It is my great pleasure to welcome you at the 1stConference on Medical and Biological Engineering in Bosnia and Herzegovina (CMBEBIH 2015) held in Sarajevo from 13th to 15th of March 2015. It is a true joy to share with you this very special event, as CMBEBIH is the first Conference of Biomedical Engineering in our country and hopefully it will become a tradition for all of us.

Sarajevo is a special place. Sarajevo, the host city of the CMBEBiH2015, is the meetingpoint of four world's largest religions, the unique connection of east and west. It is the leading political, social and cultural center of Bosnia and Herzegovina and one of the most interesting tourist destinations in Europe. Many come for the first time, and are enchanted by the soul of this place. And they keep returning.

The general theme of CMBEBIH 2015 is: „Expand your horizonst hrough biomedical engineering". The Conference program consists of Plenary/Keynote lectures, oral and poster sessions, workshops, special sessions, round table discussions and student workshops.

Members of the Bosnia and Herzegovina Medical and Biological Engineering Society are very proud that they were the initiators and organizers of the 1stConference in our country. Also, special thanks to our collaborators, the International Federation for Medical and Biological Engineering, Academy of Science and Arts of Bosnia and Herzegovina, University of Sarajevo, University of Tuzla, International Burch University, University of Bihac and University of Zenica for their continuous support through this process.

I would like to thank all the members of the CMBEBIH 2015 Conference Committee, Honorary Chairs, Scientific Committee, Sponsors, Partners and Organising Committee for their help before and during the Conference. I also thank all reviewers for their time spent on reviewing the papers and all their comments aimed at helping authors improving their papers. I am particularly grateful to all Keynote Speakers. Finnally, I thank all authors for submitting papers and for their patience through the process.

I feel confident that you will enjoy CMBEBIH 2015 both scientifically and socialy. We will make every effort to make CMBEBIH 2015 an unforgettable event, and an event you will want to attend again next year. This is also the place where you will meet your old friends and make new ones.

Together we will continue on the journey expend horizons through biomedical engineering and we will face new challenges and opportunities that will make us a stronger, more innovative, and most importantly, a more cohesive scientific community.

We look forward to meeting you all in Sarajevo. And we look forward to welcome you back in the future, because, believe me, you will want to come back!

Almir Badnjević
Conference Chair
President of Bosnia and Herzegovina Medical
and Biological Engineering Society

COMMITTEES

Conference Chair

Badnjević Almir, Bosnia and Herzegovina Medical and Biological Engineering Society, Verlab, Verification Laboratory, Sarajevo, Bosnia and Herzegovina

Conference Co-chairs

Omerhodžić Ibrahim, Bosnia and Herzegovina Medical and Biological Engineering Society, Clinical Centre University of Sarajevo

Dedić Mirza, Bosnia and Herzegovina Medical and Biological Engineering Society, University of Sarajevo, Faculty of Pharmacy

Honorary Chairs

Magjarević Ratko, President of Internation Federation of Medical and Biological Engineering (IFMBE)

Avdispahić Muharem, Rector of University of Sarajevo

Antunović Ranko, University of East Sarajevo, Faculty of Mechanical Engineering Behlilović Narcis, University of Sarajevo, Faculty of Electrical Engineering

Bodonyi Claire, Embassy of France in Bosnia and Herzegovina

Džaferović Ejub, University of Sarajevo, Faculty of Mechanical Engineering

Hadžović-Džuvo Almira, University of Sarajevo, Faculty of Medicine

Hodžić Atif, University of Bihać, Faculty of Technical Engineering

Kunosić Suad, University of Tuzla, Faculty of Science

Ljuca Farid, Pro rector for scientific research of University of Tuzla

Mujagić Zlata, University of Tuzla, Faculty of Pharmacy

Pjanić Edin, University of Tuzla, Faculty of Electrical Engineering

Šahinović Refik, Rector of University of Bihać

Škrijelj Rifat, University of Sarajevo, Faculty of Science

Uzunoglu Mehmet, International Burch University

Završnik Davorka, University of Sarajevo, Faculty of Pharmacy

Zečić Dževad, Rector of University of Zenica

Scientific Committee

President of Scientific Committee: MujčićAljo, University of Tuzla, Faculty of Electrical Engineering

Aganović Damir, Clinical Center University of Sarajevo

Avdagić Zikrija, University of Sarajevo, Faculty of Electrical Engineering

Avdaković Samir, University of Sarajevo, Faculty of Electrical Engineering

Babić Zdenka, University of Banja Luka, Faculty of Electrical Engineering

Beganović Adnan, Clinical Centre University of Sarajevo

Begić Zijo, Clinical Centre University of Sarajevo

Biščević Mirza, Clinical Centre University of Sarajevo, Faculty of Medicine

Bečić Fahir, University of Sarajevo, Faculty of Pharmacy

Bošković Dušanka, University of Sarajevo, Faculty of Electrical Engineering

Busuladžić Mustafa, University of Sarajevo, Faculty of Medicine

Božić Milorad, University of Banja Luka, Faculty of Electrical Engineering

Čorić Jozo, University of Zenica, Faculty of Health Studies Zenica

Džudžević-Čančar Hurija, University of Sarajevo, Faculty of Pharmacy

Hasić Sabaheta, University of Sarajevo, Faculty of Medicine

Hukić Mirsada, Academy of sciences and arts of Bosnia and Herzegovina

Huseinagić Haris, University Clinical Center Tuzla, Faculty of Medicine Tuzla

Jadrić Radivoj, University of Sarajevo, Faculty of Medicine

Kiseljaković Emina, University of Sarajevo, Faculty of Medicine

Kovačević Peđa, Univesity of Banja Luka, Faculty of Medicine

Kozarić Amina, International Burch University Sarajevo

Lacković Igor, University of Zagreb, Faculty of Electrical Engineering and Computing Zagreb

Marjanović Damir, International Burch University Sarajevo

Nurkić Midhat, University of Tuzla, Faculty of Medicine, University Clinical Center Tuzla

Mešić Elmedin, University of Sarajevo, Faculty of Mechanical Engineering

Mašić Izet, University of Sarajevo, Faculty of Medicine

Omanović Mikličanin Enisa, University of Sarajevo, Faculty of agricultural and food science

Omerbašić Ago, University of Sarajevo, Faculty of Medicine

Pilav Ilijaz, Clinical Center University of Sarajevo, Faculty of Medicine

Rotim Krešimir, President of Southeast Europe Neurosurgical Society

Sapčanin Aida, University of Sarajevo, Faculty of Pharmacy

Stojanović Radovan, University of Montenegro, Faculty of Electrical Engineering

Solakovic Nedim, University of Bihac

Subasi Abdulhamit, International Burch University

Suljanović Nermin, University of Tuzla , Faculty of Electrical Engineering

Turan Yusuf, International Burch University Sarajevo

Velija Zelija Ašimi, Clinical Center University of Sarajevo

Vehabović Midhat, Bosnalijek Sarajevo

Vranić Edina, University of Sarajevo, Faculty of Pharmacy

Zajc Matej, University of Ljubljana, Faculty of Electrical Engineering

Zubčević Smail, Clinical Center University of Sarajevo, Faculty of Medicine

Organising Commitee

Begić Edin

Binakaj Zahida

Čatić Tarik

Dedić Adi

Drljević Harun

Gurbeta Lejla

Hadžić Mirsad

Herenda Safija

Hrvat Emina

Huskić Vildana

Insanić Jusufović Fatima

Kadić Ajdin

Kadić Azra

Kadić Nedžad

Klepo Lejla

Kulović Edin

Maleškić Emina

Ostojić Jelena

Rovčanin Bekir

Škrijelj Venesa

Tahto Ema

Trogrlić Darko

PARTNERS

Organised by:

Co-Organiser

Endorsed by:

Partners:

Exclusive media partners:

Friend:

Conference

Tourist partner:

Media partners:

SPONSORS:

Golden sponsor:

Silver sponsor:

Sponsors:

CONFERENCE THEMES

1. BIOMEDICAL SIGNAL PROCESSING

Physiological systems modeling
Time-frequency and time scale analysis
Nonlinear dynamic analysis
Adaptive and parametric filtering and estimation
Pattern recognition and soft computing techniques
Data mining and processing

2. BIOMEDICAL IMAGING AND IMAGE PROCESSING

Magnetic resonance imaging / Computed tomography / Mammography
Ultrasound imaging / Optical imaging and microscopy
PET and SPECT
Electrical and magnetic source imaging / Impedance imaging
Multimodality imaging / Novel imaging modalities
Image processing, analysis and classification

3. BIOSENSORS AND BIOINSTRUMENTATION

Physical sensors and sensor systems
Bioelectric, biological and chemical sensors and sensor systems
Physiological monitoring / Instrumentation / Integrated systems
Implantable technologies, sensors and systems
Wearable sensors / Body area and wireless sensor networks / Telemetric systems

4. BIO-MICRO/NANO TECHNOLOGIES

Internal, implanted and portable miniaturized systems
BioMEM / NEMS
Microfluidics / Lab-on-a-chip devices
Nano-biotechnology

5. BIOMATERIALS

Biomaterials for sensing and actuation
Biomimetics, bioinspired and patterned biomaterials
Biomaterials in cellular and tissue engineering

6. BIOMECHANICS, ROBOTICS AND MINIMALLY INVASIVE SURGERY

Musculoskeletal models and human movement analysis

Orthotic, prosthetic and rehabilitation robotics and biomechanics

Cardiovascular and respiratory fluid mechanics and biomechanics

Human-robot interaction / Robot-aided surgery

Biologically inspired robotics / Micro-biorobotics

Minimally invasive surgery

7. CARDIOVASCULAR, RESPIRATORY AND ENDOCRINE SYSTEMS ENGINEERING

Cardiac and respiratory function and modeling

Cardiovascular and respiratory signal processing and modeling

Cardiovascular electrophysiology and regulation

Respiratory disease / Sleep disorder / Respiratory engineering

Endocrine systems, function, modeling and control

8. NEURAL AND REHABILITATION ENGINEERING

Brain physiology and modeling

Neural signal processing

Neural interfaces and regeneration

Motor and sensory neuroprostheses/ Brain-machine interface

Rehabilitation and wearable technologies

Brain functional imaging / Neurological disorders

9. MOLECULAR, CELLULAR AND TISSUE ENGINEERING

Biomaterial-cell interactions

Cellular force transduction

Embryonic and stem cells in regenerative medicine

Electrical fields at the cell and protein scale

Electroporation

Tissue engineering / Scaffolds in tissue engineering

10. BIOINFORMATICS AND COMPUTATIONAL BIOLOGY

Bioinformatics and computational modeling of complex omic data

Systems biology / Systems medicine

Translational biomedical informatics for clinical applications

Modeling of molecular, cellular and organ pathways

11. CLINICAL ENGINEERING AND HEALTH TECHNOLOGY ASSESSMENT

Clinical engineering / Health technology management
Health technology policy, economics and ethics / Health technology assessment
Technology development, commercialization, assessment and management
Safety and human factors engineering for medical devices and systems
IT in medicine / Equipment interconnectivity and integration
Clinical engineering and disaster preparadness

12. HEALTH INFORMATICS, E-HEALTH AND TELEMEDICINE

Personal, pervasive, preventive, and participatory health systems
Ambient assisted living / Smart homes
Body area networks / Wireless
technologies mHealth/ eHealth /
Telemedicine
Health information management / Electronic health records
Decision support methods and systems

13. BIOMEDICAL ENGINEERING EDUCATION

Biomedical engineering education and curriculum development
Biomedical undergraduate and graduate student research projects
Career development in biomedical engineering

14. PHARMACEUTICAL ENGINEERING

Pharmaceutical Development in Industry
Bio-/Pharmaceutical Manufacturing
Pharmaceutical Devices
Pharmacokinetics

KEYNOTE SPEAKERS

Ratko Magjarevic, Ph.D.

The President of International Federation for Medical and Biological Engineering (IFMBE)

Full Professor of Electronic Instrumentation and Biomedical Engineering

University of Zagreb

Title:Challenges of Biomedical Engineering – Research, Industrialization, Sustainability

Leandro Pecchia, Ph.D.

Treasurer of the Health Technology Assessment Division of the International Federation of Medical and Biomedical Engineering (IFMBE)

Assistant Professor of Biomedical Engineering

University of Warwick

Title:Applied Biomedical Signal Processing and Intelligent eHealth for falls prediction in the elderly

Dejan Milosevic, Ph.D.

Academician, Professor of Physics, University of Sarajevo, Faculty of Science Title:Attoscience

Werner Mäntele, Ph.D.

Institut für Biophysik der Johann Wolfgang Goethe-Universität

Title:Spectroscopists do it with Light: Development of Optical Sensors for Medical Applications

Hervé Liebgott, Ph.D.

InstitutUniversitaire de France &Creatis, Lyon, France Title:Ultrasound advanced imaging: beyond anatomy

Mustafa Kahramanyol, Ph.D.

Professor emeritus from Gülhane Military Medical Academy, presently Consultant at Kent ENT

Medical Centre, Ankara, Türkiye
Title:The
GülhaneMastoidectomy

Atilla Aydinli, Ph.D.

Bilkent University, Department of Physics, Turkey

Title:Advances in Plasmonic Detection: Plexcitonic Crystals

Dragan Primorac, Ph.D.

University professor, pediatric medical doctor, forensic expert and geneticist

Title:Personalised medicine: myth or reality

Yves Lemoigne, Ph.D.

IFMP Ambilly France & CERN, Geneva, Switzerland

Title:17 years of high-level education in Medical Physics for Eastern Europe

Mark Bale, Ph.D.

Chair of Bioethics committee of the Council of Europe

Title:Emerging technologies and human rights: what are the challenges?

Mario Medvedec, Ph.D.

Clinical Biomedical Engineer

Professor of Biomedicine and Health; Clinical Medical Sciences; Nuclear Medicine

University Hospital Centre Zagreb, Department of Nuclear Medicine and Radiation Protection

Title:Vision and Provision of Clinical Engineering Division - CED/IFMBE

Damir Marjanovic, Ph.D.

Head of Genetics and Bioengineering Department, International Burch University
Title:Automation of the Forensic DNA Analysis Procedures: Advantages and Challenges

Zijad Dzemic, M.S.

Member of Board of Directors of European Association of National Metrology Institutes (EURAMET), Institute of Metrology of Bosnia

Title:National metrology institute for Quality of life

GENERAL INFORMATION

Organizer: Bosnia and Herzegovina Medical and Biological Engineering Society

Co-organizers: International Burch University and Faculty of Medicine University of Sarajevo

Endorsed by: International Federation for Medical and Biological Engineering (IFMBE), Academy Of Sciences and Arts of Bosnia and Herzegovina, IEEE Section of Bosnia and Herzegovina, University of Sarajevo, University of Tuzla, University of Zenica, University of Bihać.

Sponsors:

Golden sponsorship: Verlab doo

Silver sponsorship: Medtronic

Regular sponsorship: DevLogic, Bosnalijek, Bor Banka, Prevent, Pobjeda- RudetddGoražde, Hotel Europe Sarajevo, Print Design doo

Partners: Faculty of Electrical Engineering (University of Sarajevo), Faculty of Pharmacy (University of Sarajevo), Faculty of Pharmacy (University of Tuzla), University Clinical Center of Sarajevo, Faculty of Mechanical Engineering (University of Sarajevo), Faculty of Mechanical

Engineering (University of East Sarajevo), Faculty of Science (University of Sarajevo)

Conference Friend: Embassy of France with her Excellenay Claire Bodonyi

Partner Associations: Pharmaceutical Chamber of Federation of Bosnia and Herzegovina, Southeast European Neurosurgical Society (SENS), STELEX, BoHeMSA, Pharmaceutical Society of Bosnia and Herzegovina, Association of Students of Medical Faculty, UNUBIH, Federal Medical Chamber of Bosnia and Herzegovina.

Exclusive TV partner: N1 TV

Exclusive Radio partner: RSG radio

Exclusive web media: eKapija portal

Media partners: BH-index, Valetudo, Krajina u srcu.net, krajina.ba, ekskluziva.ba, krupljani.ba, Studomat, biscani.net, FENA

Event partner: IEEE MECO 2015

Tourist partner: Kompas Sarajevo

CONFERENCE VENUE

INTERNATIONAL BURCH UNIVERSITY

Francuske revolucije bb, Ilidza

71000 Sarajevo,

Bosnia and Herzegovina
http://www.ibu.edu.ba/

STUDENT WORKSHOP VENUE

MEDICAL FACULTY, UNIVERSITY OF SARAJEVO

Cekaluša 90, 71000 Sarajevo, Bosna i Hercegovina

Tel: +387 33 226 478
http://mf.unsa.ba//

REGISTRATION:

The registration desk will open as follows: **Friday, March 13:** from 09:00 to 17:00

Saturday, March 14: from 08:00 to 17:00

Sunday, March 15: from 08:00 to 10:00

When registering for the conference, student status is proved with valid student index or any other official document of the university institution.

FEES INCLUDE:

Member and nonmember fee includes:

Conference materials including Program book and Proceedings (on CD/DVD)

Admission to all Conference sessions

Welcome reception

Coffee breaks

Lunches

Guided city tour/Excursion
Conference Galla dinner

Student fee includes:

Conference materials including Proceedings (on CD/DVD)

Admission to all technical sessions

Coffee breaks

Lunches

Welcome reception

Student party

Accompanying person fee includes:

Welcome reception

Conference Galla dinner

The conference materials will be handed to pre-registrated participants upon their arrival.

CERTIFICATE OF ATTENDANCE:

A Certificate of Attendance will be given on Registration desk..

COFFEE BREAKS:

Coffee break will be served in front of session rooms.

INTERNET:

Wireless internet is avaliable in the venue free of charge.

LIABILITY AND INSURANCE:

The organizers cannot be held responsible for accidents to conference participants or accompanying persons, for damage or loss of their personal property, or for cancellation expenses, regardless of cause. Participants are advised to carry out their own insurance arrangements during their stay in Bosnia and Herzegovina.

LUNCHES:

Lunches are included in the fee. Lunches will be served in the Restaurant at the venue of the conference.

PRESENTING AUTHORS INSTRUCTIONS

ORAL PRESENTATIONS:

1. Please make your presence known to one of the chairmen 5 minutes before your session starts and be present during the entire session in which your presentation is scheduled. Time slot for plenary sessions is 60 minutes, including room switching time of 15 minutes.
2. Time slots for oral sessions are 90 minutes. Number of papers in each session is up to 6 meaning that 15 minutes is allocated for each presentation. However, there are exceptions to this rule; therefore, please refer to the final program for actual duration of your presentation.
3. Authors and Speakers must report to the Speakers Area in order to preview and upload their presentations. Files must be handed-in a minimum of 2 hours prior to the start of their session (for morning sessions starting at 9.30h please upload it the day before). We recommend that you take advantage of the early file uploading opportunity. More details will be available soon.
4. All session rooms will be equipped with a data projector and a computer. You do not need to bring your own laptop to the lecture room. Please prepare your presentations for display with aspect ratio 4:3.
5. When building your presentation, use standard fonts (e.g., Times New Roman, Arial, etc.). Basic fonts are included on the session room PC computers, but if an unusual font is used it may not display well.
6. Even if you have submitted your presentation files in advance, please plan to bring the latest version of your presentation to the session on a Windows-readable USB flash Drive or CD-ROM.
7. Computers in conference rooms are equipped with Windows 7, Microsoft Office 2010 package. Apple Mac computers will not be provided in any of the session rooms. If you are using Mac, please check compatibility with Microsoft Office 2010

package or use your own Mac computer if your presentation is created in Apple's "Keynote" presentation application. Videos handed in as an independent file must be coded under standard codec. Users are recommended to preview them in standard universal software, such as VLC Player or Quicktime.

POSTERS:

Poster sessions are a valuable method for authors to present papers and meet with interested attendees for in-depth technical discussions. Therefore, it is important that you display your results clearly to attract people who have an interest in your work and your paper. Your poster should cover the KEY POINTS of your work. The ideal poster is designed to: attract attention; provide a brief overview of your work; initiate discussion and questions.

Use color to highlight and make your poster more attractive, by using pictures, diagrams, cartoons, figures, etc., rather than only text wherever possible. There is however no specific template for the poster: font size and text are free.

Maximum outside dimensions of each poster, including the title, must not exceed 90 cm width x 120 cm height.

SET UP AND DISMANTLING TIMES:

A poster number display will be placed at the top corner of the board. Double sided tape will be supplied at each poster board.

Poster sessions will be held on Saturday, 14th March according to the program.

Poster set up time: 15:.00 – 15:30h at Friday 13th March.

Dismantling time: Sunday 15th March, 13.00-13:300h

Authors are requested to be next to their posters during poster session.

SOCIAL EVENTS

Conference Dinner

Date: March 14, 2015

Time: 20:00

Location: Pivnica Sarajevo (The organizer reserves the right to change the location.)

The Conference dinner will be held in Pivnica (Tavern) Sarajevo. Pivnica (Tavern) Sarajevo is located in the Center of the City. The address is MarsalaTita No 7.

Conference dinner is included in registration fee for delegates (members, nonmembers) and registered accompanying persons. It is not included in student registration fee. Additional tickets will be sold on a first come, first served basis.

More about Location you can find on:

http://www.pivnica-sarajevo.ba/

Students' Party

Date: March 13, 2015

Time: 22:00

Location: Club Jez Sarajevo

Don't miss this great opportunity to connect and expand your network by meeting students from at CMBEBIH2015 students' party in the Club Jez. Located in the Center of Sarajevo, Club Jez is a great place to relax and dance the night away! The club has a luxurious atmosphere and cocktails to match. Our DJ's and live music band will make you dance to the point of exhaustion. Students' party is included in thestudents registration fee. Additional tickets will be sold on site.

More about Location you can find on:

http://www.jez.ba/

PRACTICAL INFORMATION

Venue

The CMBEBIH 2015 will take place at the INTERNATIONAL BURCH UNIVERSITY in Sarajevo (IBU). IBU is located in Ilidza, 8 km from centre and 2 km from airport.

Workshops

Student's workshops will take place at the Faculty of Medicine, University of Sarajevo. Faculty of Medicine is located in the Center of Sarajevo, around 1,5 km from the old town Bascarsija.

Hosting City

Sarajevo is the largest city and country's administrative, economic, cultural, university and sport center. Due to its long and rich history of religious diversity and coexistence Sarajevo has often been called the "Jerusalem of Europe". The history of Sarajevo is very rich. Sarajevo became a city in the 15th century. It is also a place of assassination that sparked World War I. 1984 it was hostcity for Winter Olympics. More recently, Sarajevo underwent the longest siege in modern military history during the Bosnian War.

The city itself has its fair share of hilly terrain, as evidenced by the many steeply inclined streets and residences seemingly perched on the hillsides. The Miljackariver is one of the city's chief geographic features. It flows through the city from the east to the west where eventually meets up with the Bosna river.

Sarajevo Attractions:

- Sarajevo bridges,
- Bascarsija (Bashcharshiy- sightseeing in the old town),
- The City Hall,
- InatKuca (Despite House; House of Spite; House of Pride),
- Tunnel Museum,
- GaziHusrev-beg's mosque,
- Tzar's Mosque or Emperor's mosque,
- Franciscan's monastery and the Church of the Saint Anthony of Padua,
- Cathedral of Jesus' Sacred Heart,
- The Orthodox Cathedral,
- The Old jewish temple,
- Ashkenazi synagogue,
- The Svrzo house,
- Abandoned Winter Olympic sites,
- Discover the delights of Bosnian cuisine (cevap - minced meat and fried onions in bread, burek- pastry stuffed with meat, vegetables or cheese and baklava - a sweet pastry soaked in honey and sprinkled with nuts).

Time zone

- CET – Central European Time (Europe)
- GMT +01:00

Climate

- § medium continental
- § average summer temperature 19,1°C
- § average winter temperature –1,3°C
- § average annual temperature 9,5°C

Population

- § The city of Sarajevo in (the area of) four municipalities (Old City, Center, New City and New Sarajevo) has 297,416 residents.
- § Area: 141,5 km2

Important phone numbers

- § Area code + 387 33
- § Police 122
- § Fire 123
- § Emergency (First Aid) – 124
- § University Clinical Center of Sarajevo, (www.kcus.ba), Bolnicka 25 - 29 70
- § General Hospital "Prim. dr. AbdulahNakas", Kranjceviceva 12 - 28 51 00
- § Dental Clinic, Bolnicka 4a - 21 42 49
- § 24-hour Pharmacy Bascarsija, ObalaKulinabana 40 - 27 23 00, 27 23 01
- § 24-hour Pharmacy Novo Sarajevo, Zmaja od Bosne 51 - 71 38 30, 71 38 31
- § 24-hour PharmacyDobrinja, SalkeLagumdžije 15 - 76 63 80
- § 24-hour Pharmacy Ilidza, EmiraBogunićaČarlija 15 - 76 21 80
- § BIHAMK – Road Assistance, (www.bihamk.ba) - 28 21 21, 1282
- § Telephone Information(www.bhtelecom.ba) - 1182
- § International Airport Sarajevo - 28 91 00
- § Bus Station Sarajevo (www.centrotrans.com) - 21 31 00, 21 30 10
- § Bus Station Lukavica- +387 57 31 73 77
- § Railway Station Sarajevo - 65 53 30
- § Žuti/Yellow Taxi - 66 35 55
- § Sarajevo Taxi - 1515
- § Crveni/Red Taxi - 76 06 00

Electricity

The electric supply is 220V with 50Hz frequency.

Water Supply

It is safe to drink tap water in Sarajevo.

Currency

Currency in BiH is Convertible Mark. The international abbreviation for currency is BAM, while KM is used locally (1,95 KM = 1 Euro). You can exchange your currency in any bank or post office. Banks are generally open from 08:00 to 18:00 on working days, and from 09:00 to 13:00 on Saturdays. Main post office is open from 07:00 to 20:00 from Monday to Saturday.

Public Transport

Sarajevo is well connected with a network of trams, trolley-buses, buses and minibuses. The oneway ticket for an inner-city zone is 1,6 KM if you purchase it in a kiosk and 1,8 KM if you purchase it with a driver. The ticked must be punched as soon as you enter the vehicle. Failure to do so will result in a fine, on the spot. The bus line connecting airport with Bascarsija runs several times per day and it costs 6 KM (3 Euros) one way.

Taxi

Sarajevo has one of the cheapest taxi services in Europe. Several private taxi companies operate in the city 24 hours a day. For example, taking a taxi from Sarajevo Airpost to the city centre will cost between 17 and 20 KM. All vehicles use the taxi meter. The driver will issue the receipt upon a request.

Where to shop

Souvenirs

To pick up authentic souvenirs, head to Baščaršija, the city's Turkish quarter. During its golden period, it boasted 12 000 various shops selling products and services of 80 different craftsmen and tradesmen. Baščaršija's most popular street is Kazandžiluk (Coppersmith Street), where you can find superbly created engraved copper products: džezve (coffee pots), fildžani (cofee cups), ibrici (copper water dish). The city's jewelry makers were well known throughout Ottoman Empire for their particular designs. Jewelry makers (silver and gold smiths) are mostly located on GaziHusrev-begova Street (Zlatarska or Goldsmiths' Street). While in Baščaršija you can also visit the GaziHusrevBey'sBezistan (covered bazaar) which was built between 1537 and 1555 and newly renovated City Hall.

Shopping Centers

Sarajevo is increasingly becoming an interesting shopping destination. Modern boutiques and fashion shops, as well as those featuring designs of local designers, can be found along Ferhadija and Titova Street. We recommend a visit to BBI Center (www.bbicentar.ba), located in the city center and Importanne Center (www.importanne.ba), located near the Wilson's Walkway and Historical Museum of BiH. There is also the recently opened Alta (www.alta.ba) as well as SCC (www.sarajevocitycenter.com) shopping center on MarijinDvor.

Natural landmarks

VreloBosne

VreloBosne (engl.: Spring of the Bosna River) is the spring of the River Bosna located in the central region of Bosnia and Herzegovina, southwest of Sarajevo.

The park is usually entered by foot or by horse-carriage via the main avenue leading into it. The avenue itself contains traditional buildings from the Austro-Hungarian-era offering a peek into the luxuries of the past.

The paths and roads inside the park are ideal for walks and give the visitors the opportunity to take a closer look at the bubbling streams and waterfalls. Typical animals are ducks and swans among others.

Olympic mountains

Igman, Bjelašnica and Jahorina are aproximatly 40 minutes drive form the city center. These Mountains hosted Winter Olympics in 1984. Extraordinary configuration, good quality snow, suitable climate make these mountains worth of seeing.

PROGRAME AT A GLANCE

Program of the 1th Conference of Medical and Biological Engineering in Bosnia and Herzegovina (CMBEBIH 2015), Sarajevo, from 13th to 15th March 2015.

From	To	FRIDAY 13 March 2015	From	To	SATURDAY 14 March 2105	From	To	SUNDAY 15. MARCH 2015
9:00	9:30	Registration	9:00	9:30	PL2	9:00	9:30	S9 / S10
9:30	10:00		9:30	10:00		9:30	10:00	
10:00	10:30	Opening Ceremony	10:00	10:30		10:00	10:30	
10:30	11:00	PL1	10:30	11:00	Coffe Break- Poster Session	10:30	11:00	Coffee Break
11:00	11:30		11:00	11:30		11:00	11:30	
11:30	12:00		11:30	12:00	PL3	11:30	12:00	S11 / S12 / S13
12:00	12:30		12:00	12:30		12:00	12:30	
12:30	13:00	SPL1	12:30	13:00		12:30	13:00	Closing Ceremony
13:00	13:30		13:00	13:30	SPL2	13:00	13:30	
13:30	14:00	Lunch Break	13:30	14:00	Lunch Break	13:30	14:00	
14:00	14:30		14:00	14:30		14:00	14:30	
14:30	15:00	Student Workshop at Medical Faculty / S1 / S2	14:30	15:00	Student Workshop at Medical Faculty / S5 / S6	14:30	15:00	
15:00	15:30		15:00	15:30		15:00	15:30	
15:30	16:00		15:30	16:00		15:30	16:00	
16:00	16:30	Coffee Break	16:00	16:30	Coffee Break	16:00	16:30	
16:30	17:00	S3 / S4	16:30	17:00	S7 / S8	16:30	17:00	
17:00	17:30		17:00	17:30		17:00	17:30	
17:30	18:00		17:30	18:00		17:30	18:00	
18:00	18:30		18:00	18:30	SPW2	18:00	18:30	
18:30	19:00		18:30	19:00		18:30	19:00	
19:00	19:30		19:00	19:30		19:00	19:30	
19:30	20:00		19:30	20:00		19:30	20:00	
20:00	20:30		20:00	20:30	Conference Dinner	20:00	20:30	
20:30	21:00		20:30	21:00		20:30	21:00	
21:00	21:30		21:00	21:30		21:00	21:30	
21:30	22:00		21:30	22:00		21:30	22:00	
22:00	23:00	Student Party	22:00	23:00		22:00	23:00	
23:00	0:00		23:00	0:00		23:00	0:00	
0:00	1:00		0:00	1:00		0:00	1:00	
1:00	2:00		1:00	2:00		1:00	2:00	

S1	BIOMEDICAL SIGNAL PROCESSING
S2	BIOMEDICAL IMAGING AND IMAGE PROCESSING
S3	BIOSENSORS AND BIOINSTRUMENTATION
S4	BIOSENSORS, BIOINSTRUMENTATION AND BIOMATERIALS
S5	BIOMECHANICS, ROBOTICS AND MINIMALLY INVASIVE SURGERY
S6	CARDIOVASCULAR, RESPIRATORY AND ENDOCRINE SYSTEMS ENGINEERING
S7	MOLECULAR, CELLULAR AND TISSUE ENGINEERING
S8	CLINICAL ENGINEERING AND HEALTH TECHNOLOGY ASSESSMENT
S9	HEALTH INFORMATICS, E-HEALTH AND TELEMEDICINE I
S10	HEALTH INFORMATICS, E-HEALTH AND TELEMEDICINE II
S11	BIOMEDICAL ENGINEERING EDUCATION
S12	PHARMACEUTICAL ENGINEERING
S13	STUDENT SESSION

PL1-1	Challenges of Biomedical Engineering – Research, Industrialization, Sustainability
PL1-2	Applied Biomedical Signal Processing and Intelligent eHealth for falls prediction in the elderly
PL1-3	Personalised medicine: myth or reality
PL1-4	The Gülhane Mastoidectomy
PL1-5	Emerging technologies and human rights: what are the challenges?
PL2-1	Spectroscopists do it with Light: Development of Optical Sensors for Medical Applications
PL2-2	Attoscience
PL2-3	Ultrasound advanced imaging: beyond anatomy
PL2-4	Automation of the Forensic DNA Analysis Procedures: Advantages and Challenges
PL2-5	17 years of high-level education in Medical Physics for Eastern Europe
PL3-1	Vision and Provision of Clinical Engineering Division - CED/IFMBE
PL3-2	Advances in Plasmonic Detection: Plexcitonic Crystals
PL3-3	National metrology institute for Quality of life

PROGRAM – DAY 1 – FRIDAY 13 March 2015

FRIDAY 13 March 2015	From	To
Registration	9:00	9:30
	9:30	10:00
Opening Ceremony	10:00	10:30
PL1	10:30	11:00
	11:00	11:30
	11:30	12:00
	12:00	12:30
SPL1	12:30	13:00
	13:00	13:30
Lunch Break	13:30	14:00
	14:00	14:30
Student Workshop at Medical Faculty: S1 / S2	14:30	15:00
	15:00	15:30
	15:30	16:00
Coffee Break	16:00	16:30
Student Workshop at Medical Faculty: S3 / S4	16:30	17:00
	17:00	17:30
	17:30	18:00
	18:00	18:30
	18:30	19:00
	19:00	19:30
	19:30	20:00
	20:00	20:30
	20:30	21:00
	21:00	21:30
	21:30	22:00
Student Party	22:00	23:00
	23:00	0:00
	0:00	1:00
	1:00	2:00

S1	BIOMEDICAL SIGNAL PROCESSING
S2	BIOMEDICAL IMAGING AND IMAGE PROCESSING
S3	BIOSENSORS AND BIOINSTRUMENTATION
S4	BIOSENSORS, BIOINSTRUMENTATION AND BIOMATERIALS

PL1-1	Challenges of Biomedical Engineering – Research, Industrialization, Sustainability
PL1-2	Applied Biomedical Signal Processing and Intelligent eHealth for falls prediction in the elderly
PL1-3	Personalised medicine: myth or reality
PL1-4	The Gülhane Mastoidectomy
PL1-5	Emerging technologies and human rights: what are the challenges?

PROGRAM – DAY 2 – SATURDAY 14 March 2015

SATURDAY 14 March 2105	From	To
PL2	9:00	9:30
	9:30	10:00
	10:00	10:30
Coffe Break- Poster Session	10:30	11:00
	11:00	11:30
PL3	11:30	12:00
	12:00	12:30
	12:30	13:00
SPL2	13:00	13:30
Lunch Break	13:30	14:00
	14:00	14:30
Student Workshop at Medical Faculty: S5 / S6	14:30	15:00
	15:00	15:30
	15:30	16:00
Coffee Break	16:00	16:30
Student Workshop at Medical Faculty: S7 / S8	16:30	17:00
	17:00	17:30
	17:30	18:00
SPW2	18:00	18:30
	18:30	19:00
	19:00	19:30
	19:30	20:00
Conference Dinner	20:00	20:30
	20:30	21:00
	21:00	21:30
	21:30	22:00
	22:00	23:00
	23:00	0:00
	0:00	1:00
	1:00	2:00

S5	BIOMECHANICS, ROBOTICS AND MINIMALLY INVASIVE SURGERY
S6	CARDIOVASCULAR, RESPIRATORY AND ENDOCRINE SYSTEMS ENGINEERING
S7	MOLECULAR, CELLULAR AND TISSUE ENGINEERING
S8	CLINICAL ENGINEERING AND HEALTH TECHNOLOGY ASSESSMENT

PL2-1	Spectroscopists do it with Light: Development of Optical Sensors for Medical Applications
PL2-2	Attoscience
PL2-3	Ultrasound advanced imaging: beyond anatomy
PL2-4	Automation of the Forensic DNA Analysis Procedures: Advantages and Challenges
PL2-5	17 years of high-level education in Medical Physics for Eastern Europe
PL3-1	Vision and Provision of Clinical Engineering Division - CED/IFMBE
PL3-2	Advances in Plasmonic Detection: Plexcitonic Crystals
PL3-3	National metrology institute for Quality of life

PROGRAM – DAY 3 – SUNDAY 15 March 2015

From	To	SUNDAY 15. MARCH 2015
9:00	9:30	S9
9:30	10:00	S9
10:00	10:30	S9
10:30	11:00	Coffee Break
11:00	11:30	S11
11:30	12:00	S11
12:00	12:30	S11
12:30	13:00	Closing Ceremony
13:00	13:30	Closing Ceremony
13:30	14:00	
14:00	14:30	
14:30	15:00	
15:00	15:30	
15:30	16:00	
16:00	16:30	
16:30	17:00	
17:00	17:30	
17:30	18:00	
18:00	18:30	
18:30	19:00	
19:00	19:30	
19:30	20:00	
20:00	20:30	
20:30	21:00	
21:00	21:30	
21:30	22:00	
22:00	23:00	
23:00	0:00	
0:00	1:00	
1:00	2:00	

S9	HEALTH INFORMATICS, E-HEALTH AND TELEMEDICINE I
S10	HEALTH INFORMATICS, E-HEALTH AND TELEMEDICINE II
S11	BIOMEDICAL ENGINEERING EDUCATION
S12	PHARMACEUTICAL ENGINEERING
S13	STUDENT SESSION

Conference Program Friday, March 13 2015

09:00 - 10:00 Registration

10:00 - 10:30 Opening Ceremony, Conference Hall

Ika Ferer Gotic- CMBEBIH Programme Manager, Editor in chief, N1-CNN

Welcome Speeches

Almir Badnjević – CMBEBIH 2015 Chair
Aljo Mujčić – President of the Scientific Committee of CMBEBIH 2015
Mehmet Uzunoğlu – Rector of International Burch University
Almira Hadžović – Džuvo – Dean of Faculty of Medicine, University of Sarajevo
Mirsada Hukić – Representative of Academy of Sciences and Arts of Bosnia and Herzegovina
Senaid Memić – Mayor of Ilidža Municipality
Ratko Magjarević – President of International Federation for Medical and Biological Engineering (IFMBE)

10:30 - 12:30 Plenary Lectures I, Conference Hall

Ratko Magjarevic, Ph.D. – *Challenges of Biomedical Engineering – Research, Industrialization, Sustainability*
Leandro Pecchia, Ph.D. - *Applied Biomedical Signal Processing and Intelligent eHealth for Falls Prediction in the Elderly*
Dejan Milosevic, Ph.D. - *Attoscience*
Mustafa Kahramanyol, Ph.D. - *The Gülhane Mastoidectomy*
Mark Bale, Ph.D. - *Emerging Technologies and Human Rights: What Are the Challenges?*

13:00 - 13:20 Special Lecture I, Conference Hall

SPL1: Božidar Ferek – Petrić, Ph.D. – MEDTRONIC: *Remote Pacemaker Programming - 15 Years After*

13:30 -14:30 Lunch Break, Burch Restaurant

13:30 – 14:00 Student transfer for Student Workshop to the Faculty of Medicine

14:00 – 15:00 Lunch Break for Students at Faculty of Medicine

15:00 – 20:00 Student's Workshop, Faculty of Medicine

SW1-1: *Testing the Safety of Automated External Defibrilators* – University of Novi Sad, Faculty of Technical Sciences, Novi Sad, Serbia

SW1-2: *Evaluation of repetitive physical exercise using inertial and magnetic sensors* – University of Zagreb, Faculty of Eletrical Engineering and Computing, Zagreb, Croatia

SW1-3: *ERP signal measurement and processing* – University of Novi Sad, Faculty of Technical Sciences, Novi Sad, Serbia

SW1-4: *ZigBee wireless communication protocol and comparison with affined standards commonly used in body sensor networks* – University of Novi Sad, Faculty of Technical Sciences, Novi Sad, Serbia

SW1-5: *Software differentiation of occurrence of acute myocardial infarction and display of its localization* – University of Sarajevo, Faculty of Electrical Engineering and Faculty of Medicine, Sarajevo, Bosnia and Herzegovina

14:30 - 16:00 Plenary Session I, Sarajevo Room (207)

BIOMEDICAL SIGNAL PROCESSING

Chairs: ***Leandro Pechia,*** *University of Warvick (UK)****, Dusanka Boskovic,*** *University of Sarajevo (Bosnia and Herzegovina)*

S1-1: *Investigation of Heart Rate Variability using Wavelet Packet Transform in Major Depressive Disorder,* Akar S.A, Kara S, Bilgiç V.

S1-2: *Theoretical and Experimental UV-Vis Spectroscopic Analysis Of Chamazulene*, Salihovic M, Sapcanin A.

S1-3: *Sleep stage classification using AR Burg and C4.5 classifier* Arnaut N, Subasi A.

S1-4: *EEG verified diagnosis of epilepsy using Hilbert Huang transform*, Ibric S, Avdakovic S, Omerhodzic I, Suljanovic N, Mujcic A.

S1-5: *Surface EMG pattern recognitionby using DWT feature extraction and SVMclassifier,* Podrug E.

14:30-16:00 Plenary Session II, Motive Room (208)

BIOMEDICAL IMAGING AND IMAGE PROCESSING

Chairs: ***Adnan Beganovic,*** *University Clinical Centre Sarajevo (Bosnia and Herzegovina),* ***Haris Huseinagic,*** *University of Tuzla (Bosnia and Herzegovina)*

S2-1: *Three Dimensional Airway Tree Segmentation from Computed Tomography Lung Images,* Mesanovic N, Huseinagic H, Smajic E.

S2-2: *Texture-based automatic polyp detection in colonoscopy videos,* Avramovic A, Sevo I.

S2-3: *Three-dimensional rotational angiography in the control of the results of endovascular coiling of intracranial aneurysms,* Huseinagic H, Moranjkic M, Mesanovic N.

S2-4: *RTG diagnostics in paediatric infirmary,* Begic N, Begic Z, Begic E, Dobraca A, Mandzuka M.

S2-5: *Fractal Analysis of Digital Mammograms,* Đedović E, Gazibegović-Busuladžić A, Beganović A.

16:00-16:30 Coffee Break

16:30-18:00 Plenary Session III, Sarajevo Room (207)

BIOSENSORS AND BIOINSTRUMENTATION

Chairs: ***Mustafa Busuladzic,*** *University of Sarajevo (Bosnia and Herzegovina),* ***Almir Badnjevic*** *Verification Laboratory VERLAB (Bosnia and Herzegovina)*

S3-1: *Metamaterial Absorber Based Biosensor Applications,* Karaaslan M, Dincer F, Bakir M, Unal E, Delihacioglu K, Ozer Z, Akgol O, Sabah C.

S3-2: *Biosensor Application by Using Gammadion Shaped Chiral Metamaterials,* Karaaslan M, Bakir M, Dincer F, Unal E, Delihacioglu K, Ozer Z, Akgol O, Sabah C.

S3-3: *A virtual environment to test and validate model based insulin infusion therapies,* Smajlagic D, Palumbo P.

S3-4: *Adjustment of quantification of catecholamines and their metabolites in biological samples using the Shimadzu LCSOL SINGLE-LC EN HPLC system with electro- chemical detection,* Ibragic S, Sofic E.

S3-5: *A polymer-based, optical biosensor chip for detection of microbial leucine aminopetidase (LAP) activity and its potential as a novel, medical diagnostic test,* Ibrisimovic- Mehmedinovic N, Ibrisimovic M, Kesic A.

16:30-18:00 Plenary Session IV, Motive Room (208)

BIOSENSORS, BIOINSTRUMENTATION AND BIOMATERIALS

Chairs: ***Enisa Omanovic-Miklicanin,*** *University of Sarajevo (Bosnia and Herzegovina),* ***Elma Feric,*** *International Burch University (Bosnia and Herzegovina)*

S4-1: *Conducting Polymer Based Efficient Surface Design for the Detection of Cholesterol,* Soylemez S, Udum Y.A, Kesik M, Gündoğdu Hızlıateş C, Ergun Y, Toppare L.

S4-2: *Practices the different cells types like target genotoxic endpoint in micronucleus assey,* Velickova N, Milev M, Nedeljkovik B, Gorgieva P.

S4-3: *Bioelastic extramedullary bone osteosynthesis in locomotor surgery,* Hadziahmetovic Z, Vavra Hadziahmetovic N.

Conference Program Saturday,March 14 2015

09:00 – 10:30 Plenary lectures II, Conference Hall

Werner Mantele, Ph.D. - *Spectroscopists do it with Light: Development of Optical Sensors for Medical Applications*
Dragan Primorac, Ph.D. - *Personalised Medicine: Myth or Reality*
Herve Liebgott, Ph.D. - *Ultrasound Advanced Imaging: beyond anatomy*
Damir Marjanovic, Ph.D. - *Automation of the Forensic*

10:30 – 11:30 Coffee Break and Poster session

Chairs: **Ratko Magjarevic**, University of Zagreb (Croatia), **Igor Lackovic**, University of Zagreb

P1: *Analysis of proteins with IR spectroscopy*
Authors: Dzafic E, Mantele W.

P2: *The Impact of PET Reconstruction Parameters on SUV values*
Authors: Skopljak-Beganovic A, Beganovic A, Gazdic-Santic M, Drljevic A.

P3: *Four-dimensional computer tomography: a review*
Author: Rovcanin B.

P4: *Development of a New Amperometric Sensor for Adrenaline Based on the Carbon Electrode Modified with Ru(III) Complex*
Authors: Redzic S, Kahrovic E, Turkusic E.

P5: *Selenium Containing Conducting Polymer Based Pyranose Oxidase Biosensor for Glucose Detection*
Authors: Gokoglan T.C, Soylemez S, Kesik M, Toksabay S, Toppare L.

P6: *Synhesis of Graphene Layers for biomedical applications*
Authors: Satilmis H, Yildiz B, Tanis Y.E, Unlu C.G, Ozmen Y.

P7: *Stem Cells and plastic surgery – Future and Perspectives*
Authors: Jakirlic M, Dujso V.

P8: *Stem cells of bone marrow - isolation and cultivation*
Authors: Redzic I, Aljicevic M.

P9: *Laser – induced nonlinear processes in molecules*
Authors: Habibovic D, Hasovic E, Gazibegovic-Busuladzic A, Odzak S, Cerkic A, Busuladzic M, Milosevic D.B.

P10: *Teaching Physical Aspects of Medical Imaging Techniques*
Authors: Kiseljakovic M, Sotonica M, Ejubovic M, Fatic V, Omerbasic A, Dalipagic S, Zoranovic D, Muharemovic Z, Busuladzic M.

P11: *3D technology in the manufacture of a medicament forms with controlled – release*
Authors: Maleskic E, Maleskic S, Dedic M.

P12: *Application of nano-drugs in cancer therapy*
Authors: Ziga N, Dobraca A, Becic F, Cordalija V, Dedic M.

P13: *Evaluation of xenoestrogenic effects of organic UV filters*
Authors: Imamovic B, Dujic T, Malenica M, Becic E, Dedic M

P14: *In silico models to predict the absorption, distribution, metabolism, elimination and toxicity of drugs*
Authors: Mujkic S, Vojinovic T, Smajovic A.

P15: *Determination influence of inhibiting platinum acid on the activity of catalase*
Authors: Herenda S, Ostojic J, Klepo L, Galic B.

P16: *Determination of Body Surface Area Using the Mathematical Harmony*
Authors: Omerbašić A, Šečić D, Muharemović Z, Musuladžić M.

P17: *Nanoparticles as bioactive nanocarriers for cancer therapy*
Authors: Vranic E, Rahic O, Hadziabdic J, Elezovic A, Boskovic D.

P18: *New advances in human skin subtitles*
Authors: Vranic E, Grizic D, Lamprecht A.

P19: *The future of Healthcare: Nanomedicine and Internet Nano Things*
Authors:Omanovic-Miklicanin E, Maksimovic M, Vujovic V.

P20: *Determination of gender and age specific differences in total iron levels in human serum using a spectrophotometric method*
Authors: Tahirovic I, Boloban A, Ibragic S, Dzudzevic-Cancar H, Toromanovic J, Lepara O, Ajanovic A, Dizdar M.

P21: *Promising tissue engineering approaches using biodegradable poly (D,L-lactic-co-glycolic acid) scaffolds*, Grizic D, Vranic E, Lamprecht A.

11:30 – 13:30 Plenary lectures III, Conference Hall

Yves Lemoigne, Ph.D. - *7 years of high-level education in Medical Physics for Eastern Europe*
Mario Medvedec, Ph.D. - *Vision and Provision of Clinical Engineering Division - CED/IFMBE*
Atilla Aydinli, Ph.D.- *Advances in Plasmonic Detection: Plexcitonic Crystals*
Zijad Dzemic, M.S. - *National metrology institute for Quality of life*

13:30 -14:30 Lunch Break, Burch restaurant

13:30 – 14:00 Student transfer for Student Workshop to the Faculty of Medicine and to Institute for Nuclear Medicine CCU Sarajevo

14:00 – 15:00 Lunch Break for Students at Faculty of Medicine

15:00 – 20:00 Student's Workshop, Faculty of Medicine and Institute for Nuclear Medicine CCU Sarajevo

SW2-1: *Novel biomedical engineering applications for the teaching of various STEM subjects* – University of Warwick, United Kingdom

SW2-2: *Illustrating Genetic Variation through DNA Analysis* – International Burch University, Sarajevo, Bosnia and Herzegovina

SW2-3: *The system for monitoring patients in physical therapy* – University of Sarajevo, Faculty of Electrical Engineering and Faculty of Medicine, Sarajevo, Bosnia and Herzegovina

SW2-4: *Neural networks as a basis for the design of smart drugs* – University of Sarajevo, Faculty of Electrical Engineering and Faculty of Pharmacy, Sarajevo, Bosnia and Herzegovina

14:30-16:00 Plenary Session V, Sarajevo Room (207)

BIOMECHANICS, ROBOTICS AND MINIMALLY INVASIVE SURGERY

Chairs: Elmedin Mesic, University of Sarajevo (Bosnia and Herzegovina), **Ibrahim Omerhodzic,** University Clinical Centre (Bosnia and Herzegovina)

S5-1: *The computer modelling and biomechanical analysis of musculoskeletal systems in The AnyBody Modeling System*, Spahic D, Karac A.

S5-2: *Analysis of sub-cerebellar regions in patients with Chiari Malformations*, Akar E, Kara S, Akdemir H, Kırış A.

S5-3: *Numerical and experimental stress analysis of an external fixation system*, Mesic E, Avdic V, Pervan N.
S5-4: *Sensory re-education after median and ulnar nerve repair*, Jakirlic M, Dujso V, Omerhodzic I.

S5-*5: Analysis of signals collected by intraoperative neuromonitoring procedure during the neurosurgical operation of patients with complex intramedullary spinal cord tumors*, Omerhodžić I, Zahirović S, Avdaković S, Hodžić H, Vardo A, Bišćević M, Drnda S, Adilović A, Badnjević A.

14:30-16:00 Plenary Session VI, Motive Room (208)

CARDIOVASCULAR, RESPIRATORY AND ENDOCRINE SYSTEMS ENGINEERING

Chairs: Lejla Divovic-Mustafic, University Clinical Centre (Bosnia and Herzegovina), ***Alma Badnjevic-Cengic,*** Canton Hospital Zenica (Bosnia and Herzegovina)

S6-1: *Treatment of iatrogenic dissection of the left subclavian artery*, Huseinagic H, Jaganjac S, Moranjkic M, Mesanovic N.

S6-2: *Evaluation of the amount of used OnyX*, Huseinagic H, Moranjkic M, Mesanovic N, Ademovic Z, Begic A.

S6-3: *Comparation of postoperative outcomes within patients treated with different stent types,* Divovic Mustafic L, Kulic M.A.

S6-4: *Heart rate variability in assessment of autonomic nervous system function in preoperative period,* Omerbegovic M, Ferhatovic M.

S6-5: *Evaluation of factors that influence the occurrence of early hypothyroidism following radioactive iodine treatment in thyrotoxicosis,* Dzubur M, Kucukalic - Selimovic E, Dzubur-Aganovic M, Bahtic A, Begic E, Hrvo S.

S6-6: *Serum nitric oxide levels in patients with acute myocardial infarction with ST elevation (STEMI),* Badnjević – Cengic A, Kovacevic P, Badnjevic A, Gurbeta L, Hasanefendic B.

16:00-16:30 Coffee Break

16:30-18:00 Plenary Session VII, Sarajevo Room (207)

MOLECULAR, CELLULAR AND TISSUE ENGINEERING

Chairs: ***Damir Marjanovic,*** *International Burch University (Bosnia and Herzegovina),* ***Radivoj Jadric,*** *University of Sarajevo (Bosnia and Herzegovina),* ***Emina Cengic Kiseljakovic****, University of Sarajevo (Bosnia and Herzegovina)*

S7-1: *User verification for hemoglobin a1c on cobas 501 roche analyzer,* Kucukalic E, Coric J, Hasanefendic B, Mujic J, Curovic L, Bodulovic A.

S7-2: *Raman chemical imaging of collagen-based biomineralized composits,* Masic A.

S7-3: *Stem cell technology,* Balkaya H.

S7-4: *Transcutaneous elestrical nerve stimulation in the treatment of lumbar pain syndrome,* Miladinovic K, Vavra-Hadziahmetovic N.

16:30-18:00 Plenary Session VIII, Motive Room (208)

CLINICAL ENGINEERING AND HEALTH TECHNOLOGY ASSESSMENT

Chairs: ***Leandro Pecchia,*** *University of Warvick (UK),* ***Mario Medvedec,*** *University of Zagreb (Croatia)*

S8-1: *Continuous ECG holter monitoring in child age,* Begic Z, Mesihovic Dinarevic S, Kadic A, Halimic M.

S8-2: *Internal exposure arising from intravenous administration of F-18 fluorodeoxyglucose,* Beganovic A, Modronja M, Odzak S, Skopljak-Beganovic A, Gazdic-Santic M.

S8-3: *Determination possibility of skin distance focus by using camera in order of verification patient's position in radiotherapy,* Fazlic S, Osmic H, Osmic J.

S8-4: *From regenerative dentistry to regenerative medicine: potential of oral stem cells,* Porovic S, Jurisic S, Juric H.

S8-5: *The role of endoscopic capsule in finding the cause of gastrointestinal bleeding*, Zubcevic N, Zubcevic S, Mesihovic R, Vanis N, Puhalovic A, Pilav A.

18:00-19:00 Special Workshop II, USA Room (206)

SPW2: DEVLOGIC - *Software Development in Biomedical Engineering*

20:00-00:00 Conference Dinner at RESTAURANT PIVNICA SARAJEVO

Conference Program Saturday,March 15 2015

09:00-10:30 Plenary Session IX, Sarajevo Room (207)

HEALTH INFORMATICS, E-HEALTH AND TELEMEDICINE I

Chairs: ***Adnan Salihbegovic,*** *University of Sarajevo (Bosnia and Herzegovina),* ***Aljo Mujcic****, University of Tuzla (Bosnia and Herzegovina)*

S9-1: *Data mining, processing and web –based ECG signal imaging* **,** Zunic E, Zunic B.

S9-2: *Software solution in differantion and treatment of acid-base disorders,* Begic E, Mandzuka M, Begic Z, Boskovic D, Masic I.

S9-3: *Development of domain specific language and IDE for Internet of Things applications in remote patient monitoring,* Salihbegovic A, Kaljic E, Eterovic T, Ribic S.

S9-4: *IoT Wireless Sensor Networks for Healthcare Applications,* Ugrenovic D, Gardasevic G, Golic D, Gazdic V.

S9-5: *Internet of Thing for health care – new level "smart" of health care services,* Macinkovic D.

S9-6: Nav1.7 Expression in adult mouse sensory neurons, Feric E, Gingras J, McDermott J

09:00-10:30 Plenary Session X, Motive Room (208)

HEALTH INFORMATICS, E-HEALTH AND TELEMEDICINE II

Chairs: ***Edin Skaljo,*** *University of Sarajevo (Bosnia and Herzegovina),* ***Alma Secerbegovic,*** *University of Tuzla (Bosnia and Herzegovina)*

S10-1: *Smartphone-based remote health monitoring: opportunities and challenges,* Secerbegovic A, Suljanovic N, Mujcic A.

S10-2: *Comparison of Bioinformatics Web-Tools for Prediction of G-quadruplexes,* Jasarevic F, Doluca O.

S10-3: *Overview for computer aided detection of aortic diseases,* Smajic E, Mesanovic N.

S10-4: *High frequence technology in telemedicine services,* Skaljo E, Hodzic M, Mujcic A.

10:30-11:00 Coffee break

11:00-12:30 Plenary Session XI, Sarajevo Room (207)

BIOMEDICAL ENGINEERING EDUCATION

Chairs: ***Radovan Stojanovic,*** *University of Podgorica (Montenegro),* ***Dusanka Boskovic,*** *University of Sarajevo (Bosnia and Herzegovina)*

S11-1: *Opportunities and Challenges in Biomedical Engineering Education,* Boskovic D, Badnjevic A.

S11-2: *Turning the Challenge into Opportunity – A Strategic Framework for the Biomedical Engineering Development in Bosnia and Herzegovina,* Mustoo S, Gurbeta L.

S11-3: *Measurement in medicine – Past, present, future,* Badnjevic A, Gurbeta L, Boskovic D, Dzemic Z.

S11-4: *Alternative approach to addressing infrastructure needs in biomedical engineering programs (Case of emerging economies),* R. Stojanovic, A. Caplanova, Z. Kovacevic, N. Filipovic, Z. Bundalo

S11-5: *Pediatric dilemmas in using modern biotechnologies,* Zubcevic S.

11:00-12:30 Plenary Session XII, Motive Room (208)

PHARMACEUTICAL ENGINEERING

Chairs: ***Hurija Dzudzevic - Cancar,*** *University of Sarajevo (Bosnia and Herzegovina),* ***Fahir Becic,*** *University of Sarajevo (Bosnia and Herzegovina)*

S12-1: *Pharmaceutical engineering,* Mehovic S, Dedic M, Jordamovic N.

S12-2: *In vitro models to determine the pharmacokinetic parameters,* Pehlivanovic B.

S12-3: *Drug design,* Maleskic E, Dedic M, Becic F.

S12-4: *Usage of neuron circles in drug development,* Haseljic N, Smajovic A.

S12-5: *Detection of non-esterified fatty acids in plasma samples in diabetes management,* Mandal S, Causevic A, Semiz S.

11:00-12:30 Plenary Session XIII, USA Room(206)

STUDENT PAPERS

Chairs: ***Aljo Mujcic,*** *University of Tuzla (Bosnia and Herzegovina),* ***Mirza Dedic,*** *University of Sarajevo (Bosnia and Herzegovina),* ***Ibrahim Omerhodzic****, University Clinical Centre Sarajevo (Bosnia and Herzegovina)*

S13-1: *The validation of smartphone's built-in cameras for heart rate extraction,* Nišić J, Beganović N, Zaimović E, Goletić L, Hujdur E, Šećerbegović A.

S13-2: *Non-contact video-based heart rate and heart rate variability extraction from different body regions,* Alic A, Bajric B, Hodzic A, Kameric O, Basic A, Secerbegovic A.

S13-3: *Radioiodine therapy of differentiated thyroid cancer* **,** Kaimovic S, Hairlahovic A.

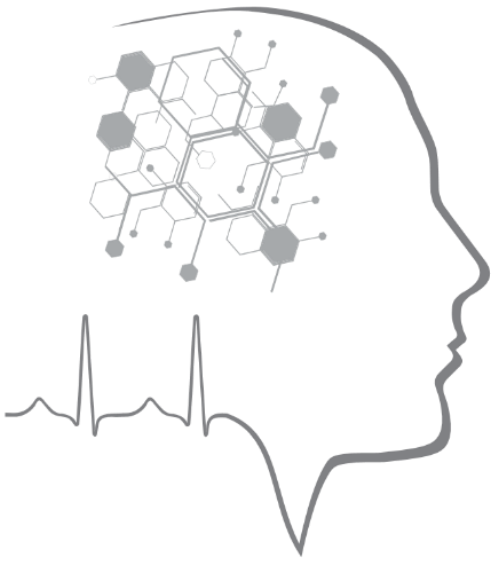
S13-4: *BioEcomat (BEC) Machine for recycling biotech drugs,* Sijerčić A.

S13-5: *AC and DC Coupling of Electrocardiograph in Mobile Monitoring,* Jurić D, Akšamović A

S13-6: *Localization and 2D imaging of ST elevation myocardial infarction using software differentiation,* Huskic V, Vardo A, Begic E, Hrvat E, Gurbeta L, Dzubur M, Badnjevic A, Dajic A, Kadic A.

S13-**7:** -*Possibbilities of applying stem cells to treat MS. Parkinson*, Mali G

12:30-13:30 Closing Ceremony, Conference Hall



CMBEBiH 2015

ABSTRACTS

INVITED LECTURES

Applied Biomedical Signal Processing and Intelligent eHealth for falls prediction in the elderly

Leandro Pecchia [1]

Applied Biomedical Signal Processing and Intelligent eHealth Lab, School of Engineering, University of Warwick, Coventry, UK

Abstract— Falls are a major problem of later life. Several multifactorial intervention have been proposed to prevent falls. Healthcare technologies to support falls prediction have been proposed too, in order to: assess the risk of falling, detect falls, and predict fall impact. This paper will present the preliminary results of two studies using physiological monitoring to predict falls in medium term (months) and short term (few minutes before. The preliminary results here described suggests that physiological monitoring can support fall prevention, by informing prevention strategies (i.e. helping priorities subjects at higher risk of falling) or by generating warning to patients and nurses in case an elevated risk of falling in the next few minutes is forecasted. Keywords— falls in elderly, accidental falls prediction, physiological monitoring, HRV. I.

in this study, a depressed HRV was significantly associated with an increased risk of severe blood pressure dropdowns, which are responsible for up to the 30% of indoor falls. These results suggested that the HRV can be used to indirectly monitor the status of ANS, which is responsible of controlling several physiological mechanisms that are essential to maintain balance in humans.

INVITED LECTURES

Attoscience

D.B. Milošević[1, 2]

[1] Faculty of Science, University of Sarajevo, Sarajevo, Bosnia and Herzegovina
[2] Academy of Sciences and Arts of Bosnia and Herzegovina, Sarajevo, Bosnia and Herzegovina

Abstract— Lasers, as sources of strong electromagnetic field, have enabled the investigation of nonlinear light-matter interaction. Thirty years ago ultrafast lasers have reached a fundamental limit – the duration of the laser pulses in visible and near infrared range was limited to few optical cycles and was measured in femtoseconds (1 fs = 10^{-15} s). The route to generate and measure even shorter attosecond (1 as = 10^{-18} s) pulses is based on extreme nonlinear optics and on the technology of laser carrier-envelope phase stabilization. In the 21st century researchers have broken the femtosecond barrier and new area of science – attoscience – has emerged. We discuss these revolutionary attosecond tools and their application to myriad problems in science.

Keywords— Physics, Attoscience, Atomic and Molecular Physics, Optics, Lasers.

INVITED LECTURES

The Gülhane Mastoidectomy

Mustafa Kahramanyol

Abstract:

This study is being presented in order to acquaint the audience with the outcomes of a previously described technique of chronic otitis media surgery: which consists of improved radical mastoidectomy, inferiorly based fascioperiosteal flap and large meatoconchoplasty [7,9]. The technique is named as the Gülhane Mastoidectomy. In this technique, autologous bones and soft tissues have been used as a reparative material.

255 patients have been operated on and treated utilizing the technique mentioned above during a period of 22 consecutive years. Despite extensive otologic destruction and the concomitant severe complications, the technique rendered impressive outcomes: the surgical cavities of the destructed mastoid bones became smaller by the time and remained healthy, providing a good life quality for the patients. Fourteen patients experienced immediate postoperative complications. Cholesteatoma recurrence was observed in but one patient.

The outcomes confirm the value and usefulness of the technique. The value of use of autologous bone and soft tissue as a reparative material is unchallengeable.

Key words: Chronic otitis media, Radical mastoidectomy, Saucerization, Meatoconchoplasty, Surgical flaps, Gülhane mastoidectomy, Gülhane flap

SPONSORED LECTURE

Remote Pacemaker Programming – 15 Years After

Božidar Ferek-Petrić

Medtronic Academia Central&Eastern Europe, Principal Medical Affairs Specialist, Zagreb, Croatia

Abstract—We demonstrated 15 years ago the remote programming of cardiac pacemakers utilizing the Internet infrastructure. Our system comprised client and server whereby TCP/IP protocol was deployed as a link provider. An old programmer was connected to server. Server controlled the programmer and pacing parameters. Patient's ECG signal was led into the same computer. Remote computer, running the client software displayed the graphic user interface comprising patient's ECG waveform in real time and programming control pull-down menu. 9 patients having implanted Siemens-Elema Prolog pacemakers underwent the remote follow-up sessions whereby server was at the patient's site, while the client was in the pacemaker center.

Remote follow-up sessions were regularly done until the battery end-of-life. We successfully performed: magnet rate measurement for battery voltage test, Vario™ threshold test and patient's intrinsic rhythm test. ECG waveform quality was sufficient and there was no arrhythmia observed. We didn't experience problems with the link between client and server. Patients accepted the new method of follow-up, being confident about its safety and reliability.

Our acute human experiments demonstrated feasibility of the remote patient follow-up. Therefore, development of new systems for patient follow-up have been initiated worldwide. Nevertheless, there is still today no commercial system available for remote programming of implantable devices. There are various systems for remote interrogation of diagnostic memory that can reveal patient's arrhythmia and status of an implantable device. More than million users in US and 350 000 in Europe of the Medtronic CareLink system avoid travel discomfort and expenses whereby increasing the patient's safety. Latest wireless telemetry devices have continuous connection to the patient's home unit that transmits the interrogated data via mobile network. Any impeding failure of the therapy delivers an alarm to the physicians having access to the system. The alarm is even sent to the personal smart-phone. Though significantly improving the principles of follow-up, patients still have to refer to the pacemaker center if any changes of the therapy parameters are needed. Regarding safety and reliability, the technology for implementing of our teleprogramming system in the latest devices is completely mature. Nevertheless, legislative obstacles prevent rapid development and practical application.

Keywords— pacemakers. ICD, telemedicine, follow-up, CareLink

INVITED LECTURES

Spectroscopists do it with light:

On the development of optical sensors for medical diagnostics

Werner Mäntele

Institut für Biophysik, Goethe-Universität Frankfurt am Main
Max-von-Laue-Strasse 1, D-60438 Frankfurt am Main, Germany

Medical diagnostics presently relies on the laboratory analysis of blood and other body fluids and is mostly based on chemical, biochemical and enzymatic reactions. These require frequent recalibration, they need enzymes and chemical consumables, and are typically remote from the patient, thus leading to a unnecessary long delay between taking a blood sample and finding a therapeutic decision.

In contrast to these established techniques, optical sensors can be used in a *point-of care* fashion, they can get along without recalibration, and they would need little or no consumables.

The lecture presents developments from our group to establish optical and infrared techniques in medical diagnostics.

As a first example, we present a novel method for direct determination of the level of the anticoagulant heparin in blood based on a light scattering assay [1]. The intraoperative measurement of heparin during heart surgery allows a much more precise blood coagulation management, thus avoiding bleeding and reducing the need for blood transfusions. We present here the biophysical principle and its realization in a device that will be on the market for clinical use in 2015.

As a second example, we present the reagent-free quantitative spectroscopic analysis of body fluids by mid-infrared (MIR) spectroscopy, combined with sophisticated chemometry and a carefully designed calibration procedure [2,3]. This spectroscopic method either uses standard Fourier transform infrared (FT-IR) spectrometers or novel compact tunable quantum cascade lasers (QCL). At the present stage, we can determine up to eight blood parameters (glucose, urea, triglycerides, cholesterol, total protein, albumin, hemoglobin and immunoglobulin) at clinical precision from a single drop of blood.

As the third example – and the holy grail of spectroscopy in medicine – we present the use of quantum cascade lasers and photoacoustic/photothermal detection for the non-invasive measurement of glucose for diabetes patients [4,5]. Glucose exhibits a highly specific molecular fingerprint in the MIR around 8-11 µm which can be used for the non-invasive quantitative analysis of glucose (and other substances) in the interstitial fluid (ISF) of skin. The level of skin ISF glucose is closely related to capillary blood glucose and follows rapidly its ups and downs. The lecture will describe the physiochemical background, the technical realization, and the validation of this method on diabetes patients.

INVITED LECTURES

Ultrasound advanced imaging: beyond anatomy

Hervé Liebgott

Department of Electrical Engineering of IUT Lyon

Ultrasound advanced imaging: beyond anatomy Ultrasound imaging is one of the most popular medical imaging modalities. This success comes from its many advantages: low cost, portability, absence of ionizing radiation, real-time capacity etc… Despite these many pros, ultrasound images have always had the reputation of being of poor quality. However this modality has undergone a real revolution during the last decade. With the technical progresses in processing power, data transfer speed and more generally in electronics, a new generation of ultrasound systems is born. These scanners are able to perform ultrafast imaging at frame rates up to several thousands of images per second. Motivated initially by the development of tissue elasticity imaging, the potential applications of this technology represent an extraordinary breakthrough in the domain of medical imaging. The objective of this talk is to draw the picture of the current developments in the field of medical ultrasound and to illustrate the potential of this fantastic modality.

INVITED LECTURES

Automation of Forensic DNA Analysis Procedures: Advantages and Challenges

Marjanovic D., Feric E.

Department of Genetics and Bioengineering International Burch University, Sarajevo, BiH

Forensic genetics focuses on applications of genetic findings in a legal context, and it involves the processing of individual traces and results obtained by genetic methods with the aim of reconstructing the course of events as well as the precise individualization of those involved within the judicial, police and other investigative realm. Even though the foundations of forensic genetics date back before the first official DNA analysis in 1985, the first PCR thermocycler that simulated all means necessary for the conduction of all phases of the PCR method was conducted not long after that. What followed in the coming two decades was a significantly rapid progress in the biotechnological advancement in laboratory methods that resulted in the advancement of forensic DNA analysis from. Even these days technological developments, such as next generation sequencing, will possibly initiate a revolution in this field of science. Efforts of the automation in the field of forensic genetics is focused in the direction of establishing platforms for more informative, cheep, simple, fast and high-throughput analysis. Therefore, we highlight this technological evolution from what once used to be an involved procedure that yielded fewer results in as long as three days to the advancement of biotechnological tools that enable rapid obtainment of tens of thousand-fold more data within as little as a half hour.

INVITED LECTURES

7 years of high-level education in Medical Physics for Eastern Europe

Yves LEMOIGNE

ABSTRACT: Yves LEMOIGNE TALK about Medical Physics Training in Eastern Europe. I will report about the help we would like to provide to training of medical physicists and biological engineers in Eastern Europe. First step was the European School of Medical Physics offering innovative programs of intensive training for medical physicists already at work in European hospitals and who wish to acquire advanced knowledge in a field that is growing rapidly and becoming more complex. The school was founded by Yves LEMOIGNE and Fridjof NÜSSLIN (now IOMP). In 16 years, this School located in Geneva area has received more than 1,100 students from diverse backgrounds. The school as clearly gained a strong tradition of excellence, openness, friendliness and hospitality of all. Participants were mainly professionals in charge of treating patients in various hospitals (2/3) or improving their knowledge in universities (1/3). During six weeks in autumn the courses covered a wide range of topics that medical physicists face in their work, ranging from clinical routine to biomedical science. The lecturers were first class physicists with confirmed experience in hospitals or universities. They were coming from 20 European countries (and USA). Every week of the course was dedicated to one or two specific topics: • Medical imaging with ultrasound and digital radiology. • Medical imaging in nuclear medicine and magnetic resonance. • Medical informatics (Image treatment, simulation, modulation…) • the physics of modern radiotherapy (External beams) • The Brachytherapy (internal seeds) • Radiation protection in medical physics (Imaging, radiotherapy, design of labs) Second step is the Institute For Medical Physics (IFMP).

The previous experience near Geneva demonstrated the ongoing challenges for Eastern Europe countries to send their young scientists for advanced training in a geographical area that unfortunately boasts high living costs, expensive airline tickets and strict visa requirements for non EU members. This context has essentially led to student selection from these countries through discretionary money. To avoid that IFMP organizes annual workshops hosted by universities or hospitals in Eastern Europe or south side of Mediterranean Sea. Lectures are given by world experts in the domains of medical imaging and/or radiotherapy (mainly same as previously). They provide the necessary courses to students from countries where such a need arises due to the mismatch between the lack of available high-level training and the ever growing installation of increasingly sophisticated equipments. This requires expert involvement from Medical Physicists in many domains: Computed Tomography (CT) scanners, gamma camera (e.g., Single Photon Emission Computed Tomography - SPECT), positron emission tomography (PET), magnetic resonance (imaging -MRI, spectroscopy - MRS, etc.) and all new hybrid imaging systems, accelerators for radiotherapy, brachytherapy, radiation Protection, etc. In 2014 IFMP was in charge of Medical Physics teaching in Sarajevo (Bosnia) in May and in Shkodra (Albania) in October for young medical physicist training in cooperation with universities. We verified that the chosen formula was efficient for contacts with students and cooperation with Eastern Europe colleagues. More than any long report about IFMP last year you can have a look to our website: http://www.ifmp.eu

INVITED LECTURES

Vision and Provision of Clinical Engineering Division - CED/IFMBE

Medvedec M.
University Hospital Centre Zagreb/Department of Nuclear Medicine and Radiation Protection, Zagreb, Croatia

Abstract— Clinical engineering is the branch of biomedical engineering dealing with all aspects of medical equipment and technologies used in hospitals and other clinical settings. Clinical Engineering Division is a special division of the International Federation for Medical and Biological Engineering (CED/IFMBE).

The CED/IFMBE vision is to be a primary international thriving professional, scientific and educational forum for developing, establishing and promoting clinical engineering. The CED/IFMBE mission is to advance worldwide research, development, learning, knowledge, skills and competences on healthcare technology management, to promote global communication and networking, to advance and disseminate worldwide safety tools and effective decision-making processes within the healthcare technology management system, to define and promote quality standards and to encourage excellence in clinical engineering practices and processes worldwide, to stimulate innovation and efficient use of technology-related resources in healthcare worldwide, and to internationally represent and advocate the interests of clinical engineering profession and their global exchange.

In recent years, the CED/IFMBE has been making efforts to provide revised division's charter, multilingual translations of the six volumes from the Ziken 'How to manage' book series for healthcare technology, a comprehensive publication on human factors engineering, an open-access international journal of clinical engineering and healthcare technology assessment, its dedicated web-site and e-conferencing tool, an on-line directory of clinical engineering teaching units and professional associations, clinical engineering awards, international program for certification in clinical engineering, global center for healthcare technology managers on disaster preparedness training, as well as other benefits.

The IFMBE is the only international professional organization that has the CED focusing specifically on all aspects of life cycle management of healthcare technologies. Taking into account the recent activities and the outcomes of its completed and running projects during the last two terms of the CED/IFMBE Board, the latter time seems to be probably one of the most fruitful periods in its history, to the benefit of clinical engineers and healthcare systems, but primarily for the benefit of all patients worldwide.

Keywords— biomedical engineering, clinical engineering, International Federation for Medical and Biological Engineering, Clinical Engineering Division

INVITED LECTURES

Advances in Plasmonic Detection: Plexcitonic Crystals

Ertugrul Karademir, Atilla Aydinli

Deparment of Physics, Bilkent University, 06800 Ankara, Turkey

Abstract— Optical detection at the nanometer scale is based on light matter interaction. Surface plasmons offer a method to localize light into subwavelength dimensions. In this work, a new platform for investigation of plasmon-exciton coupling called plexcitonic crystals is presented. These crystals demonstrate reversible plasmon-exciton coupling control with azimuthal rotation.

Keywords— Light-matter interaction, plexcitonic crystals

BIOMEDICAL SIGNAL PROCESSING

Investigation of Heart Rate Variability using Wavelet Packet Transform in Major Depressive Disorder

S.A. Akar[1] , S. Kara[1] , V. Bilgiç[2]

[1] Institute of Biomedical Engineering, Fatih University, İstanbul, Turkey

[2]Psychiatry Department, Faculty of Medicine, Fatih University, İstanbul, Turkey

Abstract— Depression is a common mood disorder that is characterized by impairment of mood regulation, and loss of interest in enjoyable activities. According to the previous studies, it has been reported that this disorder is related with elevated rates of cardiovascular morbidity and mortality. Therefore, as an important indicator for diagnosis and classification of cardiac dysfunctions, heart rate variability (HRV) has been widely used in depression. Differ from the previous studies in this field, wavelet packet transform (WPT) is used for determination of effective very low frequency (VLF), low frequency (LF), and high frequency (HF) bands in HRV signals of depressed patients in this study. Twenty patients who met the DSM-IV criteria for major depressive disorder and age, gender-matched twenty healthy controls were participated for this study. HRV data of these participants were first were recorded using the Brainamp ExG data acquisition system and then decomposed into sub-bands including VLF, LF, HF using WPT with 9 level Daubechies (db4) family and variations of energy in these bands were analyzed in MATLAB. The HRV measures as each sub-band average energy and sympathovagal balance (LF/HF ratio) were compared statistically between patients and controls. The results of this study indicates that especially the mean energy values of sub-frequency ranges in VLF band for each participant are higher than that the values of other bands as LF and HF. In addition, the mean energy values of the regions in LF band of control subjects are significantly lower than the same measure of patients. In contrast, in comparison with control subjects, patients with major depression exhibited low HF band energy. Finally, results indicate that sympathovagal balance that reflects the equilibrium between sympathetic and parasympathetic activity of the autonomic nervous system in patients was higher than that of control subjects indicating autonomic dysfunction throughout the entire experiment. It can be conclude that low cardiovagal activity in patients with major depression may contribute to the higher cardiac dysregulations of these patients.

Keywords— Major depressive disorder, heart rate variability, wavelet packet transform, sympathovagal balance.

BIOMEDICAL SIGNAL PROCESSING

Theoretical and Experimental UV-Vis Spectroscopic Analysis Of Chamazulene

Salihovic M., Sapcanin A.

Faculty of Pharmacy, University of Sarajevo, Bosnia and Herzegovina

Abstract— In the present research, UV/Vis spectra of chamazulene was recorded. Density Functional Theory (DFT) B3LYP level using 6-31G(d) basis set have been carried out to investigate the structure of chamazulen, and to investigate the UV/Vis spectra and some additional properties. Correlation coefficients were used to compare the experimentally observed and theoretically computed vibrational frequencies for compound. Calculations were done using software Spartan 10. The theoretical characterization matched the experimental measurements, showing a good correlation. Experimental data showed that chamazulene have absorption maximum at 340 nm to 530 nm. The position of max did not much different with theoretical calculation. The calculated density of states showed excellent agreement with UV/Vis diffuse reflectance spectra predicting the absorption maximum at 310 nm (calculated 332 nm) to 530 nm (calculated 516 nm). The calculated values are lower than the experimental absorption maximum. The reason for the discrepancies between the theory and experiment can be the vibrational effects, which are not taken into account and hydrogen bonding with the solvent molecules. DFT calculations have been used extensively for calculating a wide variety of molecular properties such as equilibrium structure, charge distribution UV/Vis, FTIR and NMR spectra, and provide reliable results which are in agreement with experimental data.

Keywords— UV/Vis spectra, density functional theory (DFT), chamazulene.

BIOMEDICAL SIGNAL PROCESSING

Sleep stage classification using AR Burg and C4.5 classifier

Nejra Arnaut, Abdulhamit Subasi

International Burch University, Faculty of Engineering and IT, Electrical and Electronics Department, Sarajevo, Bosnia and Herzegovina

Abstract-In this study, an effective automatic novel system for sleep staging that is based on AR Burg and C4.5 decision tree method is constructed in order to enhance pertinence of automatized sleep staging classification. It is of huge significance to analyze human sleep during various life cycles. Sleep stage classification process is long-term and demanding job performed by sleep professionals. Traditional sleep staging technique is the study of polysomnograms (PSGs) records from a sleep laboratory. One of the most significant signals in PSGs are electroencephalogram (EEG) signals. However, it is challenging and complex job to accurately record and analyze these EEG signals. The main aim of this study is to solve this problem. For processing of EEG signal is used AR Burg signal processing technique. The AR Burg features were extracted from characteristic waves of EEG signals were used to classify various sleep stages. C. 4.5 decision tree classification methods is used for automatic classification of various sleep stages based on AR Burg features that are extracted from the a single Electroencephalogram (EEG) Fpz-Cz channel. Features extracted from EEG signals using AR Burg method were fed into C4.5 decision tree classifier to distinguish between various sleep stages, such as wakefulness (W), rapid eye movement (REM), non-rapid eye movement sleep stages (NREM-1, NREM-2, NREM-3 and NREM-4) and Movement time (M). EEG sleep recording used to prove the efficiency of the system, proposed in this study, are taken from the publically available Sleep-EDF database (expanded). Obtained overall classification accuracy is 91.01 %. The efficiency of the proposed automatic system for sleep stage classification is proved with obtained experimental results.

Keywords- Classification, Sleep stages, AR Burg, Decision Trees, C 4.5.

BIOMEDICAL SIGNAL PROCESSING

Dijagnoza epilepsije na osnovu EEG signala korištenjem Hilbert Huang-ove transformacije

Sandra Ibrić[1] , Samir Avdaković[2] , Ibrahim Omerhodžić[3] , Nermin Suljanović[1] , Aljo Mujčić[1]

[1] Fakultet elektrotehnike Univerziteta u Tuzli

[2]Elektrotehnički fakultet Univerziteta u Sarajevu

[3]Klinički centar Univerziteta u Sarajevu

Sažetak — U ovom radu, predstavljena je primjena Hilbert Huang-ove transformacije (HHT) u analizi elektroencefalogram (EEG) signala radi lakšeg uspostavljanja dijagnoze sindroma epilepsije. HHT se sastoji od empirijske dekompozicije signala (EMD) i Hilbert-ove analize, a Hilbertov marginalni spektar predstavlja raspodjelu totalne amplitude (energije) u zavisnosti od frekvencije. Korištenjem ovog pristupa urađena je analiza nad 200 EEG signala, pri čemu je pola signala od zdravih osoba, a druga polovina od osoba sa sindromom epilepsije ali ne u trenutku napada. Pokazano je da je primjena ove metode uspješna, te da omogućava uspostavljanje jasne razlike u vizualizaciji EEG signala zdravih i bolesnih osoba, što može pomoći u jasnoj identifikaciji osoba sa sindromom epilepsije. Također, ovakav pristup može biti podloga za razvoj jednostavnih automatiziranih klasifikatora EEG signala sa aspekta identifikacije osoba sa epilepsijom i pronaći svoje mjesto u uobičajenoj kliničkoj praksi.

Ključne riječi — EEG, epilepsija, Hilbert Huang-ova transformacija, Hilbert-ov marginalni spektar.

BIOMEDICAL SIGNAL PROCESSING

Surface EMG pattern recognitionby using DWT feature extraction and SVMclassifier

Ermin Podrug, Abdulhamit Subasi

Faculty of Engineering and Information Technologies, International Burch University, Sarajevo, Bosnia and Herzegovina

Abstract—In this study we proposed a surface electromyogram (EMG) pattern classification approach for the recognition of different myoelectric signals. EMG signals are used in human motion pattern recognition. In exoskeleton robot control, EMG signals are used in the detection of the electrical activity associated with muscle contraction and obtained by measurement of the electrical activity of a muscle during contraction. Since different categories of contraction can cause EMG signals to vary, the recognition performance also affected by this variation. In order to eliminate this variation in EMG signal during contraction, different time and frequency techniques are used for feature extraction from surface EMG signals. Then a set of feature selection method based on different statistical techniques is developed so that the high-dimensional features can be reduced by a supervised feature reduction algorithm. Then, support vector machine (SVM) is used to classify the EMG signals. The experimental results show the high accuracy of the proposed system and also revealed that it is betterfor EMG signals from the same type of muscle contraction, whether dynamic or isometric, are consistently used in both the training and validation phases. The methodology developed in this study has potential applications in exoskeleton robot control and rehabilitation.

Keywords—EMG, DWT feature extraction, SVM classifier, pattern recognition, myoelectric signals.

BIOMEDICAL IMAGING AND IMAGE PROCESSING

Three Dimensional Airway Tree Segmentation from Computed Tomography Lung Images

Nihad Mešanović[1] , Haris Huseinagić[2], Elnur Smajić[3]
[1] University Clinical Center Tuzla, IT Department, Tuzla, B&H
[2]University Clinical Center Tuzla, Radiology Department, Tuzla, B&H
[3]University Clinical Center Tuzla, Cardiology Department, Tuzla, B&H

Abstract— One of the most important operations in analysis of medical images is segmentation. Computer aided detection (CAD) systems for analysis of medical images always involve segmentation of the image, as well as extraction of region of interest (ROI) and correct classification of area of interest. In this work, we are proposing a region growing algorithm for segmentation of lung structures, that is, airway segmentation. Due to the natural complex anatomical structure of the airways, with different branching levels, as well as originated noise and other artefacts in the CT image, the segmentation is more complex that other lung structures. A common method to segment the airway structure is region growing and semiautomated as well as fully automatic algorithms have been used for segmentation. This algorithm works in three dimensional space and the results are compared with the raw gray-scale volume image. The algorithm is using also morphological operators for accuracy. For evaluation of the results, three newly invented descriptors are used for efficient airway segmentation. The algorithm is tested on images from patients with lung CT scans. For verification of the results, we used Student t-test and Pearson correlation test that showed high correlation with the manual segmentation.

Keywords - Airway Segmentation, CAD System, CT.

BIOMEDICAL IMAGING AND IMAGE PROCESSING

Texture-based automatic polyp detection in colonoscopy videos

Avramović A., Ševo I.

Faculty of Electrical Engineering, University of Banja Luka, Bosnia and Herzegovina

Abstract— Analysis of colonoscopy, endoscopy and smart pill videos are often used during the diagnostic procedure, so automatic detection of colon polyps, tumors and internal bleeding can be helpful. Automatic video analysis can ease or improve diagnostic process in cases where physician needs to analyze long-duration videos in order to check if there are signs of early tumor stage or bleeding. Automatic detection of regions of interest and video annotation can be used to mark relevant frames and enable faster and more efficient diagnosis. In this paper, a method for texture analysis of colonoscopy video is presented. Different texture descriptors are extracted from regions containing polyps and compared with the texture descriptors taken from the regions of healthy tissue and other non-informative regions. The goal was to systematically assess the possibilities for automatic detection of colon polyps in colonoscopy videos based on their texture.

Keywords— Colonoscopy, polyp, texture

BIOMEDICAL IMAGING AND IMAGE PROCESSING

Three-dimensional rotational angiography in the control of the results of endovascular coiling of intracranial aneurysms

Haris Huseinagić [1] , Mirza Moranjkić [2] , Nihad Mešanović [3]

[1] Department of Radiology and nuclear medicine, University Clinical Centre, Tuzla, Bosnia and Herzegovina

[2] Department of Neurosurgery, University Clinical Centre, Tuzla, Bosnia and Herzegovina

[3] Department of IT, University Clinical Centre, Tuzla, Bosnia and Herzegovina

Abstract— The process of endovascular treatment of cerebral aneurysms requires intensive use of 3D rotational angiography in planning and monitoring the entire process. 3D RA allows unlimited manipulation of model blood vessels and defining the morphology of the aneurysm without using radiation. The purpose of the study was to compare the results of the analysis of residue or recurrence of the aneurysm after endovascular treatment using 3D RA and 2D digital subtraction. Method. In 68 patients with 76 cerebral aneurysms, we made regular controls using both techniques, 2D DSA and 3D RA. Residual and recurrent aneurysms are classified into five stages, and the pictures taken by both modalities are compared. Results. 2D DSA detected the residual and recurrent aneurysm in 53.70% of cases (29/54 aneurysms), and 3D RA in 66.67% (36/54 aneurysms). In nine cases in 2D DSA did not detected residues of which was discovered in 3D RA, and 3 cases of 2D DSA reveals little short neck aneurysm, which is on the 3D RA, in fact, a small aneurysm. In five cases from the use of 3D RA reduced the level of classification aneurysm. Conclusion: 3D RA reveals more residues aneurysms.

Keywords— 3D RA, 2D DSA, endovascular treatment of cerebral aneurysms.

BIOMEDICAL IMAGING AND IMAGE PROCESSING

Uloga rentgen dijagnostike u pedijatrijskoj praksi

Nedim Begić[1] , Zijo Begić[2] , Edin Begić[1] , Amra Dobrača, Mensur Mandžuka[3]

[1] Medicinski fakultet, Univerzitet u Sarajevo, BiH

[2] Pedijatrijska klinika, KCU Sarajevo, BiH

[3] Elektrotehnički fakultet, Univerzitet u Sarajevu, BiH

Sažetak — Uvod: Rentgen dijagnostika se u svakodnevnom radu kod pedijatrijske populacije koristi kao značajan dijagnostički i terapijski postupak. Najstarija je, ali još vrlo značajna metoda konvencionalne radiologije. Dobiva se djelovanjem rentgenskih zraka iz rentgenske cijevi na poseban film koji kao medij za prikaz različitih tkivnih gustoća nije dovoljno osjetljiv. Moguće je prikazati i razlikovati samo veće razlike u gustoći tkiva (patološke procese). Cilj rada: Prikaz, uloga i značaj, poduzetih rentgenoloških metoda u svakodnevnom radu sa djecom u okviru primarne i sekundarne zdravstvene zaštite. Materijal i metode: Istraživanje je obuhvatilo 2691 pacijenta (18,32 % od ukupnog broja stanovnika opštine, odnosno 23,43 % participanata korištenja zdravstvene zaštite) u dobi od rođenja pa do kraja 18-te godine života, tokom kalendarske 2014 godine, u „Domu zdravlja Breza“, Breza, Bosna i Hercegovina. Istraživanje je imalo retrospektivni i deskriptivni karakter. Rezultati: Protekle godine je urađeno ukupno 4719 rentgenoloških procedura od čega 530 kod djece (11,23%). Od toga je bilo 222 (41,89%) rentgenskih snimaka kostiju (sumnja i/ili povrede, razvojni poremećaji i bolesti kostiju i zglobova), 198 pluća i srca (37,36%), 48 zuba i vilice (9,06 %) , 48 paranazalnih sinusa, (9,06 %), 8 rtg nativnih snimaka abdomena/uro trakta (1,51%) i 6 snimaka stranog/ili sumnje na strana tijela u mekim tkivima ili digestivnom sistemu (1,13%). Rentgen snimanje su indicirali pedijatri u 301 slucaju,(56,79%), specijalisti urgentne medicine i ljekari opšte prakse u 181 slučaju (34,15%), te stomatolozi u 48 slučajeva (9,06 %). Zaključak: Rentgen dijagnostika je nezamjenljiv segment svakodnevnog rada primarne i sekundarne zdravstvene zaštite dječije populacije. Rentgenološke metode u svakodnevnom radu sa pedijatrijskom populacijom, zajedno sa drugim dijagnostičkim i terapeutskim metodama, uveliko pomažu u postavljanju pravovremene i ispravne dijagnoze, te u adekvatnoj terapiji. Istovremeno omogućavaju dobru trijažu, odnosno skrining, za eventualni tretman u tercijarnim ustanovama zdravstvene zaštite.

Ključne riječi — rtg dijagnostika, pedijatrijska populacija, značaj

BIOMEDICAL IMAGING AND IMAGE PROCESSING

Fractal Analysis of Digital Mammograms

E. Đedović[1] , A. Gazibegović-Busuladžić[1] and A. Beganović[1,2]

[1] Faculty of Science, Department of Physics, Sarajevo, Bosnia and Herzegovina

[2] Clinical Center University of Sarajevo, Sarajevo, Bosnia and Herzegovina

Abstract— It has been shown that fractal analysis is useful in image processing, texture analyses and texture image segmentation. It is important to clearly detect edges of breast masses, and precisely locate individual microcalcification in mammograms. We present practical help in that area by fractal analysis, using the concept of fractional Brownian motion. It can be shown that there is a correlation between specific quantitative result of such analysis (Hurst coefficient) and the type of breast mass or tumor.

Keywords— digital mammograms, image segmentation, fractals, fractional Brownian motion, Hurst coefficient .

BIOSENSORS AND BIOINSTRUMENTATION

Metamaterial Absorber Based Biosensor Applications

M. Karaaslan[1] , F. Dincer[2] , M. Bakir[1] , E. Unal[1] , K. Delihacioglu[3] , Z. Ozer[4] , O. Akgol[1] , C. Sabah[5]

[1] Mustafa Kemal University, Department of Electrical and Electronics Engineering, Hatay 31200, Turkey

[2] Mustafa Kemal University, Department of Computer Engineering, Hatay 31200, Turkey

[3] Kilis 7 Aralik University, Department of Electrical and Electronics Engineering, Kilis 79000, Turkey

[4] Mersin University, 1Vocational School of Mersin, Yenisehir, Mersin 33343, Turkey

[5] Middle East Technical University – North. Cyprus Campus, Dept.of Elect.and Elect. Eng.Kalkanli, Guzelyurt, TRNC, Mersin 10, Turkey

Abstract— In this work, sensor abilities of a metamaterial absorber is investigated and demonstrated. Temperature sensing application is numerically demonstrated in C band frequency regime. This study is important since it has perfect metamaterial absorber and sensor application features together. Sensor application is such a bio sensing application that can be applied to other sensing applications according to sensor layer's contents. This application is related with sensor layer's dielectric constant so if sensor layer is composed of biological tissues, it results with a change in resonance frequency. This change in the resonance frequency can be used to sense material properties accordingly. Numerical results show that absorbance value is greater than 95% in all temperature sensing studies. The proposed perfect MA based sensor variations enable many potential applications in medical or food technologies which will be demonstrated in the paper.

Keywords— Metamaterial, Absorber, bio-sensor.

BIOSENSORS AND BIOINSTRUMENTATION

Biosensor Application by Using Gammadion Shaped Chiral Metamaterials

M. Karaaslan[1] , M. Bakir[1] F. Dincer[2] , E. Unal[1] , K. Delihacioglu[3] , Z. Ozer[4] , O. Akgol[1] , C. Sabah[5]

[1] Mustafa Kemal University, Department of Electrical and Electronics Engineering, Hatay 31200, Turkey

[2] Mustafa Kemal University, Department of Computer Engineering, Hatay 31200, Turkey

[3] Kilis 7 Aralik University, Department of Electrical and Electronics Engineering, Kilis 79000, Turkey

[4] Mersin University, 1Vocational School of Mersin, Yenisehir, Mersin 33343, Turkey

[5] Middle East Technical University – North. Cyprus Campus, Dept.of Elect.and Elect. Eng.Kalkanli, Guzelyurt, TRNC, Mersin 10, Turkey

Abstract— In this work, sensor abilities of a chiral metamaterial which is based on gammadion shaped resonators is investigated and demonstrated. Moisture content sensing by using gammadion shaped resonators is presented in different frequency bands. Hevea rubber latex is chosen for moisture content sensing. Due to sensor configuration of the structure it is applicable to other sensing applications as temperature and pressure. Simulation studies showed that gammadion shaped chiral metamaterial provides good measurement opportunities in bio sensing. Sensor layer in this biosensing study, creates a suitable approach for sensing biological parameters. When sensor layer is assumed to be composed of related material, it leads to a change in the resonance frequency of the system and which results to shift of the resonance frequency. Numerical results show that gammadion shaped biosensor has nihility function and can be used effectively in bio sensing applications which will be demonstrated in the rest of the paper.

Keywords— Metamaterial, Chiral, biosensor, nihility.

BIOSENSORS AND BIOINSTRUMENTATION

A virtual environment to test and validate model based insulin infusion therapies

Dinka Smajlagić[1] , Pasquale Palumbo[2]

[1] Faculty of Biomedical Engineering, University of Technology, Gußhausstraße 27-29, A-1040 Vienna, Austria;

[2] Istituto di Analisi dei Sistemi ed Informatica "A.Ruberti", Consiglio Nazionale delle Ricerche (IASI-CNR), BioMatLab – UCSC – Largo A. Gemelli 8, 00168 Rome, Italy;

Abstract— In the last decades many closed-loop control algorithms have been published, mainly devoted to control Type 1 diabetic patients, who definitely lack the endogenous insulin release. Recently a novel model-based approach has been developed to investigate the artificial pancreas for Type 2 diabetic patients who, differently from Type 1, do have a pancreatic insulin release, though it reveals to be not sufficient. This note applies the aforementioned algorithm and tests it on a virtual environment that accounts for the many uncertainties a real artificial pancreas is forced to cope with. Numerical results show the robustness of the model-based control law.

Keywords— Time-delay systems, non-linear observer, feedback control law, artificial pancreas.

BIOSENSORS AND BIOINSTRUMENTATION

Adjustment of quantification of catecholamines and their metabolites in biological samples using the Shimadzu LCSOL SINGLE-LC EN HPLC system with electrochemical detection

S. Ibragic[1], E. Sofic[1,2]

[1] University of Sarajevo, Faculty of Science, Zmaja od Bosne 33-35, 71000 Sarajevo, Bosnia and Herzegovina

[2]University of Sarajevo, Faculty of Pharmacy, Zmaja od Bosne 8, 71000 Sarajevo, Bosnia and Herzegovina

Abstract— BACKGROUND: Catecholamines are a group of biogenic amines, present in low concentrations in human physiological fluids, yet involved in the regulation of numerous physiological processes (neurotransmitters and hormones). They are sensitive to oxidative degradation and their determination in complex biological matrices was a challenge in the development of highly sensitive bio-analytical techniques that enable precise quantification. OBJECTIVE: To adjust the method of quantification [1] of adrenaline (A), noradrenaline (NA), dopamine (DA), 5-hydroxyindoleacetic acid (5-HIAA) and homovanillic acid (HVA) in biological samples using the Shimadzu LCSOL SINGLE-LC EN HPLC system that allows a maximum injection volume of 20 µl. The system was coupled to the BAS liquid chromatography CC-5E LC-4C Amperometric Detector with a glassy carbon working electrode and Ag/AgCl reference electrode. METHODS: Catecholamines from human serum and cerebrospinal fluid (CSF) were adsorbed on alumina, eluted with only 40 µl perchloric acid and 20 µl sample injected into the HPLC-ED system. The mobile phase, delivered at the flow rate of 1 ml/min, consisted of 23.0 g citric acid monohydrate, 11.5 g sodium hydroxyde, 27.2 g sodium acetate, 4.2 ml of 100% acetic acid and water up to 1 l. Then, 300 ml of that solution was diluted with 600 ml water and used as a mobile phase. The stationary phase was the BDS Hypersil C18, 250 x 4.6 column, the potential was 0.70 V. Dihydroxybenzylamine (DHBA) was used as an internal standard. The metabolites were determined in CSF, which was diluted and centrifuged. The mobile phase had a flow rate of 1 ml/min and consisted of 372 mg EDTA, 0.1 M sodium acetate, 50 % methanol (63.3 ml), 7.9 ml glacial acetic acid and filled with water to 1 l. A BDS Hypersil C18, 250 x 4.6 column was used and the potential was 0.75 V. RESULTS AND CONCLUSIONS: The utilisation of the described method enabled a precise

quantification of catecholamines and their metabolites that are present in the pg/ml and ng/ml range, respectively. The development of electrochemical detectors has led to quantitative and qualitative analyses of electroactive substances. Such analyses are fundamental for diagnostic purposes, clinical and pharmacological research.

Keywords— biogenic amines, serum, cerebrospinal fluid, HPLC-ED

BIOSENSORS AND BIOINSTRUMENTATION

A polymer-based, optical biosensor chip for detection of microbial leucine aminopetidase (LAP) activity and its potential as a novel, medical diagnostic test

Nadira Ibrišimović- Mehmedinović [1] , Mirza Ibrišimović [2] , Aldina Kesić [1]

[1] Department of Chemistry, Faculty of Science, University of Tuzla, Univerzitetska 4, 75000 Tuzla, Bosnia and Herzegovina

[2] Medical School Faculty-Sarajevo School of Science and Technology, Hrasnièka cesta 3a, 71 000 Sarajevo, Bosnia and Herzegovina

Abstract— The test methods commonly used for detection of microorganisms are often demanding, expensive, timeconsuming or not fast enough to start with a therapy at early phase of infection. Leucine aminopeptidase (LAP) enzyme is produced by various microbes, including hospital bacteria of Pseudomonas and Enterobacter genus. The aim of this study was to demonstrate the ability of a thin-layer, polymer-based biosensor chip for detection of heat activated bacterial LAP, within a few hours. The biosensor setup is described in one of our previous studies consisting of a thin-metal layer called inconnel, which is covered by polymer layer that can be degraded by lytic enzymes such as LAP. A reduction of polymer thickness, caused by degrading action of the LAP enzyme, is manifested as a colour change of the sensor's surface that is visually detectable. We also investigated bacterial LAP activity in correlation with a total bacterial count. This fast, inexpensive biosensor technology shows a great potential for becoming a quantitative method for detection of bacterial infections in a real-time. Here tested biosensor chip could reduce time between microbial detection and patient's drug treatment, or prevent unnecessary antibiotic treatments before bacterial infection was confirmed.

Keywords— Biosensor chip, polymer, leucine aminopeptidase, microbial detection, quantitative test

BIOSENSORS, BIOINSTRUMENTATION AND BIOMATERIALS

Conducting Polymer Based Efficient Surface Design for the Detection of Cholesterol

S. Soylemez[1] , Y.A.Udum[2] , M. Kesik[1] , C. Gündoğdu Hızlıateş [3] , Y. Ergun[3] , L. Toppare[1,4,5,6]

1 Department of Chemistry, Middle East Technical University, Ankara 06800, Turkey

2 Institute of Science and Technology, Department of Advanced Technologies, Gazi University, 06000, Turkey

3 Department of Chemistry, Faculty of Science, Dokuz Eylul University, Izmir 35160, Turkey

4 Department of Biotechnology, Middle East Technical University, Ankara 06800, Turkey

5 Department of Polymer Science and Technology, Middle East Technical University, Ankara 06800, Turkey

6 The Center for Solar Energy Research and Application (GUNAM), Middle East Technical University, Ankara 06800, Turkey

Abstract – A simple and robust cholesterol biosensor was designed and tested for the determination of cholesterol in real blood samples since estimation of cholesterol is an important issue for the diagnosis and prevention of several heart diseases. For this purpose, a monomer; (Z)-4-(4-(9H-carbazol-9-yl) benzylidene)-2-(4-nitrophenyl) oxazol-5(4H)-one (CBNP) was electrochemically polymerized on an electrode to achieve an effective immobilization platform for enzyme immobilization. Functionalization of the surface is a crucial step in the fabrication of biosensors. Conducting polymers allow the structural modification of several surfaces to be used as immobilization matrices since conducting polymer based enzyme electrodes exhibit high operational stability and fast response. The efficient interaction of the enzyme with the polymer coated surface brings easy and long-life detection of the substrate. Finally, kinetic parameters, operational and storage stabilities, LOD and sensitivity values were determined.

Keywords – Conducting polymer, Cholesterol biosensor, Amperometric biosensor, Cholesterol oxidase

BIOSENSORS, BIOINSTRUMENTATION AND BIOMATERIALS

Practices the different cells types like target genotoxic endpoint in micronucleus assey

Velickova, N., Milev, M., Nedeljkovik, B., Gorgieva, P.

Faculty of medical science University "Goce Delcev" – Stip R.Macedonia

Apstract: Introduction: The toxicological relevance of the micronucleus (MN) assey is well defined: it is a multi-target genotoxic endpoint, assessing not only clastogenic and aneugenic events but also some epigenetic effects, which is simple to score, accurate, applicable in different cell types. Scoring of micronuclei can be performed relatively easily and on different cell types relevant for human biomonitoring: lymphocytes, fibroblasts and exfoliated epithelial cells. Aims of the study: To indicate the importance of the application of micronucleus test as standardized cytogenetic method as an important biomarker in detecting the impact of ionizing radiation on the entire genetic material in occupationally exposed health care workers. Matherial and methods: The study include health professionals who are directly and on daily basses exposed to ionizing radiation as physical agents and a control group that represents young and healthy population that is not exposed to any physical and chemical agents. Results. The major advantage of lymphocytes is that they are primary cells, easy to culture in suspension. The choice between whole blood and isolated lymphocytes depends upon the question addressed. The most important differences among the protocols are the hypotonic treatment (critical in particular for image analysis), fixation of the cells (dependent on laboratory preferences) and the final slide preparation. Conclusion: In recent years the in vitro micronucleus test has become an attractive tool for genotoxicity testing because of its simplicity of scoring and wide applicability in different cell types but the lymphocytes are the most reperesentative cells for this kind of research.

Keywords: cells cultures, lymphocytes, micronucleus, genotoxicology, radiation

BIOSENSORS, BIOINSTRUMENTATION AND BIOMATERIALS

Bioelastična ekstramedularna koštana premosnica u lokomotornoj hirurgiji

Bioelastic extramedullary bone osteosynthesis in locomotor surgery

Zoran Hadžiahmetović [1] , Narcisa Vavra Hadžiahmetović [2]

[1] Klinički centar Univerziteta u Sarajevu, Sarajevo, Bosna i Hercegovina

[1] Institut za edukaciju, nauku i razvoj

[2] Klinika za fizikalnu medicinu i rehabilitaciju

Abstract— The authors of this study will show experimental development, and then the clinical application of bioelastic extramedullary bone osteosynthesis (BEO). The main problem that has caused the work to develop BEO is the inability proper fixation of bones in small diaphysis in situations lack proclaimed osteosynthesis. In this respect, after the PC estimate material used basic task of experimental research, and it is determined that the reliability of the effect as BEO ekstramedulary binder in simple and complex fractures of small animals (13 dogs and 19 cats). By default the parameters of the research showed that a wide segment bioelastic BEO which is reflected in the prevention: shear, rotation, contraction and distraction. The method is a new original surgical technique was introduced into clinical practice in 2006, dialed indication field. Final results compared with other alternative methods in favor of the application of BEO. Bypass has shown its strong foothold in strong comminuted fractures, interphalangeal and metacarpophalangeal necessary and arthrodesis with the installation of intercalary bone grafts bones of the hand with 12 applications (10 patients) at the Clinical Center University of Sarajevo in period 2007./2012.

Keywords— bioelastic osteosynthesis, fractures, bone defects, arthrodesis

POSTER SESSION

Analysis of proteins with IR spectroscopy

E. Džafić , W. Mäntele

Institute for Biophysics/ Physics Department, J. W. Goethe University, Frankfurt/Main, Germany

The function of membrane proteins is crucial for many cellular processes. Understanding the function of a protein requires information about its structure, dynamics and interaction with the environment. Spectroscopic techniques like FTIR-spectroscopy are widely used to get such information. In the present work this method provides detailed insights about conformational changes of Na+ /H+ antiporters. The inactivation of this proteins in human cells leads to heart or kidney diseases. The use of a novel FTIR-ATR-perfusion-cell to record reaction-induced FTIR-difference spectra enabled us to detect even small changes in secondary structure and dynamics of the protein caused by changes of pH and binding of effector molecules. Na+ /H+ antiporter NhaA from E. coli has the highest transport activity at pH 8.5 and is completely inactive below pH 6.5. FTIR- spectra analysis revealed that protein secondary structure is composed mainly of α-helical structure, but also of some β-sheet, loops and unordered structures. The FTIR-spectra of inactive and active state showed two spectral components, which indicate the presence of α-helices with different properties. The temperature-induced structural changes and reorganisation of the protein during the unfolding process demonstrate that activation of the protein causes a change in the properties of α-helices. Thermal stability of this structure decreases with activation. The structure of β-sheet, which is responsible for the main contact between monomers, shows different thermal behaviour for the inactive and the active state. While the temperature profiles for α-helices and β-sheet structure are the same in the active state, they differ in the inactive state. Hence we could conclude that activity of NhaA is associated with the existence of NhaA as a dimer. Protein dynamics and flexibility in the inactive and the active state were analysed by probing water and H+ accessibility by 1H/2H exchange experiments. In the hydrophilic region of the protein, the amino acid side chains exchange faster in the active state than in the inactive state as a result of the conformational change concomitant with activation. In the transmembrane region, activation also leads to conformational changes resulting in an open conformation which is more accessible for the solution. The recording of reaction induced difference spectra yielded unique spectroscopic signatures for the “inactive” and “active” states. The difference spectra of pH-titration showed that the pH value has a dramatic effect on the secondary structure as well as on the protonation state of the amino acid side chains. The pH- and Na+ -induced activation of the protein leads to structural rearrangement of transmembrane α-helices in terms of length, order and/or orientation accompanied by changes in protonation state of glutamic- and/or aspartic acid side chains. pD induced secondary structure changes gave additional information about changes in the environment of tyrosine side chain with activation. Comparison of difference spectra induced by binding of sodium and an inhibitor of transport indicated different binding sites.

Keywords— proteins, Na+ /H+ antiporters, IR-spectroscopy, conformational changes

POSTER SESSION

The Impact of PET Reconstruction Parameters on SUV values

A.Skopljak-Beganović, A. Beganović, M.Gazdić-Šantić, A.Drljević

University Clinical Centre Sarajevo, Department for Medical Physics and Radiation Safery, Sarajevo Bosnia and Herzegovina

Abstract - Positron emission tomography/computed tomography (PET/CT) is a type of diagnostic nuclear medicine imaging modality. The F-18 FDG is a positron emitting radiopharmecutical that is used for PET imaging. The result of PET/CT imaging is the fused image of functional and anatomic information from PET and CT. The aim of this study was to investigate the impact of reconstruction parameters on PET images and to compare assessed values of activity concentration. The number of iterations, cutoff filter values and the number of subsets were the main parameters whose impact on assessed activity concentration was analysed. In this study we used the National Electrical Manufacturers Association (NEMA) Image Quality (IQ) phantom. Spheres and rest of the phantom were filled with the known activity of FDG. Phantom was scanned using the protocol recommended by the manufacturer. After the scanning finished, the images were retro-reconstructed with the combination of different parameters. The maximum and average values of activity concentration were assessed from the image region of interest (ROI) in 6 spheres of NEMA IQ phantom. Values of the maxima varied form 9.6 kBq/ml to 15.8 kBq/ml for the smallest sphere, and from 18.6 kBq/ml to 30.8 kBq/ml for the largest sphere. Best images were obtained using following parameters: 2 iterations, 32 subsets and cut-off filter 5. After the analysis we concluded that the cut-off filter has the greatest impact on assessed concentration values, more than the number of iterations and subsets have. This in turn reflects on how standardized uptake value (SUV) depends on these parameters making its determination a semiquatitative method that highly depends of reconstruction parameters.

Keywords— PET/CT, reconstruction, SUV

POSTER SESSION

Four-dimensional computer tomography: a review

Bekir Rovčanin

Faculty of Medicine, University of Sarajevo, Sarajevo, Bosnia and Herzegovina

Four-dimensional computer tomography (4D CT) is a technology that includes the fourth dimension in the process of making computer tomography scan: time. With this technology it is possible to capture the location of the tumor, another pathological process or an organ and his function, but also movement of the tumor with movement of the organs. With this real time scan it is possible to capture a better shape and to reduce motion artefacts of the moving pathological process in the body, especially in the chest and abdomen, and to stage it. With traditional 3D CT if the tumor (e.g. lung cancer) is located nearby a big blood vessel (e.g. aorta) it is mostly staged as inoperable tumor, because it is probably that the tumor has invaded the blood vessel and has made hematogeneous metastasis, but with the 4D CT we can see that the tumor slides along the aorta, that suggest that the tumor has not invaded the aorta and it is operable. The 4D CT is useful in Image Guided Radiation Therapy (IGRT), where it is possible to capture the tumor in his original shape in movement, like lung cancer, and to radiate the tumor area only and reduce the risk of damaging the healthy tissue, that can occur in standard IGRT due to the movement of the tumor in and out the radiating area. With 4D CT IGRT is more effective, with a lower radiation dose. The usage of 4D CT is not only in oncology, studies have showed that 4D CT can give important information about the functional status of the organs, like ventilation of the lungs and perfusion of the organs. In neurology 4D CT angiography shows better results in detecting thrombus burden in ischemic stroke and the presence of collateral vessels than standard angiography. Also, with 4D CT the perfusion of the organ can be better traced in all three phases of the perfusion.

Keywords: computer tomography, four-dimensional computer tomography, 4D CT angiography, 4D CT IGRT

POSTER SESSION

Selenium Containing Conducting Polymer Based Pyranose Oxidase Biosensor for Glucose Detection

T.C. Gokoglan[1] , S. Soylemez[1] , M. Kesik[1] , S. Toksabay[1] , L. Toppare[1,2,3,4]

[1]Department of Chemistry, Middle East Technical University, Ankara 06800, Turkey

[2]Department of Biotechnology, Middle East Technical University, Ankara 06800, Turkey

[3]Department of Polymer Science and Technology, Middle East Technical University, Ankara 06800, Turkey

[4]The Center for Solar Energy Research and Application (GUNAM), Middle East Technical University, Ankara 06800, Turkey

Abstract – Conducting polymers (CPs) provide fascinating stability for enzyme molecules on electrode surface and their uses have rapidly increasing in the field of biological analysis for the detection of various analytes. Therefore, CPs have been used as one of the most fascinating transducers due to their simple preparation. Conducting polymer based biosensors bring reliable, accurate, simple and low–cost determination of different analytes and act as very effective analytical tools in many of applications. In this study, conducting polymer of (4,7-bis(thieno[3,2-b]thiophen-2-yl)benzo[c][1,2,5] selenadiazole) (BSeTT) was used as the immobilization matrix for biomolecule deposition to achieve an effective surface design to detect glucose. After successful electrochemical polymerization of BSeTT on gold electrodes, pyranose oxidase (PyOx) as a model enzyme was immobilized on a polymer coated electrode surface via physical adsorption technique. Amperometric detection of oxygen consumption was observed at -0.7 V vs Ag reference electrode in phosphate buffer (50 mM, pH 7.0). Moreover, the constructed biosensor was characterized using Scanning Electron Microscopy (SEM), Electrochemical Impedance Spectroscopy (EIS) and Cyclic Voltammetry (CV) techniques to investigate the surface morphologies and electrochemical characterizations. KM app , Imax, and sensitivity were calculated as 0.229 mM, 42.37 nA, and 6.4 nA/mM cm2 , respectively. The biosensor shows a wide linear range between 0.02 mM and 0.5 mM glucose concentration with a low limit of detection (LOD) of 3.3 x 10- 4 mM as S/N = 3. Finally, the proposed biosensor was tested for the detection of glucose in beverage samples successfully.

Keywords – Amperometric biosensor, Conducting polymer based biosensor, Glucose biosensor, Pyranose oxidase

POSTER SESSION

Synthesis of graphene layers for biomedical applications

H. SATILMIŞ[1] , B. YILDIZ[1] , Y. E. TANIŞ[1] , C. G. ÜNLÜ[2] , Y. ÖZMEN[2]

[1] Faculty of Technology, Department of Material Science and Eng., Pamukkale University, Denizli, TURKEY.

[2] Faculty of Technology, Department of Biomedical Engineering, Pamukkale University, Denizli TURKEY.

Abstract— Recently it has been witnessed many breakthroughs in research on graphene (the first two-dimensional atomic crystal) as well as a significant advance in the mass production of this material. This one-atom-thick fabric of carbon uniquely combines extreme mechanical strength, exceptionally high electronic and thermal conductivities, reasonably good biocompatibility, as well as many other supreme properties, all of which make it highly attractive for numerous applications. This work deals with deposition and characterization of graphene layers on biomaterial substrates. Graphene layers are synthesized by Chemical Vapor Deposition (CVD) technique. Graphene layers deposited with different flow rates of gases and variable working temperatures. The morphology, atomic structure and electrochemical properties determined by Raman spectroscopy, XRD, SEM, EDX, TEM analysis.

Keywords— Biomaterial, Graphene, CVD, Structural properties.

POSTER SESSION

Stem Cells and plastic surgery – Future and Perspectives

Malik Jakirlić, Vanis Dujso

Clinic for Plastic and Reconstructive Surgery, University Clinical Center Sarajevo, Bosnia and Herzegovina

Stem cells are biological cells that can differentiate into specialized cells which have the remarkable potential to develop into many different cell types. They can play a very important role in the repair and replacement of damaged cells and tissues. They are valuable option for regenerative treatments for procedures in plastic surgery. Various types of stem cells have been studied for clinical applications. Embryonic stem cells have the greatest regenerative potential. They are natyrally pluripotent and can differentiate into different cellular types. Adult stem cells are very useful cell population in regenerative medicine as their ease of isolation, differentiation and potential for autologous transplantation. Methods: The purpose of this paper is to evaluate the applications of stem cells in plastic surgery, especially in wound healing, peripheral nerve regeneration, skin rejuvenation and soft tissue regeneration.

Current therapies in tissue regeneration include biomaterials and tissue flaps, wich can be complicated by infection, fibrosis and contracture. Fat grafting is a commonly performed procedure for tissue filling that can be used for several indications like brest augmentation and reconstruction. Fat grafts are restricted by varying rates of resorption and complications of partial necrosis. Autologous bone grafts have been the gold standard for reconstructing bony defects, but donor site morbidity and complications have led researchers to investigate cell-based therapies. Current clinical stem cell therapies for bone regeneration have shown promising results for craniofacial defects and defects involving the maxilla and mandible. Cartilage defects are reconstructive problem due to the tissue's limited intrinsic capacity for self-repair. Cellular-based therapy for cartilage defects involves autologous chondrocyte implantation, in which chondrocytes harvested from low-contact areas are expanded in culture and then re-injected into a defect. Wound healing is a highly coordinated process involving complex interactions among cells, growth factors and extracellular matrix molecules to sequentially achieve hemostasis, cell proliferation, angiogenesis, re-epithelialization and remodeling of tissue.

Adipose tissue-derived stem cells have been promoted as favorable candidates for wound therapies as they secrete numerous growth factors and cytokines critical in wound healing and also increase macrophage recruitment, enhance granulation tissue, and improve vascularization. Skin aging involves a number of different degenerative processes, notably a decrease in collagen production by fibroblasts. Several cytokines and growth factors are involved in stimulating fibroblast collagen synthesis for skin rejuvenation, and have also been shown to be part of the secretome of Adipose tissue-derived stem cells, suggesting that these cells may be suitable for promoting repair of atrophic and photo-damaged skin. The repair of peripheral nerve injuries, particularly those with large defects, is limited by donor site morbidity and suboptimal functional recovery, prompting research for alternative treatments that have included a wide spectrum of regenerative therapies.

A majority of experimental stem cell treatments for nerve injuries focus on replacing host support cells, particularly the Schwann-cell population, as these cells are crucial in providing trophic,

structural and directional support for regenerating axons. Conclusions: Stem cells have encouraging therapeutic potential for the treatment of various tissue defects and attractive appliance in aesthetic medicine. It will be helpful for future studies to focus on further investigating the survival of transplanted cells and appropriate integration into their surrounding environment.

Keywords: Stem cells, plastic surgery, tissue.

POSTER SESSION

Laser – induced nonlinear processes in molecules

D. Habibović[1] , E. Hasović[1] , A. Gazibegović-Busuladžić[1] , S. Odžak[1] , A. Čerkić[1] , M. Busuladžić[2] and D. Milošević[1,3]

[1]Faculty of Science, University of Sarajevo, Zmaja od Bosne 35, 71000 Sarajevo, Bosnia and Herzegovina

[2]Faculty of Medicine, University of Sarajevo, Čekaluša 90, 71000 Sarajevo, Bosnia and Herzegovina

[3]Academy of Sciences and Arts of Bosnia and Herzegovina, Bistrik 7, 71000 Sarajevo, Bosnia and Herzegovina

Abstract – Nonlinear phenomena can occur when atoms or molecules are exposed to strong laser fields (see review articles [1,2] and references therein). The study of atomic and molecular processes in fewcycle laser pulses is important. For example, using pump-probe techniques with ultra-short laser pulses one can get insight into the short-time dynamics of atoms and molecules. Nonlinear processes have attracted a lot of attention in the last few decades due to numerous applications in physics, chemistry, biology and various areas of medical science. Some of these processes (high-order above-threshold ionization – HATI, high-order harmonic generation – HHG) are particularly important for a deeper understanding of the laser-matter interaction [3,4]. HATI and HHG processes can be described using the so-called three-step model. In the first step system absorbs more photons from the laser field than is necessary for ionization. Now, the electron is free from the parent atom, and can go to the detector without any significant interaction. This process is called the direct above-threshold ionization (ATI). The other scenario includes the influence of the laser field. The ionized electron may also return to the parent ion (second step) and elastically scatter off it (third step), before reaching the detector. The third step of the HHG process is different. Here the electron recombines with the parent ion, and a high-energy photon is emitted. The energy spectra of the above-mentioned processes exhibit a long plateau that finishes by an abrupt cutoff. In collaboration with other theoretical and experimental groups, we simulate the experiments performed in Germany, Netherlands, France, Italy, Japan and China [5,6]. Until now, we have successfully simulated some of the most important experiments in this field. By analyzing HATI and HHG spectra we are able to draw some conclusions about the molecular structure. We analyze HATI and HHG spectra for different molecular orientation with respect to the laser polarization axis, for different values of the electron or photon energies and for different electron emission angle.

Keywords – laser, molecules, nonlinearity, interaction, ionization

POSTER SESSION

Teaching Physical Aspects of Medical Imaging Techniques

M. Kiseljaković , M. Sotonica , M. Ejubović , V. Fatić , A. Omerbašić , S. Dalipagić , D. Zoranović , Z. Muharemović and M. Busuladžić.

Faculty of Medicine, University of Sarajevo, Čekaluša 90, 71000 Sarajevo, Bosnia and Herzegovina

Abstract— Radiology is a very important branch of medicine. It is using imaging to diagnose and treat diseases emerging within the human body. The curriculum at the Faculty of Medicine in Sarajevo was developed to provide students with a general knowledge of the physical aspects of radiology. It includes how ultrasound beams and x-rays are produced and detected, as well as the differences between corresponding imaging parameters such as acoustic impedance and density of human tissues. Also, this course introduces students to the basic physics of magnetic resonance imaging, including information on nuclear structure, nuclear spin, magnetic moments, interactions with external magnetic fields, and relaxation processes. A deeper understanding of the underlying physics, which includes topics from classical as well as atomic and nuclear physics, is the most efficient way to learn about different medical imaging techniques [1,2]. Generally, this course needs to accomplish a number of key objectives in order to equip students with appropriate skills knowledge when they enter clinical years and encounter different clinical situations (see articles [3,4] and references therein). On the other hand, one has to keep in mind that most students do not intend to pursue careers in radiology. For the above-mentioned reasons, it is particularly important to find balance among the presented base concepts of physics, applied mathematical methods, and finally their apparent significance in medicine, or closer, radiology [5]. In this paper we are presenting our experiences and analyses about common student misconceptions and misunderstandings in this area of science. Also, some steps toward overcoming these obstacles are presented. Specifically, we propose the improved curriculum including more up to date interactive learning and educational technology [6] like simulations software. In this way, very complex spatio-temporal processes could be brought closer to students. It is important to point out that the desired role of available educational technology is not to replace teacher, but to enhance human performance of teacher as well as student.

Keywords— Physics, Radiology, Curriculum, Teaching, Medical education

POSTER SESSION

3D technology in the manufacture of a medicament forms with controlledrelease

Emina Maleškić[1] , Sanita Maleškić[2] and Mirza Dedić[3]

[1] University of Sarajevo, Faculty of Pharmacy, Sarajevo, Bosnia and Herzegovina

[2] University of Sarajevo, Faculty of Medicine, Department for Pharmacology and Toxicology, Sarajevo, Bosnia and Herzegovina

[3] University of Sarajevo, Faculty of Pharmacy, Department for Quality Control, Sarajevo, Bosnia and Herzegovina

Abstract— Three-dimensional (3D) drug printing is relatively new, fast technique, based on computer - designed models, with an unexpected degree of flexibility in the use of new materials, which is a special advantage in the pharmaceutical industry. Primary, 3D printing technology used in pharmaceutical production is based on an inkjet or inkjet-based 3D powder printing. This technique requires the use of 3D printers, also called "rapid prototype machines", and the technique itself includes processing of powdered and liquid binding material, which results in completion of individual layers which together form the appropriate drug form. Type of 3D printer used for drug printing depends primarily on the material and way of connecting layers in the final form. The three most commonly used printers for medical and pharmaceutical applications are: thermal inkjet (TIJ), fused deposition modeling (FDM) printer and the printer with selective laser sintering (SLS). 3D printing technology is advancing towards development and manufacture of systems for application of patient adjusted medications and personalization of therapy to meet the needs of individuals and different groups of patients. This innovative technology includes a wide range of active ingredients, such as steroid antiinflammatory drugs, acetaminophen, theophylline, vancomycin, tetracycline, dexamethasone, folic acid, and the most common of adjuvant substances: propylene glycol, cellulose, methanol, acetone, and surfactants. 3D printing in the preparation of pharmaceutical drugs provides numerous advantages, including the customization and personalization of drugs, increased control of particle size distribution, an increased dosing control, high reproducibility, possibility of manufacturing dosage forms with a complex profile of drug release, increased productivity and cost effectiveness of drug production. Production of solid drug forms with a complex internal and specific surface structure, specific geometry, a great variation of materials and active ingredients, different systems for the sustained release of a drug using a microchip for controlling the distribution of the active ingredient and the many types of implant drugs is possible thanks to 3D printing technique. 3D printed drugs became important part of the further pharmaceutical technology progress and offered new strategies in research and development of sustained release dosage forms.

Keywords— 3D printed drugs, controlled release, personalized therapy

POSTER SESSION

Primjena nanolijekova u terapiji karcinoma

Nermina Žiga[1] , Amila Dobrača[1] , Fahir Bečić [1] , Vedina Čordalija[2] , Mirza Dedić [1]

[1] Farmaceutski fakultet UNSA

[2] JU Psihijatrijska bolnica Kantona Sarajevo – bolnička apoteka

Nanotehnologija je jedan od najperspektivnijih pravaca u modernoj medicini, farmaciji i nauci uopšte. Posljednjih godina se nanoterapija pokazala izuzetno značajnom u terapiji karcinoma. Pod pojmom nanolijekovi se podrazumijevaju inkorporirane molekule citostatika u specifični biorazgradivi kalup koji se, u tijelu oboljelog od karcinoma, razgrađuje nakon nekoliko dana, postepeno oslobađajući lijek koji ciljano djeluje na stanice karcinoma. Obzirom da hemoterapija, kao najčešći oblik terapije karcinoma, ispoljava veliki broj neželjenih efekata, razvoj i primjena nanolijekova se može smatrati „onkološkom revolucijom“. Mehanizam djelovanja hemoterapeutika i nanolijekova je različit, čime ćemo se kroz komparativnu analizu baviti u ovom radu. Nanotehnološka istraživanja u medicini su usmjerena na dobivanje nove generacije lijekova, razvoj načina transporta istih, dobivanje umjetnih tkiva, te poboljšanje dijagnostičkih metoda i laboratorijskih ispitivanja lijekova. Danas se u svijetu intenzivno radi na razvoju nanolijekova koji djeluju samo na stanice karcinoma, ne uništavajući pri tome okolna tkiva. Svjetsko tržište farmaceutskih nanoproizvoda se vrlo brzo razvija, prilikom čega se prosječno troši oko 4 milijarde dolara godišnje, a tendencija rasta i ulaganja u iste je iz godine u godinu sve veća. Lider na području nanotehnologije je Amerika, a od evropskih zemalja prednjači Njemačka, Velika Britanija i Francuska. Do sada je u svijetu odobreno 6 nanolijekova koji se koriste u terapiji hronične limfocitne leukemije, hronične mieloične leukemije, gastrointestinalnih karcinoma, te u terapiji karcinoma dojke i jajnika.

Ključne riječi: nanotehnologija, nanolijekovi, karcinom

POSTER SESSION

Ispitivanje ksenoestrogenog djelovanja organskih uv filtera

B. Imamović, T. Dujić, M. Malenica, E. Bečić, M. Dedić

Farmaceutski fakultet, Univerziteta u Sarajevu, Sarajevo, Bosna i Hercegovina

Abstrakt— Ispitivanje potencijalnog ksenoestrogenog djelovanja organskih UV filtera je od izuzetne važnosti jer se oni danas tretiraju kao nova klasa polutanata. Ksenoestrogeni se definišu kao supstance koje „interferiraju sa sintezom, sekrecijom, transportom, vezivanjem i eliminacijom prirodnih hormona koji su u organizmu odgovorni za očuvanje homeostaze, reprodukcije, razvoj i ponašanje“. Ove supstance mogu se vezati za estrogen receptor, što može dovesti do ekspresije estrogen senzitivnih gena. Ekspresija estrogen senzitivnih gena za posljedicu može imati pojavu različitih nekontroliranih efekata u organizmu, što može izazvati određena oboljenja kao što je karcinom. U radu je ispitano ksenoestrogeno djelovanje etilheksil metoksicinamata (EHMC), homosalata (HS) i njihovih derivata nastalih u kontaktu sa slobodnim hlorom. U cilju ispitivanja potencijalnog ksenoestrogenog djelovanja, korišten je ELISA kit koji sadrži estrogene receptore tj. ERα. Alfa estrogeni receptor (ERα) spada u grupu nuklearnih receptora (NR). NR je jedan od faktora transkripcije koji reguliše ekspresiju target gena. ERα igra važnu ulogu u fiziološkom procesu reprodukcije. Izučavanje hemizma vezivanja za ERα je jako važno za istraživanje potencijalnih EDC-jeva i ispitivanju novih lijekova. Rezultati su pokazali da se agonistička aktivnost na estrogene receptore standarda EHMC-a i derivata EHMC-a sa slobodnim hlorom se kreće od 69,69% do 89,13% aktivnosti β-estradiola a kod standarda HS-a i uzoraka HS-a sa slobodnim hlorom kreće se od 63,88% do 99,04% aktivnosti β-estradiola. Ove vrijednosti ukazuju na jaku agonističku aktivnost standarda EHMC-a, ispitivanih uzoraka EHMC-a, standarda HS-a i uzoraka HS-a. Na osnovu ovih podataka može se zaključiti da će se EHMC i HS i njihovi derivati nastali u reakciji sa hlorom vezati za estrogene receptore živih organizama. Kao posljedica vezivanja doći će ekspresije estrogenih gena, koji mogu izazvati različita patološka stanja u živom organizmu.

Ključne riječi— ksenoestrogeno djelovanje, HS, EHMC, derivati sa hlorom;

POSTER SESSION

In silico modeli za predviđanje apsorpcije, distribucije, metabolizma, eliminacije i toksičnosti lijekova

Mujkić Sabina[1] , Smajović Alisa[2] , Vojinović Tanja [3]

[1]Alvogen Pharma d.o.o., Sarajevo

[2]Farmaceutski fakultet Univerziteta u Sarajevu, Katedra za farmaceutsku informatiku, Sarajevo, Bosna i Hercegovina

[3]Farmaceutski fakultet, Univerzitet Crne Gore, Katedra za farmaceutsku tehnologiju, Podgorica, Crna Gora

Abstract- Kompjutersko modeliranje za predviđanje apsorpcije, distribucije, metabolizma, eliminacije i toksičnosti (ADMET) lijekova predstavlja pristup koji se danas najbrže razvija u polju farmakokinetike. Razlog tome je što su ADMET osobine prepoznate kao glavni razlog odbacivanja potencijalnih lijekova u kasnoj fazi razvoja lijeka, a rezultat su finansijski gubici. Sposobnost predviđanja efekata potencijalnih lijekova in silico metodama prije sinteze će za rezultat imati manje ispitivanja. U ovom radu su prikazani in silico modeli koji se koriste za predviđanje ADMET lijekova. Veliki broj faktora, fizičko-hemijskih, fizioloških i onih vezanih za formulaciju, utiču na GI apsorpciju. Na tržištu postoje mnogi softverski paketi koji omogućavaju predviđanje ADMET procesa, a ističu se GatroPlus® i iDEA koji se temelje na procjeni topivosti i intestinalne permeabilnosti potencijalnih lijekova. Za predviđanje distribucije lijekova u tkiva dostupni su modeli koji se baziraju na određivanju volumena distribucije u stabilnom ravnotežnom stanju (Vss), u tkivima ili plazmi. Svi se zasnivaju na pretpostavci pasivne difuzije između tkivnih dijelova, što može predstavljati ograničenje imajući u vidu da postoje komponente koje zahtjevaju aktivni transport. Metabolizam je vjerovatno najveći i još uvijek najmanje razumljiv aspekt ADME procesa, što za posljedicu ima tešku evaluaciju i predviđanje. Metabolička sudbina komponenti zavisi od velikog broja varijabli povezanih sa hemijskim i biološkim sistemom. Postoje dva glavna naučna pristupa za in silico predviđanje metabolizma lijekova. Prvi je zasnovan na fizičko-hemijskim osobinama molekule, temelji se na procjeni povezanosti strukture i aktivnosti, a drugi je zasnovan na poznavanju strukture enzima i/ili njhovog mehanizma djelovanja. Dva najčešće korištena kompjuterska sistema za predviđanje metabolizma lijekova su METEOR i METABOLEXPERT. O in silico metodama predviđanja procesa eliminacije lijekova se malo zna, ali teoretski, ona može biti predviđena primjenom nekih od pristupa koji se odnose na procjenu tkivne raspodjele, jer je određena sličnim fizičkohemijskim i fiziološkim osobinama, uzimajući u obzir ograničenja. Za predviđanja toksičnosti lijekova koriste se već postojeće baze podataka. Veliki broj modela koji se koriste u tu svrhu su bazirani na QSAR metodi, pri čemu se najčešće ispituje kancerogenost. Obzirom da se velika sredstva odvajaju za ispitivanje djelovanja novih molekula, in silico dizajn se čini razumnim rješenjem kako bi se nastavio pozitivan trend pronalazaka novih lijekova.

Ključne riječi- in silico models, ADMET, drugs

POSTER SESSION

Determination influence of inhibiting platinum acid on the activity of catalase

S. Herenda, J. Ostojic , L. Klepo and B. Galić

Faculty of Science, Department of Chemistry, University of Sarajevo, Zmaja od Bosne 33-35, Sarajevo, Bosnia and Herzegovina

Abstract— In this work was tested in an in vitro experiment the inhibitory effect of hexachloroplatinic (IV) acid on the activity of the enzyme catalase. Hexachloroplatinic (IV) acid is a substance that, like other salts of platinum affect the cells of a living organism. It is known as a strong allergenic. It is important investigate the influence of inorganic substances in which platinum in the tetravalent state of the oxido-reductive activity of the enzyme catalase. Manometric method, using a modified method by Schubert-in, measured by the amount of released O2 generated by the interaction of the substrate H2O2 and catalase, with and without the presence of hexachloroplatinic (IV) acid. Assuming that the true Michaelis-Menten's model, the value of Km, Vmax and type of inhibition were calculated over Lineweaver-Burk's diagrams. Inhibition constant Ki were calculated over Dixon's diagram, on the basis of certain initial velocity of corresponding substrate concentration and hexachloroplatinic (IV) acid. In this paper, it is shown that hexachloroplatinic (IV) acid is a weak inhibitor of the enzyme catalase and the type of inhibition is competitive.

Keywords - platinum acid, catalase, manometric method

POSTER SESSION

Determination of Body Surface Area Using the Mathematical Harmony

A, Omerbašić, D. Šečić, Z. Muharemović and M. Busuladžić

Faculty of Medicine, University of Sarajevo, Čekaluša 90, 71000 Sarajevo, Bosnia and Herzegovina

In order to specify physical quantities which determine body structure and its function as accurately as possible and to make closer modern medicine and exact science, we decide to write this opus. While determining some of the standard physical quantity, we determine between which numbers its value is being changed, but they must not lead to any changes in build or function of human body as a complete organism. Being aware of the values of physical quantities is very important for therapeutical medicine (i.e. it is important to know exactly the body surface area (BSA) in order to calculate the dosage for anticancer therapy (1)). For determining the body surface area there are many formulas recommended, as well as many methods of practical measuring (2, 3). Formulas selected from previous studies were divided into four other groups: 1) formulas based on Mass + Height , 2) Mass x Height a b , 3) Mass x Height and 4) three explanatory parameters. Among the various BSA formulae used in western countries, the DuBois formula is the standard one. Due to differences in body build and the way of life, in Japan, the Fujimoto formula has been used frequently (1). Starting from the fact (by relying on fact) that the essence of the structure of human body is The law of the golden ratio, we tried to overcome difficulties and establish a general formula for determining BSA in which number PHI=1.618 will be integrated. Due to very firm connection between mass and body surface area, BSA formula includes, so called, golden mass of the human body (4). We searched and compiled frequently used BSA formulae across the world using MEDLINE search. Using these formulae, we calculated BSA for few hundred students, and compared their results with ours. Results that were calculated are almost same with standard allometric formulae for BSA calculation.

POSTER SESSION

Determination of gender and age specific differences in total iron levels in human serum using a spectrophotometric method

I. Tahirovic[1], A. Boloban[1], S. Ibragic[1], H. Dzudzevic-Cancar[2], J. Toromanovic[3], O. Lepara[4], A. Ajanovic[5], M. Dizdar[1]

[1] Faculty of Science, Department of Chemistry, University of Sarajevo, Zmaja od Bosne 35, 71000 Sarajevo, Bosnia and Herzegovina,

[2]Faculty of Pharmacy, Department of Chemistry, University of Sarajevo, Zmaja od Bosne 8, 71000 Sarajevo, Bosnia and Herzegovina,

[3]University of Bihać, School of Medical Studies*, Žegarska aleja bb, 77000 Bihać, Bosnia and Herzegovina,*

[4]Department of Physiology, School of Medicine, University of Sarajevo, Čekaluša 90, 71000 Sarajevo, Bosnia and Herzegovina,

[5]University of Sarajevo, Veterinary Faculty in Sarajevo, Zmaja od Bosne 90, 71000 Sarajevo, Bosnia and Herzegovina

Abstract - Despite being present in trace amounts, iron is required for a number of complex metabolic processes that are indispensable to human life. As a part of the haemoglobin molecule, it has a fundamental role in the transportation of oxygen. It is required for haematopoiesis, production of enzymes, proper functioning of the immune system and other essential metabolic reactions. The aim of this study was to determine the total iron content in human serum samples of 500 individuals classified into groups based on gender and age. For that purpose we used a spectrophotometric method and the Iron Flex reagent. The method is based on measuring the absorbance of the blue coloured Fe(II)-feren complex at 600 nm. The obtained results are in line with expectations. The serum iron concentrations (SICs) for men were in the interval 11.52-25.30 µmol/l, whereas the range for women was lower, 9.00-20.16 µmol/l. In the age groups 20-40 years (y.), 40-60 y. and >60 y., women had significantly lower levels of serum iron than men. Also, SICs in postmenopausal women (age >60 y.) were statistically significantly lower than SICs of younger women (age ≤20 y.), and SICs in pre-/postmenopausal women (age 40-60 y.) were statistically significantly lower than those in younger women. Statistic analysis performed by Student's t test and by one way ANOVA shows significantly differences between the serum iron levels in the groups of interest.

Keywords – *serum iron, spectrophotometric method, feren complex*

POSTER SESSION

The Future of Healthcare: Nanomedicine and Internet of Nano Things

E. Omanović - Mikličanin[1], M. Maksimović[2], V. Vujović[2]

[1] Faculty of Agriculture and Food Sciences, University of Sarajevo, Sarajevo, Bosnia and Herzegovina

[2] Faculty of Electrical Engineering, University of East Sarajevo, East Sarajevo, Bosnia and Herzegovina

Abstract - Constant population growth influences of health care demands and needs for new, more advanced scientific solutions. Classical way of providing the health care services could be very robust. It requires new paradigm and technology for more effective solutions. Rapid development information and nano technologies change the health care system in total. It gives to the health care system a new, global domain – Internet of Nano Things (IoNT) and nanomedicine. These two concepts are beginning to change the foundations of disease diagnosis, treatment, and prevention. Future healthcare based on IoNT powered e-health systems will make health monitoring, diagnostics and treatment more personalized, timely and convenient. These improvements increase the availability and quality of medical care followed with radically reduced costs. Thus, analysis of this approach is highly important for future development of healthcare.

Keywords - healthcare, nanomedicine, nanotechnology, Internet of Nano Things.

BIOMECHANICS, ROBOTICS AND MINIMALLY INVASIVE SURGERY

The computer modelling and biomechanical analysis of musculoskeletal systems in The AnyBody Modeling System

Spahic D, Karac A.,

University of Zenica, Faculty of Mechanical Engineering, Zenica, Bosnia and Herzegovina

Abstract— This paper reviews The AnyBody Modeling System, designed for simulating the mechanics of the human body during different activities of daily living. Several features of the AnyBody System are presented, demonstrating the software capabilities and visualising the musculoskeletal model of the human body in action.

Examples of a full-body model standing on a floor and doing a squat motion, with and without additional weight, and a free posture model in interaction with a piece of sport equipment are analysed, where the individual muscle forces, and the reaction forces in the human body joints are obtained.

In addition, the boundary conditions and the loads acting on the clavicle bone during the squat motion are exported for a subsequent numerical analysis. The output data and the mesh of the clavicle bone are imported into finite-element-based software. Obtained analysis demonstrates how the clavicle bone reacts with the muscle attachments and surrounding bones during performance of the analysed activities.

Keywords—The Anybody Modeling System, inverse dynamics, biomechanics, the clavicle bone , Finite Element Analysis

BIOMECHANICS, ROBOTICS AND MINIMALLY INVASIVE SURGERY

Analysis of sub-cerebellar regions in patients with Chiari Malformations

Engin Akar[1] , Sadık Kara[1] , Hidayet Akdemir[2] and Adem Kırış[3]

[1] Institute of Biomedical Engineering, Fatih University, Istanbul, Turkey

[2]Department of Neurosurgery, Medicana International Hospital, Istanbul, Turkey

[3]Department of Radiology, Mehmet Akif Ersoy Cardio-Thoracic Surgery Training and Research Hospital, Istanbul, Turkey

Abstract— Chiari Malformations are serious neurological defects involving herniation of hindbrain tissues such as cerebellar tonsils, brainstem and IV. ventricle into the spinal canal through the foramen magnum. By the severity of cerebellar descent, these malformations are classified into four different types. Clinically the least obvious and the mildest one is named as type I and defined as the descent of cerebellar tonsils into the cervical canal more than 5 mm. Magnetic Resonance Images (MRI) of brain in the sagittal plane provides the best clues in the diagnosis of the Chiari Malformation type I (CM-I). Previous studies investigated the morphological characteristics of cerebellum and nearby regions such as brain stem and fourth ventricle. Aim of this study is to analyze the cerebellar regions in chiari patients and healthy controls to search for the discriminative properties between the two groups. Sagittal brain MRI of eleven chiari patients and gender matched controls were used in order to examine the area of sub-cerebellar tissues such as gray matter (GM) and white matter (WM) and the area ratio between GM and WM. A graphical user interface (GUI) for implementing image processing techniques was developed using MATLAB environment. By means of GUI, the region embracing the whole cerebellum tissue on the mid-sagittal MR images were manually extracted. In addition, using Statistical Parametric Mapping (SPM) package the MRI slices were segmented into GM and WM tissues. Using the extracted cerebellum region as a mask, the cerebellar GM and WM tissues were achieved and the corresponding areas were computed by counting the number of pixels on each GM and WM slice. According to the statistical results, it has been found that cerebellar GM areas of the patients are significantly higher than the values of controls. As a consequence, this approach may provide a discriminative feature between patients with CM-I and health control subjects.

Keywords— Chiari malformation, magnetic resonance imaging, segmentation, gray matter, white matter

BIOMECHANICS, ROBOTICS AND MINIMALLY INVASIVE SURGERY

Numerical and experimental stress analysis of an external fixation system

E. Mešić, V. Avdić and N. Pervan

Mechanical Engineering Faculty/Department of Mechanical Design, University of Sarajevo, Bosnia and Herzegovina

Abstract— This paper presents research results of a stress analysis of a Sarafix external fixation system, applied to an unstable tibia fracture. A stress analysis was performed using FEA and experimental stress measurements using strain gauges. Research was performed on the Sarafix external fixation system controlling values and directions of principal stresses at the measuring points in the case of axial compression. Sarafix proved to be mechanically stable, confirming good clinical results in the treatment of bone fractures.

Keywords— Computer Aided Design (CAD), Finite Element Analysis (FEA), experimental stress analysis, CATIA, principal stresses.

BIOMECHANICS, ROBOTICS AND MINIMALLY INVASIVE SURGERY

Sensory re-education after median and ulnar nerve repair

Malik Jakirlić [1] , Vanis Dujso[1] , Ibrahim Omerhodžić [2]

[1]Clinic for Plastic and Reconstructive Surgery, University Clinical Center Sarajevo, Bosnia and Herzegovina

[2]Clinic for Neurosurgery, University Clinical Center Sarajevo, Bosnia and Herzegovina

The brain has a detailed map of the body where touch is registered and interpreted. Sense of touch from the right hand is mainly processed in the left part of the brain, but both halves of the brain are active during perception of touch. All our senses cooperate when we touch something, and vision and hearing for example can help to strengthen touch. After nerve repair, new axons grown to the skin and the brain map is changed again since the axons don´t grow in exactly the same paths as before the injury. The handmap becomes unstructured, and the sensibility during this time is not very useful. This functional reorganisation of the brain is a natural process and depends on the brain´s capacity to adapt when the body sends new signals.

Sensory re-education has been defined as the gradual and progressive process of reprogramming the brain through the use of cognitive learning techniques such as visualization and verbalization, the use of alternate senses such as vision or hearing and the use of graded tactile stimuli designed to maintain or restore sensory areas affected by nerve injury or compression to improve tactile gnosis. Methods: After nerve repair patient and his therapist compose a training programme to improve the functional sensibility based on how much the nerve has grown. The exercises should be done for a few minutes several times per day. Exercises are performed in two phases. In phase 1 the hand is without sensibility and the handmap in the brain has disappeared. This phase lasts up to three months after an injury at wrist level and encompasses the period direct after surgery until some growing axons have reached the palm of the hand. The aim of sensory re-education in this phase is to maintain the cortical hand representational map through techniques that bypass the interrupted sensory pathways and by using other senses. In this phase therapist is touching the areas in the hand that have no sensibility in combination with concentrated watching. Meantime the handmap in the brain is activated.

This is repeated several times per day. Also the patient can touch his finger without sensibility using the corresponding finger of the other hand. In phase 2 the axons have reached the hand and the hand map in the brain has a changed pattern. This is approximately three months after a repair at wrist level and patient has some sensibility in the palm. This means that it is time to start training with phase 2 exercises. This late phase relies on the brain's ability for neuroplasticity and combines the use of sensory input to the injured nerve territory with vision, memory, and learning. In this phase it is important to localize touch sensation with a blunt object and compare it to an area where the patient have normal sensibility. Patient needs to repeat the touch, first with his eyes open and then with his eyes closed until he know the location and character of the touch. When patient has some protective sensibility in the fingertips it is time to start exercises to relearn to differentiate textures and shapes and to identify objects. Conclusions: It takes a long time for sensory and motor recovery after nerve repair. There is a need for further well-defined clinical trials to assess the

effectiveness of sensory re-education of patients with impaired sensibility of the hand due to a peripheral nerve injury. The effect of sensory re-education programs need to be evaluated using validated impairment-based measures of sensibility and patient-rated outcome questionnaires of activities and participation.

Keywords: median, nerve, sensory, re-education, ulnar.

BIOMECHANICS, ROBOTICS AND MINIMALLY INVASIVE SURGERY

Analysis of signals collected by intraoperative neuromonitoring procedure during the neurosurgical operation of patients with complex intramedullary spinal cord tumors

I. Omerhodžić [1,2], S. Zahirović [1,2], S. Avdaković [1,3], H. Hodžić [4] , A. Vardo[5] , M. Bišćević [6] , S. Drnda[7] , A. Adilović [8] , A. Badnjević [1,9]

[1]Bosnia and Herzegovina Medical and Biological Engineering Society, Sarajevo, B&H

[2]Department of Neurosurgery, Clinical Center University of Sarajevo, B&H

[3]EPC Elektroprivreda of B&H, Department for Development, Sarajevo, B&H

[4]Medical Faculty, University of Sarajevo, Sarajevo, B&H

[5]Faculty of Electrical Engineering, University of Sarajevo, Sarajevo, B&H

[6]Department of Orthopedics and Traumatology, Clinical Center University of Sarajevo, B&H

[7]Department of Neurology, Clinical Center University of Sarajevo, B&H

[8]Mistral Technologies, Sarajevo, B&H

[9]Verlab Ltd, Sarajevo, B&H

Abstract— The principles of the intraoperative neuromonitoring are based on electrical stimulation of different parts of central and peripheral nervous system and collection and analyzing of electrical signals in real-time or latter on [1]. Intraoperative neuromonitoring helps to understand and to minimize the risk to the patient. It is of great help to the neurosurgeon and enables him to operate more precisely and with less risk of postoperative neurological deficit and includes motor evoked potentials (MEP), somatosensory evoked potentials (SSEP) and electromyography (EMG) [2]. Decreasing of the negative high amplitude potentials is the most sensitive indicator of damage to the motor- or somato-sensory system of the spinal cord and indicates damage to the ventral or dorsal columns respectively [3]. The purpose of this study is to analyze the signals collected during the surgery of complex spinal cord intramedullary tumors. All patients were operated in the Department of neurosurgery, at Clinical Center, University of Sarajevo. Signals were collected and analyzed with standard neuromonitoring (MEP, SSEP and EMG). We tried to achieve and define the possibility of improving and having more precise information concerning the changes in signal magnitude and frequency during the very precise surgical intervention.

Keywords— neuromonitoring, spinal cord tumor, MEP, SSEP, EMG

CARDIOVASCULAR, RESPIRATORY AND ENDOCRINE SYSTEMS ENGINEERING

Treatment of iatrogenic dissection of the left subclavian artery

Haris Huseinagić[1] , Suad Jaganjac[2] , Mirza Moranjkić[1] , Nihad Mešanović[3]

[1] Department of Radiology and nuclear medicine, University Clinical Centre, Tuzla, Bosnia and Herzegovina

[2] Schön Klinik Hamburg Eilbek, Abteilung für Radiologie, Hamburg, Germany 1 Department of Neurosurgery, University Clinical Centre, Tuzla, Bosnia and Herzegovina

[3] Department of IT, University Clinical Centre, Tuzla, Bosnia and Herzegovina

Abstract— Dissection and treatment of subclavian artery are rarely in the medical literature. Dissection is usually the result of catheterization, anomalies port aortae or occurs after trauma. We present the case of women aged 60 years whose main symptom is painful and cold left hand. Stenosis of left subclavian artery immediately distal to the origin of the left vertebral artery was found and angioplasty was performed. The second intervention was followed after 8 months with the aim of stent.

Keywords— subclavian artery dissection. balloon expandable stent.

CARDIOVASCULAR, RESPIRATORY AND ENDOCRINE SYSTEMS ENGINEERING

Evaluation of the amount of used OnyX

Haris Huseinagić [1] , Mirza Moranjkić [2] , Nihad Mešanović [3] , Zahida Ademović [4] , Amela Begić [4]

[1] Department of Radiology and nuclear medicine, University Clinical Centre, Tuzla, Bosnia and Herzegovina

[2] Department of Neurosurgery, University Clinical Centre, Tuzla, Bosnia and Herzegovina

[3] Department of IT, University Clinical Centre, Tuzla, Bosnia and Herzegovina

[4] University of Tuzla, Tuzla, Bosnia and Herzegovina

Abstract — A report on initial experiences in working with liquid embolic agent (Onyx) in the embolisation of arteriovenous brain malformations. METHOD Embolization of the brain AVM was performed in 7 patients (5 women and 2 men, mean age 30.6 years (median 33, range of 16-41 years) in the period from December 2013 to December 2014. Clinically, 7 patients were presented with seizures, hemorrhage from the AVM in 2 patients, subarachnoid hemorrhage from concomitant aneurysm in one patient, disorders of vision in one patient and one patient was diagnosed with AVM accidentally. The average size of the AVM was 3.7 cm (median 4, the range from 2- 7 cm). RESULTS In all seven patients carried a total of 8 embolization procedures with a total of 22 embolisation of artery feeders. Mean reduction in size of the AVM was 75% (median 80%, the range of 40% - 100%). We did not achieved total obliteration, no embolization was preceded to a surgical procedure or radiosurgery. In our relatively small sample, there was not one death or permanent complications. CONCLUSION Onyx is a safe means of embolisation of cerebral AVM. Complete obliteration of the AVM of the brain is only possible with small malformations. Great AVM of the brain can be treated by repeated embolisation, surgicaly or radiosurgicaly after the original embolisation. Modern approach to the treatment of brain AVM embolisation may be embolisation alone, or a combination of embolisation with surgery or stereotaxic radiosurgery. Embolisation is used to reduce the size of the AVM or to prepare the patient for the surgical procedure. All procedures were performed using embolization Onyx EVOH (ethylene vinyl alcohol) copolymer dissolved in DMSO (dimethyl sulfoxide), with a suspension of micronized tantalum powder.

Keywords— arteriovenous brain malformations. AVM, embolisation, Onyx.

CARDIOVASCULAR, RESPIRATORY AND ENDOCRINE SYSTEMS ENGINEERING

Uporedba postproceduralnih ishoda kod pacijenata tretiranih različitim vrstama stentova

L. Divović Mustafić[1], M. A. Kulić[2]

[1]UKCS/Institut za bolest srca- Klinika za kardiohirurgiju, mr.sci.med., Sarajevo, Bosna i Hercegovina
[2]UKCS/ Institut za bolesti srca- Klinika za kardiologiju, doc. dr., Sarajevo, Bosna i Hercegovina

Abstrakt: PROBLEM: Perkutana koronarna intervencija (PCI- Percutaneus coronary intervention) je interventna kardiološka procedura kojom se uz pomoć stentova (Drug eluting stent-ova i Bare metal stent-ova) tretiraju aterosklerotske promjene unutar koronarnih krvnih sudova. „Drug eluting" stentovi (DES) reduciraju mogućnost nastanka postproceduralnih komplikacija lokaliziranim otpuštanjem visokih koncentracija bioaktivne supstance postproceduralno. Stabilna angina pektoris jeste klinička manifestacija ishemijske bolesti srca, a koja svoje osobine nije mijenjala tokom perioda od 60 dana. CILJEVI ISTRAŽIVANJA: Utvrditi demografske karakteristike i riziko faktore u odnosu na posmatrane grupe. Ehokardiografski utvrditi vrijednost Ejekcione frakcije (%) i gibljivost zidova miokarda kod ispitanika u periodu od uključenja u studiju do postproceduralnih 6 mjeseci. Utvrditi zahvaćenost koronarki u odnosu na posmatrane grupe, MACE postproceduralno te potrebu za rekateterizacijom na osnovu ponovne pojave anginoznih tegoba i pozitivnog ergometrijskog testa. Utvrditi cost effectiveness procedure u zavisnosti od vrste stenta. METODOLOGIJA ISTRAŽIVANJA: Istraživanje je bilo retrospektivno-prospektivno, komparativno u periodu 2010- 2013 godine. Uzorak istraživanja je 100 pacijenata u Klinici za kardiohirurgiju UKCS kojima je PCI-om tretiran lijevi koronarni sistem. Pacijenti su podijeljeni u: radnu skupinu (50 pacijenata sa implantiranim DES-om), te kontrolnu skupinu (50 pacijenata sa implantiranim BMS-om). Pacijenti su kontrolisani u prvih 6 mjeseci postproceduralno. REZULTATI ISTRAŽIVANJA: Razlika među demografskim karakteristikama nije značajna. Zastupljenost riziko faktora kod pacijenata tretiranih DES-om, nije veća, izuzev kod pacijenata sa diabetes melitusom tip 2. 6 mjeseci postproceduralno, vrijednost EF je porasla kod obje grupe ispitanika, statistički signifikantno kod pacijenata tretiranih DES-om. Preproceduralno su kod pacijenata tretiranih DES-om, prisutne veće i rasprostranjenije promjene gibljivosti zida lijevog ventrikla. Te promjene nakon 6 mjeseci pokazuju početne znake poboljšanja statistički signifikantno. DES su postavljeni u prosjeku više unutar proksimalnog segmenta, kao i unutar širih i dužih segmenata koronarke. Neke od MACE parametara nisu pokazale statistički signifikantnu razliku u zastupljenosti u odnosu na posmatrane grupe. Potreba za rekateterizacijom, na osnovu ponovne pojave anginoznih tegoba, kao i ergometrijskog nalaza postproceduralno, je značajnija u grupi pacijenata tretiranih BMS-om. Du- žina hospitalizacije, kod obje grupe pacijenata je u prosjeku ista. Cost effectiveness je veća kod pacijenata tretiranih DESom. ZAKLJUČAK: Pacijenti sa DES-om imaju bolji klinički, ehokardiografski i angiografski ishod, u odnosu na pacijente sa BMS-om.

Ključne riječi: PCI (Perkutana koronarna intervencija), Kateterizacija srca, Stabilna angina p ektoris, DES (Drug eluting stent), BMS (Bare metal stent)

CARDIOVASCULAR, RESPIRATORY AND ENDOCRINE SYSTEMS ENGINEERING

Heart rate variability in assessment of autonomic nervous system function in preoperative period

Omerbegović M[1] , Ferhatović M.[2]

[1] University Clinical Centre Sarajevo, Clinic of Anesthesia, Resuscitation and ICU, Sarajevo, Bosnia and Herzegovina

[2] University Clinical Centre Sarajevo, Clinic of Infectious diseases, Sarajevo, Bosnia and Herzegovina

Abstract Integrity of autonomic nervous system function has been known as an essential condition for maintaining homeorhesis and dynamic stability during perioperative period. Heart rate variability which describes alterations of the length of consecutive heart cycles has been proposed as clinically important in prognostication and monitoring in patients with different cardiac disease and patients with diabetes mellitus. Assessment of heart rate variability in preoperative evaluation could be of great interest in clinical anesthesia since perioperative period could present different demanding conditions for the patients who undergo elective surgical procedures with increased risk of cardiac events despite scrupulous technical and procedural preparations. Monitoring of baseline heart rate variability as a measure of autonomic nervous system function or dysfunction could be very important for predicting any possible hemodynamic instability and tailoring of the preoperative evaluation and preparation for surgical and anesthesia procedures and follow up during the periprocedural period. Some linear and nonlinear parameters of heart rate variability in preoperative period in patients scheduled for elective surgery with different comorbid states are presented in this paper.

Key words: heart rate variability, autonomic nervous system, perioperative period

CARDIOVASCULAR, RESPIRATORY AND ENDOCRINE SYSTEMS ENGINEERING

Evaluation of factors that influence the occurrence of early hypothyroidism following radioactive iodine treatment in thyrotoxicosis

Mirna Džubur[1] , Elma Kučukalić – Selimović [2] , Mirela Džubur-Aganović [3] , Azra Bahtić [1] , Edin Begić [1] , Semir Hrvo[1]

[1]Medical faculty, University of Sarajevo, Sarajevo, Bosnia and Herzegovina

[2]Department of Nuclear medicine, Clinical Center University of Sarajevo, Bosnia and Herzegovina

[3]General Hospital "Prim. dr Abdulah Nakaš", Sarajevo Bosnia and Herzegovina

Abstract—Introduction: Factors that could determine the patient's response following radioactive iodine (I-131) treatment in thyrotoxicosis are the type of disease, elevated thyroid autoantibodies, duration of the disease, previous use of anti-thyroid drugs (ATDs) or a partial thyroidectomy, I-131 dose, thyroid gland volume and hormone levels. Aim: The aim of this study was to evaluate the patient's response to radioiodine treatment (RAI), determine the correlation between prognostic factors and occurrence of hypothyroidism one year following the treatment and defining the possibility of predicting the outcome of RAI treatment. Material and methods: The medical records of 120 patients treated with I-131 from January 2004 to September 2014, were retrospectively analyzed. Factors were analyzed a day before and one year after RAI treatment. Results: 83% of patients were female. The mean age was 55,5 years old (31-81 years, SD-10,66). 15,8% of patients had positive thyroid autoantibodies (Graves disease), and 84,2% had negative thyroid autoantibodies (diffuse thyroid autonomy- 23,7%, uninodular toxic goiter- 43,5%, multinodular toxic goiter- 32,8%). 75% of patients were treated with ATDs, while 15% were thyroidectomized. Hypothyroidism was found in 36 (30%) patients (Graves disease-57,88% (RR-2,34, p35ml (Pearson coefficient r-0,51, p 20 mCi, hypothyroidism was found in 66,6% of patients (RR-2,29, p0,05). Conclusion: RAI treatment is a powerful therapeutic modality in selected patients with thyrotoxicosis. Hypothyroidism following RAI treatment is very common and it can often be expected in patients who received high I-131 doses, who have high titers of thyroid autoantibodies, who were previously treated with ATDs or underwent partial thyroidectomy.

Keywords— radioactive iodine, hypothyroidism, thyrotoxi cosis, risk factors

CARDIOVASCULAR, RESPIRATORY AND ENDOCRINE SYSTEMS ENGINEERING

Serum nitric oxide levels in patients with acute myocardial infarction with ST elevation (STEMI)

A.Badnjević[1], P.Kovačević[2], A.Badnjević[3], L.Gurbeta[3]

[1] Canton Hospital, Zenica, Bosnia and Herzegovina

[2] University hospital Banja Luka, Bosnia and Herzegovina

[3] Verlab Ltd Sarajevo, Medical Device Verification Laboratory, Sarajevo, Bosnia and Herzegovina

Abstract — Reduced activity of nitric oxide (NO) is one of the first and most important signs of endothelial dysfunction and it is a common feature of many atherosclerosis risk factors. Many studies have shown that the values of NO in patients with acute myocardial infarction are reduced, which is not in accordance with the results of this research. The study included 80 patients, of which 40 patients with acute myocar-dial infarction with ST elevation (STEMI) who were treated in the Coronary Care Unit of the Department for Internal Dis-eases of Cantonal Hospital in Zenica in the period from 01 January 2014 to 01 June 2014. The control group consisted of 40 healthy subjects. All study subjects were evaluated for serum nitric oxide by Griess method. The results of this study show that the mean serum levels of NO in patients with STEMI were 26.7 qmol/l (26,7 +/- 12,9), while the mean serum NO concentrations of healthy population were 4.8 qmol/l. Statistical analysis of the obtained data shows that there is a statistically significant difference between the groups ($p < 0.05$). The conclusion of the study is that patients with STEMI with associated risk factors such as hypertension, diabetes, hyperli-pidemia, cigarette smoking, have significantly higher serum levels of NO in relation to the value of NO in healthy individu-als.

Keywords— nitric oxide, STEMI

MOLECULAR, CELLULAR AND TISSUE ENGINEERING

User verification for Hemoglobin A1c on Cobas 501 Roche analyzer

Kučukalić, J. Ćorić, J. Mujić, L. Ćurović and A. Bodulović

Department of Clinical Chemistry, Clinical Center of Sarajevo University, Sarajevo, Bosnia and Herzegovina

Abstracts: Glycated hemoglobin (HbA1c) is formed by non-enzymatic binding of glucose to the free amino group of the Nterminal end of the ß-chain of hemoglobin A. HbA1c is representative of the mean blood glucose level over three months. The aim of the study was to evaluate new method in laboratory by defining precision and trueness for determination of HbA1c at the Cobas 501 Roche analyzer, by immunoturbidimetric method. We determined the concentrations of total hemoglobin and HbA1c. HbA1c is measured in a latex agglutination inhibition test. The presence of HbA1c in the sample results in reduced levels of agglutination. The increase in absorption is inversely proportional to the concentration of HbA1c in the sample. Venous blood samples from diabetic patients are collected into K3EDTA containing vacutainer tubes. Commercial controls PreciControl HbA1cN (PCA1N) and PreciControl HbA1cP (PCA1P) at two levels were used for quality control. Analytical validation of HbA1c included: within-run imprecision, between-day imprecision, inaccuracy and comparation determination on the human samples on 2 systems: Dimension XPanda and Cobas 501 Roche analyzers. Within-run imprecision on the commercially controls for PCA1N is 4,6% and PCA1P is 3,6%; betweenday imprecision on commercially controls is 7,5% PCA1N for and 8,2% for PCA1P respectively; inaccuracy on commercially controls for PCA1N is 1,8% and PCA1P is 4,8% . Method comparasion on human samples show in the range of method linearity correlation coefficient from 0,99. The presented results of the analytical evaluation methods for the determination of Cobas 501 Roche analyzer showed an acceptable accuracy and precision.

Keywords: glycated hemoglobin HbA1c, diabetes, Cobas 501 Roche analyzer

CLINICAL ENGINEERING AND HEALTH TECHNOLOGY ASSESSMENT

Kontinuirani elektrokardiografski holter monitoring dječije dobi

Zijo Begić, Senka Mesihović Dinarević, Almira Kadić, Mirza Halimić

Pedijatrijska klinika, KCU Sarajevo, Bosna i Hercegovina

Sažetak - Kontinuirani dinamički dvadeset četveročasovni elektrokardiografski (Holter) monitoring je vrlo važna metoda u dijagnostici i tretmanu aritmija dječije dobi. Aritmije su poremećaji frekvencije i regularnosti ritma srca, koje nastaju kao posljedica poremećaja u stvaranju i/ili provođenju podražaja u specifičnoj ili radnoj muskulaturi srca. Za razliku od odraslih, mehanizam nastanka aritmija u djece je raznovrsniji (kruženje, naknadni potencijal, automatizmi). Cilj rada: Prikaz mjesta i uloga metode u svakodnevnom kliničkom radu pedijatrijskog kardiologa. Materijal i metode: Istraživanje je imalo retrospektivni i analitički karakter, te je obuhvatilo period april 2003.- januar 2015. (podaci prikupljani iz „Registra EKG Holter monitoringa“). Rezultati:U nepunih 12 godina, kod 2616 pacijenta je uraĎen kontinuirani EKG Holter monitoring, dječaka 1329(50,8%), a pacijenti su bili starosne dobi od roĎenja do 19.godine života. Registracija neonatusa i dojenčadi je bilo 45 (1,7%), male djece 69 (2,6%), predškolske 262 (10%), školske 893 (34,1%), djeca u pubertetu i adolescenciji 1350 (51,6%). Kod 1775 pacijenta (67,8%) Holter je rađen prvi put, a kontrolnih 841(32,2%). Indikacije za provođenje Holtera su bile: aritmije 1075 (41,1%), prekordijalna bol 626 (23,9%), sumnja na preeksiktacije i/ili preekscitacije 276 (10,5%), krize svijesti 213 (8,1%), nekorigirane uroĎene/stečene mane srca 116 (4,4%), operisane mane srca 99 (3,7%), hipertenzija 81 (3,1%), kontrola rada pejsmejkera 43 (1,6%), ostali uzroci 87 (3,3 %). Otpusne dijagnoze nakon urađenog EKG Holter monitoringa su nesignifikantne aritmije 1189 (45,4%), lutajući centar vodič 579 (22,1 %), preekscitacije 444 (17 %), benigne ventrikularne ekstrasistole 165 (6,3%), atrioventrikularni blokovi 84 (3,2 %), sinusna pauza 63 (2,4%), ostali poremećaji ritma 92 (3,5 %). U pomenutom periodu su registrovana 54 slučaja WPW (Wolf Parkinson White) sindroma, koji su u najvećem broju slučajeva bili udruženi sa paroksizmalnom supraventrikularnom tahikardijom i čine većinu otpusnih dijagnoza preekscitacija. Kod 124 (4,7%) pacijenta se primjenjuje antiaritmijska terapija. Implanitrano je 27 pacemakera, u radiofrekventna ablacija je rađena u 23 slučaja. Zaključak: Razvoj pedijatrijske kardiohirurgije je inicirao i razvoj pedijatrijske aritmologije kao imperativni segment pedijatrijske kardiologije. Kontinuirani EKG Holter monitoring je postao nazamjenljiva metoda u svakodnevnoj dijagnostici i terapiji aritmija dječije dobi.

Ključne riječi - pedijatrijske aritmije, dvadest četveročasovni EKG Holter monitoring, razvoj.

CLINICAL ENGINEERING AND HEALTH TECHNOLOGY ASSESSMENT

Internal exposure arising from intravenous administration of F-18 fluorodeoxyglucose

A.Beganović [1,2], M. Modronja, S. Odžak[2], A. Skopljak-Beganović [1], M. Gazdić-Šantić [1]

[1] Department of Medical Physics and Radiation Safety, University Clinical Centre of Sarajevo, Sarajevo, Bosnia and Herzegovina

[2] Faculty of Science, University of Sarajevo, Sarajevo, Bosnia and Herzegovina

Abstract— F-18 fluorodeoxyglucose (FDG) is a radiopharmaceutical widely used in positron emission tomography (PET) imaging. F-18 is a positron emitting radioactive isotope. After the decay the most significant fraction of positrons go through annihilation process with neighboring orbital electrons, which results in two 511 keV gamma photons moving in opposite directions. Photons are used for imaging, but they also contribute to the high exposure of patients to ionizing radiation. Assessing the internal exposure from intravenous administration of F-18 FDG can be done using ready-available software packages that work with presimulated factors from mathematical models to convert from intake activity A_o to the effective dose E [1]. In order to improve estimation accuracy, we used uptake values taken from real patient images in order to calculate activity in relevant organs. Later, OLINDA/EXM® software was used to assess the internal exposure [2]. Average values of uptake (kBq/ml) for 36 patients in urinary bladder, liver, bones, heart cavity, brain, kidney, and remainder organs were 63.1, 6.86, 7.26, 9.63, 16.2, 12.7, and 1.64, respectively. The estimated effective dose per patient was 7.6 mSv. The results obtained correspond to the values found in literature, as well as to the values obtained using simpler software solutions (Radar®), which is expected [3]. The evaluation, however, gives possibility to differentiate between doses received by male or female patients, as well as to calculate organ doses.

Keywords— radiation, radioactivity, internal exposure, effective dose, PET, FDG, uptake

CLINICAL ENGINEERING AND HEALTH TECHNOLOGY ASSESSMENT

Mogućnosti određivanja fokus kožne distance pomoću kamere s ciljem verifikacije tačnosti pozicioniranja pacijenata u radioterapijskom tretmanu

Semir Fazlić[1] , Hasan Osmić[2] , Jakub Osmić[3]

[1] UKC TUZLA/Služba za medicinsku fiziku i zaštitu od zračenja, Tuzla, BiH

[2] UKC TUZLA/Klinika za OHR, Odjel Radioterapije, Tuzla, BiH

[3] UNIVERZITET U TUZLI/Fakultet elektrotehnike, Tuzla, BiH

Abstrakt— U radu je izvršen pregled mogućnosti određivanja fokus kožne distance reda veličine milimetra, korištenjem kamere kao i mogućnosti primjene fokus kožne distance u verifikaciji tačnosti pozicioniranja pacijenata kod radioterpijskih tretmana. Osim toga u radu je predložen jednostavan metod za određivanje fokus kožne distance koristeći fotografije projektovanog svjetlosnog polja na koži pacijenta i vrijednosti fokus kožne distance koja se dobija iz sistema za planiranje. Fokus kožna distanca je veličina koja pokazuje udaljenost između tačke fokusa linearnog elektronskog akceleratora i kože pacijenta. Svaki tretmantski plan je isplaniran u sistemu za planiranje, koji na osnovu snimaka kompjuterske tomografije rekonstruiše virtuelnog 3D pacijenta. Kao izlazni podatak sa sistema za planiranje dobija se i fokus kožna distanca. Zajedno sa radiografskim snimkama anatomskih struktura pacijenta koje se nalaze u zračnom polju, fokus kožna distanaca služi za verifikaciju pozicije definitivnog izocentra u prostoru, a koji se nalazi u samom pacijentu. Skala fokus kožne distance je centimetarska, a projektuje se kao svjetlosni pokazivač na površini kože pacijenta. Očitana vrijednost fokus kožne distance treba da odgovara dobijenoj vrijednosti iz sistema za planiranje.

Ključne riječi— Fokus kožna distanca, pozicioniranje pacijenta, izocentar.

CLINICAL ENGINEERING AND HEALTH TECHNOLOGY ASSESSMENT

From regenerative dentistry to regenerative medicine: potential of oral stem cells

S.Porovic[1] , S. Jurisic[2] and H.Juric[3]

[1] Public Health Centre of Sarajevo Canton, Sarajevo, Bosnia and Herzegovina

[2] Dental Polyclinic Jurišić, Mostar, Bosnia and Herzegovina

[3] Department of Preventive and Pediatric Dentistry, School of Dental Medicine, University of Zagreb, Croatia

Abstract: Tissue engeneering is an interdisciplinary field that connects various scientific aspects from engineering, materials science, biology, and medicine. This field has emerged as a promising area in regenerative medicine to develop a biologically functional tissue mimetics that can be used to restore malfunctioned and damaged tissues. Stem cell biology has become an important field for the understanding of tissue regeneration and implementation of regenerative medicine. Oral stem cells show their capability to repair cornea, dental pulp, periodontal, neural, bone, muscle, tendon, cartilage, and endothelial tissues without neoplasm formation. Several types of adult stem cells have been isolated from teeth, including dental pulp stem cells (DPSCs), stem cells from human exfoliated deciduous teeth (SHEDs), periodontal ligament stem cells (PDLSCs), dental follicle progenitor stem cells (DFPCs), and stem cells from apical papilla (SCAPs). Stem cells from human exfoliated deciduous teeth (SHEDs) are a population of highly proliferative, clonogenic cells capable of differentiating into a variety of cell types, including neural cells, adipocytes, and odontoblasts . SHED can be collected every time a milk tooth falls out. Banking SHED cells costs less than one third of the cost of cord blood storage. In addition, the proven facts that SHED can be directed to become pluripotential cells and generate solid tissue types, which cord blood cannot; has made them a simple, reasonable and convenient replacement to the umbilical cord blood. This paper attempts to show the protocol, advantages and disadvatages of therapeutic applications and the present scenario of tooth banking.

Keywords— stem, cells, teeth, regenerative, medicine

CLINICAL ENGINEERING AND HEALTH TECHNOLOGY ASSESSMENT

Uloga endoskopske kapsule u traženju nejasnog uzroka gastrointestinalnog krvavljenja

Zubčević Nadža[1], Zubčević Smail[2], Mesihović Rusmir[1], Vanis Nenad[1], Puhalović Amra[1], Pilav Aida[1]

[1] Institut za gastroenterohepatologiju Univerzitetskog Kliničkog Centra Sarajevo

[2] Pedijatrijska klinika Univerzitetskog Kliničkog Centra Sarajevo Bosna i Hercegovina

Abstrakt - Razvoj biomedicinskog inžinjeringa je omogućio da bežični komunikacijski medicinski implantati dobivaju sve važniju ulogu u liječenju i dijagnostici. Endoskopska kapsula je metoda za vizualizaciju gastrointestinalnog trakta, naročito tankog crijeva. Digitalne slike iz gastrointestinalnog trakta se prenose na prijemnik koji pacijent nosi na pojasu, a zatim se slike pregledavaju na računaru. Godišnja incidencija gastrointestinalnog krvavljenja je oko 100 epizoda na 100.000 stanovnika. Kod 85% slučajeva se krvavljenje otkriva proksimalnom i/ili distalnom ednoskopijom ili radiološkim metodama. Kod 5% pacijenata krvavljenje je nepoznatog uzroka. Ti pacijenti predstavljaju ozbiljan dijagnostički i terapeutski problem. Nejasno krvavljenje iz gastrointestinalnog trakta je definirano kao perzistentno ili rekurentno krvavljenje nepoznatog porijekla, prezentirano perzistentnom ili rekurentnom sideropeničnom anemijom, pozitivnim fekalnim haemocoolt testom ili vidljivo krvavljenje prezentirano melenom ili hematohezijom sa negativnim nalazom proksimalne i distalne endoskopije. Studijom je obuhvaćeno 30 pacijenata, 12 žena i 18 muškaraca, srednje životne dobi od 46 godina, kod kojih je dokazano krvavljenje iz gastrointestinalnog traka, ali imaju negativan nalaz proksimalne i distalne endoskopije. Raspon dužine traganja za nejasnim uzrokom krvavljenja je bio 6-19 mjeseci. Ovim pacijentima smo uradili pregled endokapsulom. Kod 11 pacijenata je kao uzrok krvavljenja nađena angioektazije sluznice tankog crijeva. Tumor tankog crijeva kao mogući uzrok krvavljenja je nađen kod 1 pacijenta, kod 7 pacijentata je mogući uzrok krvavljenja enteropatija uzrokovana nesteroidnim antireumaticima, kod 3 pacijeneta su detektirana oštećenja sluznice tankog crijeva, karakteristična za Crohn-ovu bolest. Kod 8 pacijenta uzrok krvavljenje nije poronađen upotrebom endokapsule. Na osnovu naših prvih iskustava sa ovom novom metodom možemo zaključiti da je biomedicinski inžinjering razvojem endokapsule dao značajnu novost u dijagnostici pacijenata sa nejasnim krvavljenjem čiji se uzrok nije mogao istražiti proksimalnom endoskopijom, distalnom endoskopijom i radiološkim metodama. Većina lezija koje uzrokuju nejasno krvavljenje se nalaze u tankom cijevu, te je dijagnostička i terapeutska evaluacija ovih poremećaja veoma zahtjevna.

Ključne riječi – endokapsula, dijagnostika tankog crijeva, nejasno gastrointrstinalno krvavljenje

HEALTH INFORMATICS, E-HEALTH AND TELEMEDICINE

Data mining, procesiranje i web-bazirani prikaz EKG signala

Emir Žunić [1] , Bahira Žunić [2]

[1] Info Studio d.o.o. Sarajevo, Sarajevo, Bosna i Hercegovina

[2] Goethe-Institut Sarajevo, Sarajevo, Bosna i Hercegovina

Sažetak — Cilj rada je da promovira primjenu računarskih znanosti i vještina u projektiranju web-baziranog sistema za analiziranje, procesiranje i prikaz EKG signala. Primjena računara u snimanju, obradi i analizi EKG signala predstavlja jednu od najranijih primjena računarske tehnike u medicinske svrhe. Od primarnog interesa za primjenu računarskih sistema u obradi EKG signala je pravilno tumačenje i detektovanje različitih valova i intervala električnih aktivnosti srca. U radu će na nekoliko konkretnih primjera biti prikazano efikasno korištenje Data mining metoda kao nove discipline koja ima za cilj da filtrira podatke u bazama podataka, da ih sumira i pronalazi obrazce prilikom obrade stvarnih EKG signala. Nad profiltriranim podacima je testirano i analizirano mnoštvo algoritama za detekciju QRS kompleksa, te je izvršena implementacija onog algoritma koji je pokazao najbolje rezultate u svrhu HRV analize.

Ključne riječi — Data mining, EKG signal, procesiranje, web-bazirana aplikacija.

HEALTH INFORMATICS, E-HEALTH AND TELEMEDICINE

Softversko rješenje u diferencijaciji i tretmanu poremećaja acido-baznog statusa

Edin Begić[1] , Mensur Mandžuka[2] , Zijo Begić[3] , Dušanka Bošković[2] , Izet Mašić[1]

[1] Medicinski fakultet, Univerzitet u Sarajevo, BiH

[2] Elektrotehnički fakultet, Univerzitet u Sarajevu, BiH

[3] Pedijatrijska klinika, Klinički Centar Univerziteta u Sarajevu, Sarajevo, BiH

Sažetak: Normalan acidobazni status (izohidrija) predstavlja vrijednost jona vodika u ekstracelularnoj tekućini unutar granica vrijednosti pH od 7,36 (44 nmol⁄L) do 7,44 (36nmol⁄L). Poremećaji acidobaznog statusa idu u dva smjera, u acidozu i alkalozu. Iz gasne analize arterijske krvi, može se utvrditi poremećaj, uvidjeti da li je nekompenzovan ili kompenzovan djelovanjem samih mehanizama organizma (puferski sistemi). Procesi koji dovode do narušavanja acidobaznog statusa su respiratorne i metaboličke prirode, i na osnovu njih je izvršena i sama klasifikacija poremećaja. Na osnovu analize krvi, dobivene informacije, uz podatak o tjelesnoj težini, se unose u softversko rješenje, i u prvom koraku se dobivaju informacije o kojoj se vrsti poremećaja acidobaznog statusa radi. U drugom koraku se određuje signifikantnost poremećaja, a treći korak bi predstavljao terapijski tretman, uzimajući u obzir i komorbiditete pacijenta. Softver nudi mogućnosti opcionalnog unošenja vrijednosti nivoa minerala, te na osnovu toga i upotpunjenje tretmana. Visok radni takt procesora u komercijalnim mobilnim uređajima nudi značajan računarski potencijal na dohvat ruke. S ciljem eliminacije potrebe za nabavkom specijaliziranog hardvera, te povećavanjem dostupnosti i mobilnosti sistema, rješenje je razvijano za Android platformu, koristeći programski jezik Java.

Ključne riječi - acidobazni status, poremećaj, tretman, Android.

HEALTH INFORMATICS, E-HEALTH AND TELEMEDICINE

Development of domain specific language and IDE for Internet of Things applications in remote patient monitoring

A.Salihbegovic, E. Kaljic, T. Eterovic and S.Ribic

Faculty of Electrical engineering, University of Sarajevo, Bosnia Herzegovina

Abstract— Paper is devoted to presentation of the results achieved so far in the area of research and development of software design tools helping designers to design and develop applications in the domain of internet of things (IoT). Three main areas of applications of internet of things paradigm are targeted: smart home, telemedicine e.g. remote patient monitoring and intelligent transportation. The development of visual domain specific language code named DSL-4-IOT, is defined as graphical high level language that is abstracting in its building blocks many specifics, peculiarities and heterogeneity of sensors, actuators, communication media and protocols, physically organized within wired or wireless sensor nodes, that are specific for internet of thing devices. Selection of sensors, actuators and devices is done by IoT application designer, only on the functional level demanded by specific application. The devices are selected from the rich application library of DSL-4-IOT designer, or if not existing within library modules, the designer can easily add new device, entering its technical data like device manufacturer and type, sensors and/or actuators integrated or hooked to device, communication media and underlying protocol. After configuring IoT application using DSL-4-IOT designer, the software suite shall output clear system architecture with bill of material and specifications of all hardware devices and components needed for build-up of the system, as well as configuration files, that are downloaded to open source runtime software application. While entering the configuration data into DSL-4-IOT designer, user is also specifying the way how ambient monitoring and control and patient monitoring interface shall look like. User interface is web application that can be presented on any PC device, mobile phone or tablet with Internet connection and standard web browser. User can view and interact with the IoT application from anywhere where Internet is available. Keywords— Internet of things, telemedicine, remote patient monitoring, smart home, wearable biomedical sensors,

HEALTH INFORMATICS, E-HEALTH AND TELEMEDICINE

IoT Wireless Sensor Networks for Healthcare Applications

Dejana Ugrenovic[1] , Gordana Gardasevic[1] , Darko Golic[2] , Vera Gazdic[2]

[1] Faculty of Electrical Engineering, University of Banja Luka, Banja Luka, BiH

[2]Clinic for Anesthesiology and Intensive Care, University Hospital Clinical Centre Banja Luka, BiH

Abstract—Internet of Things (IoT) is a paradigm that marks the convergence of the existing Internet to the new platform by allowing unambiguous IP addressing and access to physical objects. Currently, the emerging IoT field are the healthcare and biomedical applications. The aim of this paper is to report the preliminary research results for the IoT healthcare scenario based on 6LoWPAN (IPv6 over Low power Wireless Personal Area Networks) protocol stack within the Contiki operating system. In order to evaluate the performances, we measured the throughput and packet loss rate.

Keywords—Internet of Things, Wireless Sensor Networks, 6LoWPAN, Healthcare, Contiki.

HEALTH INFORMATICS, E-HEALTH AND TELEMEDICINE

Internet of Things za zdravstvenu zaštitu - Novi nivo ''smart'' usluga u zdravstvu

Daliborka Mačinković

Fond zdravstvenog osiguranja Republike Srpske/Informacione tehnologije, Banja Luka, BiH, RS

Abstract — Ovaj rad razmatra mogućnosti koje pruža Internet of Things (IoT) u oblasti zdravstvene zaštite - kao novi nivo pametnih usluga u zdravstvu. Budućnost zdravstvene zaštite se opisuje mnogim konceptima kao što su pervasive healthcare (pHelath), ubiquitous healthcare (uHealth), mobile healthcare (mHealth), electronic healthcare (eHealth), telehealth, telemedicine. Tradicionalne zdravstvene usluge su vezane za pružanje zdravstvenih usluga isključivo u zdravstvenim ustanovama, IoT za zdravstvenu zaštitu ukazuje na mogućnost pružanja zdravstvenih usluga u određenim okolnostima kod kuće ili bilo gdje, bilo kad (Anytime, Anywhere, In-home Smart Healthcare Services). IoT uključuje postojanje senzora koji prikupljaju podatke o pacijentu, mikrokontrolera koji procesiraju, analiziraju podatke i bežično komuniciraju, mikroprocesora koji omogućuju bogate grafičke korisničke interfejse, zdravstvenih-specifičnih gejtveja koji podatke sa senzora dalje analiziraju i transportuju do korisnika. IoT treba da prati procese prikupljanja podataka sa senzora, obradu korisnih informacija, vizuelizaciju znanja o objektu, reaktivnost kao novi nivo usluga u zdravstvu. Primjeri senzora koji se mogu implementirati za praćenje vitalnih parametara pacijenta su Blood Pressure Sensor (sphygmomanometer), Body Temperature Sensor, Glucometer Sensor, Sensor Electrocardiogram (ECG), Pulse and Oxygen in Blood Sensor (SPO2), Patient Position Sensor (Accelerometer), Airflow Sensor (Breathing), Galvanic Skin Response(GSR) i drugi. Najznačajnije funkcionalnosti koje uključuje IoT za zdravstvenu zaštitu su: praćenje i monitoring objekata (ljudi, opreme, medikamenata), udaljeni servisi za dijagnostiku, prvu pomoć, upravljanje tretmanima, upravljanje novim informacijama o zdravstvenoj zaštiti, međusaradnja sa drugim zdravstvenim ustanovama. Tehnologije koje obećavaju rješavanje trenutnih izazova obrade podataka u realnom vremenu su inteligentno procesiranje in-memory analytics, contex-aware computing, predictive analytics, streaming analytics. Sa tehnološkog stanovišta potrebno je razmotriti mogućnosti senzorskih uređaja za prikupljanje podataka, komunikacione mogućnosti, servise za upravljanje, aplikacije. Sa poslovnog stanovišta potrebno je razmotriti kako dobijene informacije koristiti u postojećim sistemima zdravstvene zaštite kao novi nivo pametnih usluga.

Keywords—Internet of Things za zdravstvo, senzori, realtime obrada podataka, monitoring objekata, udaljeni servisi za dijagnostiku.

HEALTH INFORMATICS, E-HEALTH AND TELEMEDICINE II

Opportunities and Challenges in Biomedical Engineering Education

D. Bošković [1] and A. Badnjević [1,2]

[1] University of Sarajevo, Faculty of Electrical Engineering, Sarajevo, Bosnia and Herzegovina

[2] Verlab d.o.o., Sarajevo, Bosnia and Herzegovina

Abstract— Biomedical engineering employs engineering expertise in solving biological and medical problems to improve the quality of life. The paper describes the significance of combining life sciences with technology and engineering, and discusses objectives and characteristics of biomedical engineering education. The huge interest in this area and also a rapid development of relevant engineering fields provides opportunities both for educators and graduates. Some of the challenges are: building competences in two demanding fields: biology and engineering, importance of medical ethics relation to study programs in other engineering disciplines and health professions, relation with relevant stakeholders as industry and healthcare institutions. The role and the need of biomedical engineering education in the region are discussed, and opportunities and challenges are explored.

Keywords— Biomedical Engineering, Education

HEALTH INFORMATICS, E-HEALTH AND TELEMEDICINE II

Turning the Challenge into Opportunity – A Strategic Framework for the Biomedical Engineering Development in Bosnia and Herzegovina

S. Mustoo[1] and L. Gurbeta[2]

[1] Verlab Ltd Sarajevo, Medical Device Verification Laboratory, Sarajevo, Bosnia and Herzegovina

[2] Faculty of Electrical Engineering, University of Sarajevo, Bosnia and Herzegovina

Abstract — In respect with growing population, health care systems are becoming main priority in social-economy policies. Within the modern health care system, overcoming challenges in human health protection, disease prevention, treatment and rehabilitation of patients require engineering involvement. Investment in biomedical engineering (BME) creates a base for progress in many fields, from cutting health care expenses, better quality and accuracy in diagnosis and patient treatment, increase of medical therapies reliability and, finally, improved populations' life quality. Economic growth, improvement and competitiveness of the country through BME require highly educated engineers, appropriate legislative in accordance with World Health Organization (WHO) and government support. Main goal of this article is to present the basic strategic framework necessary for BME development in Bosnia and Herzegovina, with potential to influence economic growth. This causea-consequent connection between economic growth and BME is still unexplored in Bosnia and Herzegovina. Discussing the BME phenomena in Bosnia and Herzegovina has a great significance since it can determine the possible reason for increase in its internal and external funding. The future holds so far unexplored possibilities in the field of BME in Bosnia and Herzegovina, which can lead to social and economic progress, and the first step toward it is to create a strategic framework as a foundation.

Keywords— biomedical engineering, strategic framework, education, knowledge society, economic growth & development

HEALTH INFORMATICS, E-HEALTH AND TELEMEDICINE II

Measurement in medicine – Past, present, future

A.Badnjevic[1] , L. Gurbeta[1] , D.Boskovic[2] and Z.Dzemic[3]

[1]Verlab Ltd Sarajevo, Medical Device Verification Laboratory, Sarajevo, Bosnia and Herzegovina

[2]Faculty of Electrical Engineering, University of Sarajevo, Sarajevo, Bosnia and Herzegovina

[3] Institute of Metrology of Bosnia and Herzegovina, Sarajevo, Bosnia and Herzegovina

Abstract— In addition to knowledge and experience of medical doctors, correct diagnosis and appropriate patient treatment largely depend on accuracy and functionality of medical devices. In a large number of serious medical situations proper functionality of medical devices is crucial for patients. Therefore it is necessary to carry out as strict and independent testing of functionalities of medical devices as possible and to obtain the most accurate and reliable diagnosis and patient treatment. This paper presents the results of study conducted by the Institute of Metrology of Bosnia and Herzegovina (IMBIH) that highlight the necessity of introducing metrology into medicine and defining standard regulations for inspections of medical devices. As it has been previously done for other kinds of devices that are under jurisdiction of the Institute of Metrology of BH, this research provides a foundation for the introduction of medical devices into the legal metrology system with precisely defined units of measurement, their ranges and errors. The study was based upon data collected through three clinical centers, 25 hospitals, 63 health centers and 320 private health institutions in BH over the course of one year. As a result of this study, the medical devices that have been introduced into the legal metrology system in BH include ECG devices, defibrillators, patient monitors, respirators, anesthesia machines, dialysis machines, pediatric and neonatal incubators, therapeutic ultrasounds, infusion pumps and perfusors. Furthermore, standard inspection regulations for the aforementioned medical devices are also defined. Additionally, a national laboratory for the inspection of medical devices was established and it currently operates under the ISO 17020 standard. With the introduction of medical devices into the legal metrology system and with the establishment of a fully operational national laboratory for inspection of medical devices, we expect that the reliability of medical devices in diagnosis and patient care will increase and that the costs of the health care system in BH will be reduced.

Keywords— medical device, healthcare system, legislative, standard, metrology

HEALTH INFORMATICS, E-HEALTH AND TELEMEDICINE II

Alternative approach to addressing infrastructure needs in biomedical engineering programs (Case of emerging economies)

R. Stojanović [1] , A. Čaplanova[2] , Ž. Kovačević[1] , N. Filipović[1] , Z. Bundalo[2]

[1] University of Montenegro, Podgorica, Montenegro

[2]University of Economics in Bratislava, Bratislava, Slovakia

[3]University of Banja Luka , Banja Luka, B&H

Abstract— This paper discusses the ways to develop low budget and high performance laboratory exercises for the purpose of the biomedical engineering education. The proposed methodology is based on the integration of 13 different sensors/actuators, 4 interfaces and 2 software, which are widely available and inexpensive. The proposed components are described separately and then integrated into specific exercises realized as virtual instruments for physiological measurements, vital signs monitoring and biomedical signal processing. Following the proposed methodology the students can use their creativity, and acquired knowledge from other disciplines to design variants of virtual instruments in order to achieve the real-world experience. Also, the economic aspects in terms of the overall system cost and the cost of its reduced variants are outlined. The ratio between the quality and cost shows that proposed approach should be very suitable for biomedical engineering education in developing countries,

Keywords— biomedical engineering, education, physiological measurements, sensors, virtual instruments, economic efficiency, MATLAB, LabVIEW.

HEALTH INFORMATICS, E-HEALTH AND TELEMEDICINE II

Dileme pedijatara u susretu sa suvremenim biotehnologijama

Zubčević Smail

Pedijatrijska klinika Kliničkog centra Univeziteta u Sarajevu Bosna i Hercegovina

Abstrakt – Biotehnološka revolucija, čiji smo svjedoci, permanentno modificira način našeg života i razmišljanja. Sve moderne tehnologije primjenjene u medicini su tu da donesu neku korist, ali ograničenja koja dolaze sa njima i etičke dileme povezane sa istima se moraju stalno razmatrati. Debate u ovom području u Bosni i Hercegovini su uglavnom nedovoljne, a liječnici vrlo često ostavljeni u nekoj vrsti etičke neizvjesnosti i kontroverze. U ovom članku pokušavamo da se bavimo vrlo osjetljivim dijelom ovog problema koji se odnosi na djecu. Bosna i Hercegovina nema jedinstvenog tijela koje bi upravljalo ovim problemima, a takozvani etički komiteti u ustanovama zdravstvene zaštite izbjegavaju da postave jasne smjernice koje bi regulirale ovu problematiku. Općenito, pedijatri, kao i drugi liječnici, imaju prilično uzak profesionalni fokus koji bi mogao biti nedovoljan za formuliranje javne politike u reguliranju biotehnologija. Moraju proširiti svoje znanje u smislu mogućnosti modernih biotehnologija, prije nego što postanu dovoljno kompetentni da uzmu udio u stvaranju politike u ovom segmentu. Ovaj članak bi trebao da pomogne u rasvjetljavanju nekoliko važnih segmenata, kao poticaj za dalju edukaciju u ovom smislu. Jedno od rješenja koje predlažemo je formiranje neovisnih, interdisciplinarnih savjetodavnih tijela koja će se baviti etičkim pitanjima koje moderne biotehnologije donose u pedijatriju. Ta tijela bi trebala biti u stanju dati ekspertna mišljenja vladi u pogledu etičkih problema koje srećemo u zdravstvenoj zaštiti djece, moderirati javne i debate u okviru zakonodavnih i upravljačkih tijela, uzeti ulogu u pravljenju etičkih okvira u svakodnevnoj praksi i pomoći definirati prihvatljivu socijalnu politiku. Kao takva ona bi bila glavni faktor u odgovoru na etičke probleme i anticipiranju istih. Trebala bi djelovati na principu ubjeđivanja i konsensusa, kao stalno tijelo, ali i sa mogučnošću formiranja ad hoc komiteta kada se radi o određenim specifičnim pitanjima. Bila bi sačinjena od eksperata iz različitih oblasti: biotehnologije, koji po profesionalnom usmjerenju dolaze i iz medicinskog i iz inžinjerskog miljea, eksperata u oblasti zdravstvene njege pacijenata, sociologa, pravnih stručnjaka, teologa, filozofa, poduzetnika itd. Na ovaj način bi bile predstavljene različite vrijednosti i razmišljanja, što bi proces odluka učinilo kompletnijim.

Ključne riječi: Etika, biotehnologije, pedijatrija

PHARMACEUTICAL ENGINEERING

Farmaceutski inženjering

Mehović Semir[1] , Dedić Mirza[2] , Jordamović Nadir[3]

[1] JU Apoteke Sarajevo, Saliha Hadžihuseinovića Muveklita 11, 71000 Sarajevo,

[2] Farmaceutski fakultet, Univerzitet u Sarajevu, Zmaja od Bosne 8, 71000 Sarajevo

[3] Eli Lilly B-H doo, Koševo 9/2, 71000 Sarajevo

Sažetak: Farmaceutski inženjering je grana farmaceutske nauke i tehnologije, koji uključuje razvoj i proizvodnju farmaceutskih oblika. Sa ozbiljnim razvojem započeo je tek nedavno, a nastao je iz hemijskog i biomedicinskog inženjeringa. Danas obrazovanje iz oblasti farmaceutskog inženjeringa pokriva oko 210 fakulteta širom svijeta. Internacionalno društvo za farmaceutski inženjering (ISPE) okuplja preko 22.000 stručnjaka iz oblasti farmaceutskog inženjeringa. Farmaceutski inženjering uključuje mnoga naučna znanja iz biologije, hemije, medicine, farmacije, a za cilj ima unaprjeđenje razvojnih procesa i proizvodnje lijekova. Samim time, farmaceutski inženjeri su uključeni u procese koncepcije, dizajna, razvoja, proizvodnje, markiranja i pakovanja lijekova. Farmaceutski inženjering pokriva nekoliko specijalnosti: farmaceutska nauka i razvoj; biofarmaceutska proizvodnja; razvoj alternativnih modela za ispitivanje lijekova; razvoj farmaceutskih preparata koji su karakterisanih ciljanim i kontrolisanim otpuštanjem lijekova, ali i novim ljekovitim oblicima (transgeni, proteini, peptidi); klinička nauka; regulativna oblast; farmaceutski uređaji tj. projektiranje instrumenata, alata, ili implantata koji olakšavaju izradu, rukovanje ili upotrebu lijekova, kao i razvoj novih analitičkih metoda, te razvoj novih sistema dostave lijekova. Oblasti u farmaceutskom inženjeringu preklapaju se i sa drugim inženjerskim područjima, kao i neinženjerskim naučnim i medicinskim poljima.

Ključne riječi: farmacija, inženjering, nanotehnologija, dizajniranje lijekova.

PHARMACEUTICAL ENGINEERING

In vitro models to determine the pharmacokinetic parameters

Pehlivanović Belma

Faculty of Pharmacy, University of Sarajevo, Sarajevo, Bosnia and Hercegovina

Abstract— The pharmaceutical industry seeks to more efficient and precise determination of the main pharmacokinetic parameters of existing and new drugs, and therefor uses new in vitro models that show a high degree of correlation with in vivo response. Determination of intestinal absorption, metabolic transformations and metabolic profile of drugs is carried out using the laboratory in vitro models, which represent innovative basis for determination of absorption, distribution, metabolism and elimination (ADME) of drugs . The aim of this paper is to present three most important in vitro models, their properties and applications in the pharmaceutical industry when determining the pharmacokinetic parameters. The rapid development of the pharmaceutical industry expressed the need for in vitro models for the determination of pharmacokinetic parameters in the laboratories that want to increase their operational efficiency and effectiveness.

Keywords— Pharmacokinetics, drugs, parameters, in vitro models

PHARMACEUTICAL ENGINEERING

Drug design

Emina Maleškić[1] , Mirza Dedić[2] and Fahir Bečić[3]

[1] University of Sarajevo, Faculty of Pharmacy, Sarajevo, Bosnia and Herzegovina

[2] University of Sarajevo, Faculty of Pharmacy, Department for Quality Control, Sarajevo, Bosnia and Herzegovina

[3] University of Sarajevo, Faculty of Pharmacy, Department for Pharmacology, Sarajevo, Bosnia and Herzegovina

Abstract— In order to identify therapeutic targets, the physiological, cellular and / or genetic basis of disease are studied. Recent advances in genomics, proteomics and the impact of information technology has broadened horizons in understanding the disease. Designing a new drug, from the earliest stages of discovery, by the time the drug is available on the market takes 10-15 years, while the average costs of research and development of successful drug are 800 million to 1 billion US dollars (USD). Discovering of a new drug begins with isolation and purification of novel compounds from natural sources or artificial synthesis. When it comes to chemical synthesis of a new identity complicated procedure of computer design is used. With the development of information technology, today it is possible to apply the software packages for prediction and study of three - dimensional (3D) structure and characteristics of the target macromolecules, with the aim of designing a successful drug, for better therapeutic response. There are three aspects of 3D molecular design strategies: pharmacophore mapping, 3D molecular design and study of 3D quantitative structure and activity. Most of used programs are using only the chemical structure of the compound for input, but there are those that enable 3D calculation of the coefficient of distribution - "logP" (partition coefficient), important constant of each substance, therefore the pharmaceutical drug. The most commonly used programs are: ALOGPs, CLOGP, LogPow, XLOGP, HyperChem, IA LogP. During the phase of pre - clinical development, in vitro laboratory tests are used for evaluating the potential biological activity of 5000-10000 new molecules. On average, 250 of them have the desired effect and are labeled as "target" molecules. Several promising molecules are chemically modified, in order to improve the specificity, chemical and metabolic stability, solubility and other pharmacological parameters. Those molecules, who meet the criteria during the pre-clinical studies using experimental animals, continue development through five phases of clinical trials in which the subjects are people. After obtaining the regulatory authorization, it continues to monitor the profile of the drug, through periodic reports and registration of adverse effects.

Keywords— drug design, in vitro, in vivo, clinical trials, 3D molecular design

PHARMACEUTICAL ENGINEERING

Primjena neuronskih mreža u razvoju lijekova

Haseljić Naida[1] , Smajović Alisa[2]

[1] Farmaceutski fakultet Univerziteta u Sarajevu, PhD Student, Sarajevo, Bosna i Hercegovina

[2]Farmaceutski fakultet Univerziteta u Sarajevu, Katedra za farmaceutsku informatiku, Sarajevo, Bosna i Hercegovina

Abstract-Najsavršeniji danas poznati stroj za obradu podataka je ljudski um. Računarski ekvivalent ljudskoj obradi podataka je umjetna neuronska mreža (engl. Artificial Neural Network, ANN). Neuronska mreža je skup međusobno povezanih jednostavnih procesnih elemenata, jedinica ili čvorova čija se funkcionalnost temelji na biološkom neuronu. Umjetna neuronska mreža predstavlja umjetnu repliku ljudskog mozga kojom se nastoji simulirati postupak učenja. Analogija s pravom biološkom mrežom nije u potpunosti adekvatna jer postoje mnogi fenomeni nervnog sistema koji nisu modelirani umjetnim neuronskim mrežama, kao što postoje i karakteristike umjetnih neuronskih mreža koje se ne slažu s onima bioloških sistema. Umjetna inteligencija i neuronske mreže razvijaju se s ciljem praktične primjene, to jeste, kvalitetnije obrade podataka, kako bi se unaprijedili i ubrzali procesi zaključivanja u nauci i tehnologiji. Umjetne neuronske mreže su moćan alat za simulaciju brojnih nelinearnih sistema i primijenjene su u rješavanju mnogih kompleksnih problema iz oblasti farmaceutskih istraživanja, inženjeringa, psihologije i medicinske hemije. U ovom radu su navedene mogućnosti primjene umjetnih neuronskih mreža u razvoju lijekova QSAR (Quantitative structure–activity relationship) metodama. QSAR povezuje fizičko-hemijske osobine spojeva sa njihovom hemijskom ili biološkom aktivnošću. QSAR modeli bazirani na umjetnim neuronskim mrežama su široko korišteni kao metoda predviđanja u virtualnom screening-u (VS). U kliničkim istraživanjima je vrlo važno utvrditi sigurnost i učinkovitost postojećih lijekova. Screening u laboratoriju i optimizacija spojeva su skupe i spore metode, ali bioinformatika može značajno pomoći u kliničkim istraživanjima za navedene svrhe pružajući mogućnost predviđanja toksičnosti lijekova i aktivnosti kod netestiranih, potencijalnih lijekova. Navedeno je moguće postići zbog dostupnosti bioinformatičkih alata i metoda VS-a koje omogućavaju testiranje svih potrebnih hipoteza prije kliničkih ispitivanja. Očekuje se da će upotreba neuronskih mreža dovesti do napretka u pretkliničkim ispitivanjima, ubrzanja u screeningu i identifikaciji novih, do sada nepoznatih molekula i formiranju eksperimentalnih modela koji do sada nisu bili izvodivi.

Keywords-neuronske mreže, QSAR,lijekovi

PHARMACEUTICAL ENGINEERING

Detection of non-esterified fatty acids in plasma samples in diabetes management

S. Mandal[1] and A. Causevic[2]

[1] Faculty of Pharmacy, University of Sarajevo/Department of Natural Sciences in Pharmacy, Analytical chemistry, Sarajevo, Bosnia and Herzegovina

[2] Faculty of Pharmacy, University of Sarajevo/Department of Biochemistry and Clinical analysis, Clincal biochemistry and Biochemistry of drugs, Sarajevo, Bosnia and Herzegovina

Abstract — Type 2 diabetes (T2D) and obesity represents today a global health problem. With an increase in numbers of patients diagnosed with T2D, there should be more ways to monitor not only the blood glucose levels but also to pursue other metabolism biomarkers associated with T2D. Patients with T2D often show a higher level of non-esterified fatty acids (NEFA), associated with increase in insulin resistance (IR) and poor disposal rate or glucose control. The fundamental pathophysiological mechanisms related to T2D include decline in pancreatic Beta-cell function and apoptosis and are accompanied by increase in visceral obesity. This is followed by elevation in the plasma concentrations of NEFA, which are associated with an increase in fat mass and IR. Monitoring of both glucose and NEFA levels provides greater information on metabolic state of patients, and is relevant in understanding the events leading to early development of prediabetic state or IR, particularly in T2D. Numerous studies indicate that NEFAs may be potential biomarkers and pharmacological targets in T2D management. In this work we have analyzed concentration of NEFAs in patients with T2D and prediabetes, in the context of an optimal diabetes control and monitoring. Our data showed significant differences in levels of individual NEFAs, namely palmitic acid (C16:0) between T2D patients and control subjects and myristic acid (C14:0) between prediabetic and T2D patients. Also, we found a significant difference in C16:0, oleic acid (C18:1) and glucose levels between patients with good-controlled diabetes, as well as between glucose levels and C16:0, C14:0, myristoleic acid (C14:1) and palmitoleic acid (C16:1) levels in patients with poor control of the disease. In conclusion, our data suggest that C16:0, C16:1, and C18:1 could be employed as potential biomarkers in progression and optimal control of T2D, while C14:0, C14:1, C16:0, and C16:1 could be used as potentially relevant biomarkers in prediabetes.

Keywords—non-esterified fatty acid, glucose control, diabetes monitoring, biomarkers, gas chromatography

STUDENT PAPERS

The validation of smartphone's built-in cameras for heart rate extraction

J. Nišić , N. Beganović , E. Zaimović, L. Goletić, E. Hujdur and A. Šećerbegović

Faculty of Electrical Engineering, University of Tuzla, Tuzla, Bosnia and Herzegovina

Abstract - The revolution of mobile devices has lead to the development of different applications for monitoring individual's health and wellbeing. Various smartphone's features can be utilized for the acquisition of different signals such as electrocardiogram, heart rate, position, location etc. Measuring heart rate is of great importance for the prevention and treatment of cardiovascular diseases. Several applications have already been introduced for heart rate measurement by placing fingertip on the back of smartphone's camera. In this paper, we have tested smartphone's front-camera for the recording of individual's face and extraction of photoplethysmography signal. Mobile application records skin color changes from face in real time and extracts average intensity of RGB components for each frame. The obtained photoplethysmography signal is being processed in real time and different filtering operations are being applied in order to increase accuracy of extracted heart rate values. iPhone application was developed and tested on ten individuals in daylight with good light conditions. Texas Instruments Chronos EZ430 watch along with Blue Robin heart rate monitor were used for validation. Our results demonstrate that low-resolution front-facing camera has potential for contactfree heart rate estimation, compared to commonly used back camera.

Keywords - heart rate, photoplethysmography, smartphone, camera.

STUDENT PAPERS

Non-contact video-based heart rate and heart rate variability extraction from different body regions

A.Alić , B. Bajrić , A. Hodžić , O. Kamerić , A. Bašić and A. Šećerbegović

Faculty of Electrical Engineering, University of Tuzla, Bosnia and Herzegovina

Abstract— Cardiovascular diseases are among leading causes of mortality around the world. Long-term monitoring of different cardiac parameters could help in prevention of heart attack or detection of life-threatening arrhythmias. With modern technology development, cheap and accessible methods for different vital signs estimation have emerged. Video-based non-contact heart rate estimation has already been implemented in literature, usually based on individual's face. In this paper, different body parts were used for estimation including forehead and palm. Heart rate and heart rate variability values were calculated based on photoplethysmography (PPG) signal, which was extracted from video recording. Video recordings were obtained by using professional camera where five individuals were filmed before and after mild exercise. As interframe compression methods degrade the quality of PPG signal, uncompressed video format was used. Separation of the observed signals was executed using Independent Component Analysis (ICA) method for obtaining red, green and blue components from acquired PPG signal. The validation of heart rate and heart rate variability was performed by using 12-channel electrocardiogram recording device. Our results demonstrate that non-contact method for heart rate and heart rate variability estimation shows sufficiently good results, assuming normal light conditions and minimal movement of the subject.

Keywords— Photoplethysmography (PPG), heart rate, heart rate variability (HRV), independent component analysis (ICA)

STUDENT PAPERS

Radioiodine therapy of differentiated thyroid cancer

Sumeja Kaimović , Arnela Hairlahović

Medicinski fakultet, Sarajevo, BiH

Abstract- As one example of the success of biomedicine and bioengineering in the area of the endocrine system can be considered the use of positron emission tomography and radiopharmaceuticals in the diagnosis and treatment of different diseases of the thyroid gland. Radioactive iodine is used in the treatment of differentiated thyroid carcinoma (glandule thyroidea) and therapeutic treatment of indolent hyperthyroidism caused by the thyroid gland adenomas. RAI is defined as the systemic administration of 131-sodium or potassium iodide (131) for the selective irradiation of the thyroid gland remains, non- resectionable or incompletely resectionable . Based on these two primary objectives, there are two main treatment options: 1- Radioactive ablation- postoperative additional option that is used to remove the remains of glandular tissue. 2- The treatment of non- resectionable or incompletely resectionable lesion, as curative or palliative treatment or as an addition to primary treatment of cancer. The decision about whether to radioactive iodine was used with the intention of treating or with the intention of palliative treatment, should be individual for each patient and should take into consideration factors such as: operability, iodine preference, location of the lesion, tumor characteristics, age and health status patient, and the potential risks that the process brings with it. General risk from the use of radioactive iodine is the decimation low while the benefits are many. It is important to note that biomedical engineering in the field of endocrinology and counting contributes to cure patients with differentiated carcinoma crutch glands, and so that is presently in clinical trials latest molecular targeted therapy.

Keywords- differentiated thyroid cancer, radioiodine therapy, radioactiv ablation

STUDENT PAPERS

BioEcomat (BEC) - Machine for recycling biotech drugs

A.B. Adna Sijerčić

International Burch University/Genetics and Bioengineering, IBU student, Sarajevo, Bosnia and Herzegovina

Abstract - Biotechnological drugs are drugs that are produced using living organisms. Modern biotechnological drugs are the result of the latest scientific achievements and production of researchers of different profiles. These drugs are a new challenge for industry, and the number of applications for obtaining traffic is continuously growing. These drugs are manufactured and usually genetically modified, and there is possibility that they ''escape'' in outside world (by wrong recycling) and they could cause genetic pollution and poisoning of the environment, maybe new ''modern'' disease. BioEcomat (BEC) is a machine that automatically recycles old, unusable biotehnological drugs, and ejects the confirmation of a transaction that can be desired in designated places exchanged for money or other medicines. The machine has a database of over 4000 medications, and code reader to recognize what you want to recycle.

Keywords – Biotechnology, biotech drugs, pharmacy, genetical mutations, environment.

STUDENT PAPERS

AC and DC Coupling of Electrocardiograph in Mobile Monitoring Applications

D. Jurić and A. Akšamović

University of Sarajevo, Faculty of Electrical Engineering, Sarajevo, Bosnia and Herzegovina

Abstract-- Recording of ECG signals is becoming more and more commonplace in the modern world today. An increasing number of smartphones, wearables and other devices have ECG signal detection, recording and analysis capability. These mobile devices have imposed upon them a different set of constraints when compared to the classic holter or ambulatory electrocardiographs such as to have low power consumption, to be lightweight and to be compact. DC coupling of ECG has become a solution to address these issues that come up before a biomedical equipment designer. Still DC coupling has its own design requirements and they are in this paper compared to design requirements of AC coupling. Analog front end requirements are discussed in terms of filtering, conversion, power consumption and compactness of size. Digital back end requirements are discussed in terms of processor number of bits required for each method and amount of digital filtering each method requires to obtain an acceptable ECG signal. Applicability of both methods to mobile electrocardiograph design is then discussed.

Keywords— Electrocardiograph, Biopotentials amplifier, Right-Leg-Drive

STUDENT PAPERS

Localization and 2D imaging of ST elevation myocardial infarction using software differentiation

Vildana Huskić [1] , Almir Vardo[2] , Edin Begić[1], Emina Hrvat[1] , Lejla Gurbeta[2] , Mirna Džubur[1] , Almir Badnjević[3] , Armin Dajić[2], Azra Kadić[1]

[1] Faculty of Medicine, University of Sarajevo, BiH

[2] Faculty of Electrical Engineering, University of Sarajevo, BiH

[3] Verlab, Sarajevo, BiH

Abstract—The key diagnostic procedure in patients with suspected acute coronary syndrome is recording of a standard 12-lead electrocardiogram (ECG) with a device that detects and records the heart's electrical activity (electrocardiograph). Localization of myocardial infarction and its developmental stages are indicated by: T wave, ST-segment and QRS complex (Q wave). T-wave inversion shows the zone of reduced blood supply (ischemia), ST segment (elevation or depression) points at the ischemic injury- lesion, and a deep Q wave indicates a developed infarction. Using these characteristics, a software application is developed. The application aim is to enable effective monitoring of patients with urgent acute conditions as well as timely therapeutic effect. The software application is developed in VisualStudio2010 and it provides a practical and clear user interface. It also detects changes related to the QRS complexes, P and T waves (using Wavelet transformation and various filters for eliminating noise), and it displays the location of myocardial infarction in a 2D view of the heart.

Keywords— Acute myocardial infarction, ST-elevation, software application, 2D.