58th ANNUAL ROCKY MOUNTAIN BIOENGINEERING SYMPOSIUM

April 8-10, 2021
Program
April 8-10, 2021

Annual Meeting Organizers

Kenneth R. Butler, Ph.D.
University of Mississippi Medical Center

Ibrahim O. Farah, Ph.D.
Jackson State University

Michelle A. Tucci, Ph.D.
University of Mississippi Medical Center

Elena Oggero, Ph.D.
Vestibular Technologies, LLC

Guido Pagnacco, Ph.D.
Vestibular Technologies, LLC

Hamed Benghuzzi, Ph.D.
Mississippi Academy of Sciences

Joseph A. Cameron, Ph.D.
Jackson State University
Our first virtual symposium!

Vision

The Rocky Mountain Bioengineering Symposium (RMBS) brings the international bioengineering community together through academia, science, and industry to drive new ideas and collaboration focused improving human life and health. The goal of this 58th annual meeting is to provide a venue to exchange information, collaborate among colleagues, and further professional and trainee education where engineers, health professionals, educators, student trainees, industry leaders, and other interested persons can assemble to exchange information in all fields of bioengineering.

The RMBS is the oldest bioengineering organization in the world dedicated to promoting advancements in all areas of bioengineering ultimately leading to improved human health. In spite of COVID-19 challenges over the past year, the RMBS has assembled a state of the art symposium to be delivered virtually. In this year's program, new novel discoveries will be presented by keynote speakers and principal investigators from prestigious national and international academic institutions and industry from five different continents. The success of RMBS stems from its promotion of both trainee and professional engineering research and

Goals

- **Learn | See | Network — from the comfort of your own home or office!**
- Deliver 17+ hours of all new content from experts, new principal investigators, and bioengineering trainees highlighting advancing research and application in key topic areas
- Provide meeting & networking opportunities with leading experts in many disciplines of bioengineering
- Offer occasions for participants to meet and participate in Q&A with speakers and poster presenters in topic-specific sessions
- Foster opportunities to expand the translation of research discoveries in bioengineering to clinical practice and applications
- Afford opportunities for attendees to learn about the latest technology developments, leveraging applications of biosensors, imaging, machine learning, biointegration, biocompatibility, and much more

Program Highlights

- Selected topics in clinical engineering
- New approaches in signal and sensor engineering
- Neurobiology of Alzheimer's disease and traumatic brain injury
- Computational bioengineering, machine learning, and medicine
- Advances in biomedical signal and image processing
- Recent developments in biomaterials, bioinstrumentation, biomechanics and biointegration
- Advances in drug and device development
- An engineer reflects on work and life at the South Pole

Sponsors and Endorsements

- Mississippi Academy of Sciences (MAS)
- Southern Biomedical Engineering Conference (SBEC)
58th Annual Meeting
Program
Thursday, April 8, 2021
Virtual from
Jackson, MS
and
Cheyenne, WY
Thursday, April 8, 2021 4:00- 9:00 PM EDT

4:00PM EDT: Platform Opens
4:00-4:30PM EDT: Meet & Greet
4:30-5:00PM EDT: Opening Ceremony
Program Co-Chairs: Drs. Butler, Farah and Tucci
Virtual Platform Co-Chairs: Drs. Oggero and Pagnacco
RMBS President: Dr Hamed Benghuzzi

5:00-6:30 PM EDT: Session 1: Clinical Bioengineering

<table>
<thead>
<tr>
<th>Time</th>
<th>Presentation #</th>
<th>Session Chair: Ibrahim O. Farah, Ph.D., Jackson State University</th>
<th>Co-Chair: Michelle Tucci, Ph.D., University of Mississippi Medical Center</th>
<th>Session Host: Elena Oggero, Ph.D., Vestibular Technologies, LLC</th>
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<tbody>
<tr>
<td>5:00</td>
<td>1-1</td>
<td>UNDERSTANDING THE ROLE OF Y1- R IN INTERVERTEBRAL DISCS</td>
<td>Michelle Tucci, Ph.D., University of Mississippi Medical Center</td>
<td><a href="mailto:mtucci@umc.edu">mtucci@umc.edu</a></td>
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6:30-7:00 Dinner Break
7:00-8:30PM EDT: Session 2: Radiology/Signals and Sensor

Keynote Speaker

Ali Fatemi

University of Mississippi Medical Center at Jackson, MS, USA

Title: “PRACTICAL GUIDELINE TO ESTABLISH A QUALITY ASSURANCE PROGRAM FOR DIAGNOSTIC MRI MACHINES INTENDED TO USE FOR STEREOTACTIC RADIOSURGERY”

Dr. Ali Fatemi, is a clinical faculty medical physicist who joined the University Medical Center faculty as an assistant professor of radiology. After receiving his BS in science/biology from Tehran University, Iran, in 1998, and his BS in medical physics and applied radiation sciences from McMaster University, Hamilton, Ontario, in 2006, Fatemi earned his Ph.D. in MRI physics at McMaster University in 2010. He had residency training in radiation oncology physics at Princess Margaret Hospital, University of Toronto, from 2010-13. Fatemi joined the staff of the Memorial University of Newfoundland, Dr. Bliss Murphy Cancer Center, St. John’s, Newfoundland, in 2013 as a clinical medical physicist and an assistant professor of radiation oncology. The following year, he moved to the Odette Cancer Centre, Sunnybrook Health Science, ON, Toronto, as a clinical faculty medical physicist and affiliated scientist. Dr. Fatemi is the author or coauthor of seven articles in peer-reviewed professional publications, one book chapter and 16 conference proceedings. Dr. Fatemi has given numerous presentations at scientific meetings and conferences internationally. His research interests include MRI-guided radiation therapy (MRIGRT), MRI microstructural imaging (SWI, QSM, DWI, DTI and STI), MRI neuroimaging, MRI cardiac imaging and automated quality assurance (aQA).

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<th>Time</th>
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<th>Session Chair: Ali Fatemi, Ph.D., University of Mississippi Medical Center</th>
<th>Co-Chair: Edward Florez, Ph.D., University of Mississippi Medical Center</th>
<th>Session Host: Ken Butler, Ph.D., University of Mississippi Medical Center</th>
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| 7:00  | Keynote        | PRACTICAL GUIDELINE TO ESTABLISH A QUALITY ASSURANCE PROGRAM FOR DIAGNOSTIC MRI MACHINES INTENDED TO USE FOR STEREOTACTIC RADIOSURGERY  
Ali Fatemi  
University of Mississippi Medical Center, Jackson, MS 39216, USA  
afatemia@umc.edu |
| 7:30  | 2-1            | ASSESSMENT OF ASYMMETRY IN BILATERAL STATIC FRONTAL BREAST THERMOGRAMS USING DIFFERENCE IMAGE AND RADIOMIC FEATURES  
Vijaya Madhavi M and T. Christy Bobby  
East Point College of Engineering and Technology, Bengaluru, India  
vijayamadhavi79@gmail.com |
| 7:45  | 2-2            | ANALYSIS OF MEDIASTINUM IN TUBERCULOSIS CHEST RADIOGRAPHIC IMAGES USING LEVEL SET SEGMENTATION AND SHAPE CHARACTERIZATION  
Sukanta Kumar Tulo, Satyavartan Govindarajan, Palaniappan Ramu, Ramakrishnan Swaminathan  
Indian Institute of Technology Madras, Chennai, India  
sukant.99r@gmail.com |
| 8:00  | 2-3            | RADIOMICS BASED BREAST MALIGNANCY INDEX TO DIFFERENTIATE PATHOLOGICAL CHANGES DUE TO NEOADJUVANT CHEMOTHERAPY  
Priscilla Dinkar Moyya, Mythili Asaithambi, Anandh Kilpattu Ramanilharan  
Vellore Institute of Technology, India  
priscilladinkar@gmail.com |
| 8:15  | 2-4            | RADIOMICS BASED SINGLE AND MULTI-CLASS GLIOMA CLASSIFICATION USING SUPPORT VECTOR MACHINE VARIANTS  
Seema P. D., Christy Bobby T and Anandh K.R.  
Ramaiah University of Applied Sciences, India  
seemapd6@gmail.com |
| 8:30  | 2-5            | ROTATIONAL MOMENT SHAPE FEATURE EXTRACTION AND DESCISION TREE BASED DISCRIMINATION OF MILD COGNITIVE IMPAIRMENT CONDITIONS USING MR IMAGE PROCESSING  
Ravi Dadse, Deboleena Sadakhan and Ramakrishnan Swaminathan  
Indian Institute of Technology Madras, India  
ravidadse54@gmail.com |
Friday, April 9, 2021 9:30AM-9:00PM
9:30-10:00AM EDT: Day Opens
10:00-11:00AM EDT: Session 3: Biosensors

| Time   | Presentation # | Session Chair: Cameron Wright, Ph.D., University of Wyoming  
|----------------|----------------|-----------------------------------------------|
| 10:00   | 3-1            | Co-Chair: Rob Streeter, Ph.D., Univ of Boulder, CO  
|         |                | Session Host: Elena Oggero Ph.D., Vestibular Technologies  
|         | FRACTAL ANGLE BASED DIFFERENTIATION OF TERM PREGNANCIES USING UTERINE ELECTROMYOGRAPHIC SIGNALS  
|         | P. Vardhini and S. Ramakrishnan  
|         | Indian Institute of Technology Madras, India  
|         | niidvardhini@gmail.com  
| 10:15   | 3-2            | VARIATION OF INSTANTANEOUS SPECTRAL CENTROID ACROSS BANDS OF SURFACE ELECTROMYOGRAPHIC SIGNALS  
|         | Divya Bharathi Krishnamani, Karthick P.A., Ramakrishnan Swaminathan  
|         | Indian Institute of Technology Madras, India  
|         | divyak0593@gmail.com  
| 10:30   | 3-3            | FEATURES SELECTION FOR FACIAL EMOTION RECOGNITION IMPROVEMENT FROM FACIAL ELECTROMYOGRAPHY  
|         | National Institute of Technology, Tiruchirappalli, India  
|         | desouzanto@gmail.com  
| 10:45   | 3-4            | WAVELET TRANSFORM FEATURES OF FACIAL ELECTROMYOGRAPHY SIGNALS FOR EMOTION DETECTION  
|         | K. Gobinath P.A. Karthick  
|         | National Institute of Technology, Tiruchirappalli, India  
|         | gobi10.31@gmail.com  

11:00-11:15  BREAK

11:15AM-12:45PM EDT: Session 4: Neurobiology

| Time   | Presentation # | Session Chair: Lir-Wan-Fan, Ph.D., University of Mississippi Medical Center  
|---------|----------------|-----------------------------------------------|
|         |                | Co-Chair: Roy Geib, Ph.D., Indiana University–Purdue University  
|         |                | Session Host: Ibrahim Farah, Ph.D., Jackson State University  
| 11:15   | 4-1            | LATERAL VENTRICLE TEXTURE ANALYSIS IN ALZHEIMER BRAIN MR IMAGES USING KERNEL DENSITY ESTIMATION  
|         | Deboleena Sadhukhan, Anrutha Veluppal, Anandh Kilppattu Ramaniharman, and Ramakrishnan Swaminathan  
|         | Institute of Technology, Madras, Chennai, India  
|         | deboleena.rainbow@gmail.com  
| 11:30   | 4-2            | SEGMENTATION OF CORPUS CALLOSUM AND LATERAL VENTRICLE STRUCTURES IN ALZHEIMER MR IMAGES USING SPATIAL FUZZY CLUSTERING BASED LEVEL SET  
|         | S Sreelakshmi and S Ramakrishnan  
|         | Indian Institute of Technology Madras, India  
|         | lakshminair.hee@gmail.com  
| 11:45   | 4-3            | CORTICAL INTEGRATIVE THERAPY EFFECTIVENESS IN THE TREATMENT OF POST-CONCUSSION SYNDROME AND MILD TRAUMATIC BRAIN INJURY  
|         | Victor M. Pedro1,2, Nicole C. Lim, and Elena Oggero3,4  
|         | 1 International Institute for the Brain, New York, NY  
|         | 2 Director of Rhode Island Integrated Medicine, Cranston, RI  
|         | 3 Electrical and Computer Engineering Department, University of Wyoming, Laramie, WY  
|         | 4 Vestibular Technologies, LLC, Cheyenne, WY  
|         | vpedro@ibrainnyc.org  


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<tr>
<td>12:00</td>
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<td>Intranasal insulin reduces impaired neurobehavioral outcomes and brain inflammation following lipopolysaccharide exposure in neonatal rats</td>
<td>Elizabeth L. White, Jonathan W. Lee, Jhanel J. Greene, Marianne H. Lee, Joseph C. Crosby, Lu-Tai Tien, Xiaoli Dai, Michelle A. Tucci, Norma B. Ojeda, Yi Pang, Abhay J. Bhatt, Lit-Wan Fan</td>
<td>University of Mississippi Medical Center, MS, USA</td>
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<td>Neonatal lipopolysaccharide exposure interferes with REM sleep and homeostatic responses to sleep disturbances in adolescent rats</td>
<td>Joseph C. Crosby, Silu Lu, James P. Shaffery, Jonathan W. Lee, Tembra K. Jones, Lu-Tai Tien, Yi Pang, Norma B. Ojeda, Michelle A. Tucci, Lit-Wan Fan</td>
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<td>Evidence-based, efficient model of speech therapy and parent education service provision in the school setting for parents of children with traumatic brain injury</td>
<td>Katandra L. Johnson, Victor M. Pedro and Elena Oggero</td>
<td>1. International Institute for the Brain, New York, NY, USA 2. Director of Rhode Island Integrated Medicine, Cranston, RI, USA 3. Electrical and Computer Engineering Department, University of Wyoming, Laramie, WY 4. Vestibular Technologies, LLC, Cheyenne, WY, USA</td>
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1:30-2:45PM EDT: Session 5: Bioinstrumentation

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<td>5-1</td>
<td>Human factors learning curve for novel firearm design using gyroscopic feedback instrumentation</td>
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<td>5-2</td>
<td>Verification of a biosensor design used for detecting changes in permittivity of aqueous materials during radio frequency wave exposure</td>
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<td>2:00</td>
<td>5-3</td>
<td>Machine learning based on CT radiomic features predicts residual tumor in head and neck cancer patients treated with chemoradiotherapy</td>
</tr>
<tr>
<td>2:15</td>
<td>5-4</td>
<td>Characterizing driver take-over accuracy: effect of age, sex, startled, and secondary task</td>
</tr>
<tr>
<td>2:30</td>
<td>5-5</td>
<td>Comorbidity characteristics of adult patients with reported neck and low back complaints-an outpatient clinical population based cohort</td>
</tr>
</tbody>
</table>
3:00-4:15PM EDT: Session 6: Computational Bioengineering I

| Time   | Presentation # | Session Chair: Shivaram P. Arunachalam, Ph.D., Mayo Clinic  
|        |                | Co-Chair: Joel Stitzel, Ph.D., Wake Forest University  
|        |                | Session Host: Elena Oggero, Ph.D., Vestibular Technologies  

3:00 | 6-1 | INVESTIGATION OF SYNCHRONIZED ACQUISITION OF ELECTROCARDIOGRAM AND PHONOCARDIOGRAM SIGNALS TOWARDS ELECTROMECHANICAL PROFILING OF THE HEART  
Devanshi N. Damani, Divaakar Siva Baala Sundaram, Shivam Damani, Anoushka Kapoor, and Shivaram P. Arunachalam  
Mayo Clinic, Rochester, WI, USA  
damani.devanshi@mayo.edu

3:15 | 6-2 | DEEP LEARNING BASED DISCRIMINATION OF PHONOCARDIOGRAM SIGNAL WITH NORMAL HEART SOUNDS AND MURMUR: FEASIBILITY STUDY  
Divaakar Siva Baala Sundaram, Devanshi N. Damani, Anoushka Kapoor, Suganti Shivaram and Shivaram P. Arunachalam  
Mayo Clinic, Rochester, WI, USA  
PoigaiArunachalam.Shivaram@mayo.edu

3:30 | 6-3 | NON-HEADER IMPACT EXPOSURE AND KINEMATICS OF MALE YOUTH SOCCER PLAYERS  
Declan A. Patton, Colin M. Huber, Susan S. Margulies, Christina M. Master, Kristy B. Arbogast  
Center for Injury Research and Prevention, Children’s Hospital of Philadelphia, Philadelphia, PA, USA  
pattonda@chop.edu

3:45 | 6-4 | BREAST CANCER SEGMENTATION OF MAMMOGRAPHIC IMAGES USING GENERATIVE ADVERSARIAL NETWORK  
Swathi N. and T. Christy Bobby  
Ramaiah University of Applied Sciences, India  
swath02murthy@gmail.com

4:00 | 6-5 | RECOGNITION OF EMOTIONS FROM TIME AND TIME-FREQUENCY FEATURES USING FACIAL ELECTROMYOGRAPHY SIGNALS  
J. Shiva, N. Makaramb, P. A. Karthicka, R. Swaminathanb  
Ramaiah University of Applied Sciences, India  
jayendhrashiva@gmail.com

4:15-4:30 | | BREAK

4:30-5:30PM EDT

Session Chair: Hamed Benghuzzi Ph.D.  
Session Host: Kenneth Butler Ph.D.

Plenary Speaker 1

Ahmed El-Ghannam  
University of North Carolina, NC, USA

Title: Long Term Evaluation of Silica-Calcium Phosphate Composite (SCPC) Bone Graft in Human Socket Augmentation and Sinus Lifting

Dr. Ahmed El-Ghannam holds a BSc in Chemistry, MSc in Glass Science and Technology, MS and Ph.D. in Bioengineering from University of Pennsylvania. He has 30 years of experience in Material Science and bioceramic engineering. He has six US patents and is the associate editor for the Journal of Biomedical Materials Research. Dr. El-Ghannam’s lab focuses on the development of bioceramics for multifaceted applications in drug delivery to treat cancer and infection, augment soft tissue and reconstruct bone. Dr. El-Ghannam’s team includes clinicians and a molecular biologist and is widely published.

5:30-6:00PM EDT: Break
<table>
<thead>
<tr>
<th>#</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
</table>
| 1  | EXPERIMENTAL INVESTIGATION OF MASK USAGE ON PREVENTING PM 2.5 RELATED DISEASES IN THE CARDIOVASCULAR SYSTEM | Travis Huff  
North Dakota  
State, ND, USA                                                          |
| 2  | 3D TEXTURE FEATURE-BASED LYMPH NODE AUTOMATED DETECTION IN HEAD AND NECK CANCER ANALYSIS | Yibin Wang  
Mississippi State  
University, MS, USA                                               |
| 3  | ARTIFICIAL INTELLIGENCE-BASED ATTENTION-DEFICIT/HYPERACTIVITY DISORDER CLASSIFICATION FOR BRAIN NETWORK | Yibin Wang  
Mississippi State  
University, MS, USA                                               |
| 4  | ANALYSIS ON THE EFFECT OF HALF ANGLE ON THE DISPLACEMENT OF PEDICLE SCREW DURING AXIAL PULL-OUT TEST IN CANCELLOUS BONE USING 2D AXISYMMETRIC FE MODEL | Harikrishna Makaram and Ramakrishnan Swaminathan Institute of Technology Madras, Chennai, India makaramhk@gmail.com |
| 5  | TRANSCULANEOUS ELECTRIC STIMULATION DECREASES NEUROPATHIC PAIN IN CHRONIC CONSTRICITION INJURY RAT MODEL | Xiuli Dai, Fai-Wen Fan, Michelle Tucci, Min Huang, University of Mississippi Medical Center, MS, USA adgarner@umc.edu |
| 6  | THREE DAYS MONITORING OF ACTIVITIES OF DAILY LIVING AMONG HEALTHY AND PARKINSON’S DISEASE PATIENTS | Seong Hyun Moon, Rahul Soangra, Christopher W. Frames, Thurmon E. Lockhart Arizona State University, AZ, USA   |
| 7  | IN VITRO ANALYSIS OF UNIVERSALLY UTILIZED IMPLANT RESTORATIVE DENTAL MATERIAL’S IMPACT ON THE ARCHITECTURAL STABILITY OF GINGIVAL FIBROBLASTS IN THE PRESENCE OF A COMMON ENDOTOXIN | Angelia D. Garner, Michelle A. Tucci, Hamed A. Benghuzzi University of Mississippi Medical Center, MS, USA adgarner@umc.edu |
| 8  | DOES TOE WALKING AFFECT MOVEMENT AND SLEEP CHARACTERISTICS IN IDIOPATHIC TOE WALKING CHILDREN? | Rahul Soangra  
Chapman University, CA                                               |
| 9  | THE IMPACT OF MOTORCYCLE HELMET USE TO REDUCE TRAFFIC FATALITIES    | Ham Benghuzzi, Chris Powe, Dennis Watts and Todd Barrett Global Training Institute, Flowood, MS, USA  
hbenghuzzi@msacad.org                                                |

**Poster link**  [https://symposium.rmbs.org/Posters.html](https://symposium.rmbs.org/Posters.html)

**7:30-9:00PM EDT:**  
**Dinner**
### Session 7: Computational Bioengineering II

<table>
<thead>
<tr>
<th>Time</th>
<th>Presentation #</th>
<th>Title</th>
<th>Authors</th>
<th>Email</th>
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<tbody>
<tr>
<td>9:30</td>
<td>7-1</td>
<td>EMOTION ANALYSIS USING SIGNAL AND IMAGE PROCESSING APPROACH BY IMPLEMENTING DEEP NEURAL NETWORK</td>
<td>S. Sushma, Christy Bobby and S. Malathi Ramaiah University of Applied Sciences, Bengaluru, India</td>
<td><a href="mailto:sushma.snk@gmail.com">sushma.snk@gmail.com</a></td>
</tr>
<tr>
<td>9:45</td>
<td>7-2</td>
<td>ANALYSIS OF CORTICOMUSCULAR COHERENCE BETWEEN CORTICAL AND LOWER LIMB MUSCLE ACTIVITIES</td>
<td>K. Arunganesh, N. Sivakumaran, S. Kumaravel, and P.A. Karthick National Institute of Technology Tiruchirappalli, Tamilnadu, India</td>
<td><a href="mailto:arunganeshkg@gmail.com">arunganeshkg@gmail.com</a></td>
</tr>
<tr>
<td>10:00</td>
<td>7-3</td>
<td>DIFFERENTIATION OF DICHOTOMOUS EMOTIONAL STATES IN ELECTRODERMAL ACTIVITY SIGNALS USING HIGHER-ORDER CROSSING FEATURES AND PARAMETRIC CLASSIFIERS</td>
<td>Yedukondala Rao Veeranki*, Nagarajan Ganapathy, Ramakrishnan Swaminathan Indian Institute of Technology, Madras, India</td>
<td><a href="mailto:ykraoveeranki@gmail.com">ykraoveeranki@gmail.com</a></td>
</tr>
<tr>
<td>10:15</td>
<td>7-4</td>
<td>ANALYSIS OF EEG RESPONSE FOR AUDIO-VISUAL STIMULI INFRONTAL ELECTRODES AT THETA FREQUENCY BAND USING THE TOPOLOGICAL FEATURES</td>
<td>Himanshu Kumar, Subha D Pathankattil and Ramakrishnan Swaminathan Madras, India</td>
<td><a href="mailto:him241994@gmail.com">him241994@gmail.com</a></td>
</tr>
<tr>
<td>10:30</td>
<td>7-5</td>
<td>DETECTION OF SEIZURE TYPES FROM THE WAVELET ENERGY OF SCALP EEG</td>
<td>Joseph Mathew, N. Sivakumaran, P.A. Karthick National Institute of Technology, Tiruchirappalli, India</td>
<td><a href="mailto:jchackompally@gmail.com">jchackompally@gmail.com</a></td>
</tr>
<tr>
<td>10:45</td>
<td>7-6</td>
<td>CYTOPATHOLOGY EDUCATION TRAINING ASPECTS OF DEVELOPING AN ON-LINE TRAINING PROGRAM</td>
<td>Zelma Cason Mississippi Academy of Sciences, MS, USA</td>
<td><a href="mailto:zelson@icloud.com">zelson@icloud.com</a></td>
</tr>
<tr>
<td>11:00</td>
<td>7-7</td>
<td>CRICOTHYROTOMY SIMULATION USING CADAVER MODEL: IMPACT ON AWARENESS, RECEPITIVENESS AND ATTITUDE AMONG HEALTHCARE PROVIDERS</td>
<td>Christopher Powe, Hamed Benghuzzi, Dennis Watts, Eric Zoog, Rickie Smith, John Carlisle, Craig Menefee Global Training Institute, Flowood, MS</td>
<td><a href="mailto:chris@globaltraining.institute">chris@globaltraining.institute</a></td>
</tr>
</tbody>
</table>
Plenary Speaker 2

Vernon K. Sondak, MD
H. Lee Moffitt Cancer Center and Research Institute-Tampa, FL

Title: Computers in Medicine; 40 Years On

Dr. Sondak is a surgical oncologist and Chair of the Department of Cutaneous Oncology at the H. Lee Moffitt Cancer Center and Research Institute in Tampa, Florida. He holds the Richard M. Schulze Family Foundation Distinguished Endowed Chair in Cutaneous Oncology there, and is also a Professor in the Departments of Oncologic Sciences and Surgery at the University of South Florida Morsani College of Medicine. Since 2004, when he arrived in Tampa, the Cutaneous Oncology Clinic at Moffitt has grown into one of the largest multidisciplinary treatment centers for melanoma and other skin cancers in the world, now seeing well over 2000 new patients each year.

Dr. Sondak serves as principal investigator of the Moffitt Skin SPORE, a major NCI-funded “team science” grant conducting translational research in melanoma and other cutaneous malignancies. His medical research interests include surgical treatment of melanoma in adults and children, surgical treatment of Merkel cell carcinoma and other rare cutaneous tumors, and evaluation of new therapies for patients with localized or disseminated melanoma.

Dr. Sondak has been a leader in studies of surgical treatment of melanoma and other cutaneous malignancies, particularly in the application of sentinel lymph node biopsy and dissection to the staging and treatment of melanoma and Merkel cell carcinoma. In addition, he has been instrumental in training many surgical oncologists over the years.

The son of a pioneer in computer science education, Dr. Sondak has been a lifelong advocate for the use of computers and computer-assisted decision-making in medical care. He is an author or editor of two books on computers, including “Computers in Medicine” – a compilation of the state-of-the-art literature on medical computing published in 1979 while he was a medical student at Boston University School of Medicine.

In addition, he is an author or coauthor of over 420 medical articles in peer-reviewed medical journals, 6 books (5 on cancer and one on the ships of the Great Lakes), and 82 medical textbook chapters. Dr. Sondak did his surgical training at the University of California Los Angeles.

Prior to joining Moffitt in 2004, Dr. Sondak was a Professor of Surgery in the Division of Surgical Oncology at the University of Michigan. Dr. Sondak has received numerous awards, including the Golden Scalpel Award (Outstanding Chief Resident) from the UCLA Division of General Surgery, a Distinguished Alumnus Award from Boston University School of Medicine, the William W. Coon Award for Outstanding Faculty Teaching from the University of Michigan Section of General Surgery, and the Rays of Hope Leadership Award from the Shade Foundation of America, devoted to skin cancer education and prevention for children.

He is a member of the National Cancer Institute’s Board of Scientific Counselors for Clinical Sciences and Epidemiology, the group responsible for peer review and oversight of the NCI’s intramural research program.

He is also an avid ice hockey goaltender, having played competitively over six different decades since the 1970s.

12:30-1:00 PM EDT: Lunch Break
Dr. Laura Cavallone is an Associate Professor and the Vice Chair for Research of the Department of Anesthesiology at the University of Mississippi Medical Center, where she has been on faculty since October 2019. Dr. Cavallone initiated and advanced her career as a translational clinical researcher at Washington University in St. Louis where she was invited in 2004 as visiting professor after graduating from medical school and specializing in anesthesiology from the University of Milan, and working in Milan for the first few years of her career. During her career as a researcher, she has been actively involved in several basic science and translational investigations, mainly focusing on mechanisms of central sensitization and brain plasticity. From 2004 until 2019, she worked in the Department of Anesthesiology and Pain Center of Washington University under the mentorship of and in collaboration with Dr. Robert W. Gereau, Ph.D.. Her main focus has been on central nervous system plasticity in response to pain, and on human experimental pain models that may be suitable to study the clinical development of novel analgesics. As part of one of her projects, she was PI and sponsor of an investigational new Drug (IND) application with the FDA to study the pharmacokinetic properties of the mGlu5 negative allosteric modulator fenobam and its effects on experimental pain.
2:45-4:00 PM EDT: Session 9: Biomechanics

<table>
<thead>
<tr>
<th>Time</th>
<th>Presentation #</th>
<th>Session Chair: Sri Kumar, Ph.D., Safety Research Institute Co-Chair: Brian Stemper, Ph.D., Medical College of Wisconsin Session Host: Elena Oggero, Ph.D. Vestibular Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>2:45</td>
<td>9-1</td>
<td>CORRELATIONS BETWEEN PLANTAR PRESSURE AND JOINT KINEMATICS IN FEMALE RECREATIONAL RUNNERS Janelle A. Cross, Fadumo Mohamud, Carolyn Meinerz, Gerald F. Harris, Cody Dziuk, Jessica M. Fritz Medical College of Wisconsin, Milwaukee, WI, USA <a href="mailto:jacross@mcw.edu">jacross@mcw.edu</a></td>
</tr>
<tr>
<td>3:00</td>
<td>9-2</td>
<td>STUDY OF THE BILATERAL ASYMMETRY OF PLANTAR MECHANICAL PROPERTIES AS A BIOMARKER FOR THE DIFFERENTIATION OF DIABETIC CONDITION Shib Sundar Banerjee, Srivatsa Ananthan, and Ramakrishnan Swaminathan Department of Applied Mechanics, Indian Institute of Technology Madras, Chennai, India <a href="mailto:banerjee2shb@gmail.com">banerjee2shb@gmail.com</a></td>
</tr>
<tr>
<td>3:15</td>
<td>9-3</td>
<td>ANALYSIS OF TRUNK POWER AND JOINT STRESSES BETWEEN PROFESSIONAL AND COLLEGIATE PITCHERS Maxwell Albiero, Cody Dziuk, Janelle A Cross Medical College of Wisconsin, Milwaukee, WI, USA <a href="mailto:malbiero@mcw.edu">malbiero@mcw.edu</a></td>
</tr>
<tr>
<td>3:30</td>
<td>9-4</td>
<td>DYNAMIC RESPONSE OF THE HUMAN HEAD DURING IMPACT WITH A DRYWALL BULKHEAD-SECTION Michael A. K. Liebschner and Leroy R. Waite Rimkus Consulting Group, Forensic Engineering Division, Houston, Texas <a href="mailto:mliebschner@rimkus.com">mliebschner@rimkus.com</a></td>
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<tr>
<td>3:45</td>
<td>9-5</td>
<td>BIOMECHANICS OF PENETRATING INJURIES IN GUARDRAIL MOTOR VEHICLE CRASHES Sri Kumar Safety Research Institute Atlanta, GA, USA <a href="mailto:kumar@srinst.com">kumar@srinst.com</a></td>
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<td>4:00</td>
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<td>BREAK</td>
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4:30- 6:00 PM EDT: Session 10: Biomaterials and Biochemistry

Keynote Speaker

Kenneth R. Butler, Ph.D.
University of Mississippi Medical Center at Jackson, MS, USA

Title: “Ceramic Implantable Devices: From Bioengineering to Biocompatibility to Biointegration”

Dr. Kenneth Butler is a professor of medicine at the University of Mississippi Medical Center and laboratory director at the Gertrude C. Ford Memory Impairment and Neurodegenerative Dementia (MIND) Research Center. He has been involved in biomaterials research for over 20 years and has primarily focused on the biocompatibility of ceramics materials by evaluating the tissue-implant response. Dr. Butler has served as research mentor to 30 residents and graduate students, post-docs, and junior faculty in the medical, graduate, and pharmacy schools. He has been an active member of both intramural and extramural grant review teams for both national and international organizations. Dr. Butler has served as a board member and officer in the Mississippi Academy of Sciences and the Rocky Mountain Bioengineering Symposium. In 2014, he was elected a fellow of the AHA in the Council on Epidemiology and Prevention. He has authored or co-authored more than 70 peer-reviewed journal articles and published more than 110 abstracts. His research interests include the evaluation of the tissue-implant response, biocompatibility of implantable materials, and development of machine learning protocols that may be useful in the prediction of material biocompatibility.
| Time      | Presentation | Session Chair: Carolyn Hampton, Ph.D., Army Research Lab  
Co-Chair: Amanda Brooks, Ph.D., Rocky Vista University  
Co-Chair: Ibrahim Farah, Ph.D., Jackson State University |
|-----------|--------------|----------------------------------------------------------|
| 4:30      | Keynote      | CERAMIC IMPLANTABLE DEVICES: FROM BIOENGINEERING TO  
BIOCOMPATIBILITY TO BIOINTEGRATION  
Kenneth R. Butler  
University of Mississippi Medical Center  
Kbutler@umc.edu |
| 5:00      | 9-1          | CYTOMORPHOLOGICAL EVALUATION OF PANCREATIC CELLS IN  
RESPONSE TO GLUCOSE CHALLENGE  
Lamar Hamil¹, Michelle A. Tucci¹, Hamed A. Benghuzzi², Zelma Cason¹, Kenneth R.  
Butler¹  
¹University of Mississippi Medical Center, Jackson, MS  
²Global Training Institute, Flowood, MS  
³Mississippi College, Clinton, MS  
kbutler@umc.edu |
| 5:15      | 9-2          | TN HYDROGELS AS A POTENTIAL ANTI-INFLAMMATORY DRUG  
DELIVERY SYSTEM TARGETED TO OSTEOARTHRITIC KNEES  
Katlynn Bussett, Katherine Goebel, Victoria Lee, Lindsey Alumbaugh  
Rose-Hulman Institute of Technology, IN, USA  
bussetkn@rose-hulman.edu |
| 5:30      | 9-3          | MAGNETIC NANOPARTICLES BASED DRUG DELIVERY TO ABATE  
NOXIOUS PAIN  
Adithya Mohandass  
University of Wyoming School of Pharmacy, WY, USA  
amohandass@uwyo.edu |
| 5:45      | 9-4          | PROBING CLINICAL RELEVANCE: ESTABLISHING THE EFFICACY OF C.  
NOVYI AGAINST A PANEL OF 2D CULTURED PANCREATIC CANCER CELLS  
K.M. Dailey, R.I.Jacobson, J. Kim, S. Malik, A.E. Brooks  
North Dakota State University, ND, USA  
kdail@ndus.edu |
| 6:00-6:15 |              | BREAK                                                   |
Rob Streeter, Ph.D. candidate.
University Colorado, Boulder, CO, USA

Title: “Stories from the South Pole”

Rob Streeter received B.S. degrees in Electrical as well as Computer Engineering from the University of Wyoming in 2011, and a M.S. in Electrical Engineering from the same school in 2013. He has worked on UAS decision-making algorithms and test protocols for the U.S. Air Force Academy as a Research Engineer; LMR and IP system design, deployment, and maintenance for public and private entities with Ryan Electronics, Inc.; and in 2017/18 was a winter-over Research Associate at the Amundsen-Scott South Pole Station (under employment by Leidos for the Antarctic Support Contract, which is operated by the NSF). Rob started his Ph.D. studies at the University of Colorado at Boulder in 2019 and is focusing on the development of a passive, non-invasive internal temperature sensor leveraging a near-field surface probe and attached radiometer to determine tissue temperature based on measured thermal noise.

Awards Ceremony
Program Chairs Remarks
President Remarks
RMBS Torch Relay (Introduction to 59th Annual RMBS Meeting 2022)
~9:00 PM EDT: Platform Closes
ABSTRACTS
Thursday, April 8, 2021

Session 1: Clinical Bioengineering

UNDERSTANDING THE ROLE OF Y1-R IN INTERVERTEBRAL DISCS
Michelle Tucci, Ph.D.
University of Mississippi Medical Center, Jackson, MS., USA
mtucci@umc.edu

Degenerative disc disease is a leading source of pain as well as increased health care costs in the United States, and research efforts into understanding the pathophysiology of this disease is necessary for the development of new management strategies. The current modalities of treating symptomatic degenerative disc disease are either conservative non-surgical or surgical modalities. However, none of these modalities is a true cure for the degenerative process. Ideally, the best treatment would be preventing the progression of degeneration. The goal of our research is to identify factors that may slow or stop the degenerative process. Recently we have shown the presence of NPY Y1 Receptors located in the annulus of the intervertebral disc. This talk will focus on the role of the Y1 receptor in pain and repair.

USING NECK DISABILITY INDEX, NUMERICAL PAIN RATING SCALE AND COMPUTERIZED DYNAMIC POSTUROGRAPHY TO ASSESS CORTICAL INTEGRATIVE THERAPY IN PRACTICE BASED CLINICAL RESEARCH
Victor M. Pedro1,2, Richard Lyons1 and Elena Oggero3,4
1International Institute for the Brain, New York, NY
2Director of Rhode Island Integrated Medicine, Cranston, RI
3Electrical and Computer Engineering Department, University of Wyoming, Laramie, WY
4Vestibular Technologies, LLC, Cheyenne, WY
vpredo@brainmrv.org

In this retrospective study of adult patient’s charts from an outpatient clinical practice, three tools, Neck Disability Index (NDI), Numerical Pain Rating Scale (NPRS), and Computerized Dynamic Posturography (CDP), were investigated to evaluate how they are affected by demographics, anthropometry and clinical status, and if they can detect the effects of Cortical Integrative Therapy (PedroCIT®) received by these patients all affected by neck pain. The results show that they are robust metrics not affected by sex, age, payee’s type, treatment duration, or comorbidities number. CDP is affected by the primary diagnosis (traumatic brain injury/concussion, vertigo/dizziness, migraine/headaches, or other), NDI and NPRS are not. Whereas NDI and NPRS could be used interchangeably as an overall measure of the pain the patient is experiencing, their results do not correlate in general with CDP, indicating the need to use both a subjective (NDI or NPRS) and an objective tool (CDP) as they capture different aspects: how the subject rates its ability to perform daily activities and how much pain it feels, and how the postural control system maintains balance. When considering the time constraint physicians often face when dealing with patients, this chart review points toward the possibility of using the simple NPRS as subjective measure of pain, and only one instead of several CDP tests to determine the pre-post effect of a therapy. Future studies evaluating PedroCIT® outcomes for specific diagnoses in larger populations, multiple location settings, and observation for longitudinal cohesion are needed before these metrics can be fully endorse.

PROPORTION AND CHARACTERISTICS OF NEW PATIENTS WITH CENTRAL SENSITIZATION PRESENTING TO A CHIROPRACTIC PRACTICE - A CROSS-SECTIONAL OBSERVATIONAL STUDY
Paul Noone1, Guido Pagnacco2,3, and Elena Oggero3,4
1Small Street Clinic, Hampton, Melbourne, Australia
2Electrical and Computer Engineering Department, University of Wyoming, Laramie, WY.
3Vestibular Technologies, LLC, Cheyenne, WY, USA
Pinoone1@gmail.com

Central Sensitization (CS) is postulated as a central explanation of chronic pain. Clinical researchers recommend that therapists screen for CS to avoid diagnostic confusion and improve the allocation of appropriate clinical resources in primary care settings when managing chronic pain patients. However, the percentage of patients presenting with CS to a chiropractic practice has not been found in the literature. This study had two objectives: to use the Central Sensitization Inventory (CSI) to screen for and identify the proportion and characteristics of consecutive new patients with chronic pain conditions and medically unexplained symptoms who are experiencing CS, and to determine if there were significant clinical relationships between patient characteristics (age, sex, BMI, complaint type and duration, balance issues and presence of comorbid overlapping CS syndromes) and CSI scores. Results indicated that 1 in 5 adult new patients may have experienced CS. ANOVA analysis revealed significant difference between fibromyalgia and chronic spinal pain patients; significant difference due to subjective dizziness; significant difference between the number of positive answers in the CSI-Part B for CS-40 subjects and subjects with 2 or more positive answers on CSI Part B compared to those with none/one positive answer. Chiropractors should consider using a validated CS screening tool, such as the CSI, for all new patients, and implementing adjunctive, evidence-based CS clinical management strategies.

CORTICAL INTEGRATIVE THERAPY EFFECTIVENESS IN THE TREATMENT OF VERTIGO/BALANCE ISSUES
Victor M. Pedro1,2 and Elena Oggero3,4
1International Institute for the Brain, New York, NY
2Director of Rhode Island Integrated Medicine, Cranston, RI
3Electrical and Computer Engineering Department, University of Wyoming, Laramie, WY
4Vestibular Technologies, LLC, Cheyenne, WY
vpredo@brainmrv.org

Primary care physicians see a very high incidence of vertigo, dizziness, and balance issues resultant from a broad spectrum of etiologies from frank vestibular dysfunction, brain injury, neck trauma, metabolic diseases to autonomic dysfunction and psychological conditions. Because dizziness is by definition a subjective condition, self-report questionnaires such as the Dizziness Handicap Index (DHI) are commonly utilized in assessing the impact of vestibular dysfunction in patients. However, objective metrics like Computerized Dynamic Posturography (CDP) can be useful tools for the assessment of dizziness and the validation of diagnoses and treatment effectiveness. In this retrospective study of 50 patients charts, the effectiveness of Cortical Integrative Therapy (PedroCIT®) was evaluated using the DHI and CDP. In particular, the therapy outcome was investigated to determine if it was affected by a vertigo diagnosis, a vertigo comorbidity or by the simple presence of vertigo symptoms. The result of this investigation showed that PedroCIT® is indeed an effective treatment method for vertigo and dizziness: subjects demonstrated and reported improvement in their clinical outcomes, and both CDP and DHI metrics in general reflected the significant improvement the subject experienced. For those subjects that still were in the worse categories according to the CDP and DHI metrics, the effect of treatment were potentially influenced by uncontrolled variables such as a change in medications, mental status, or concomitant worsening in the subject’s comorbidities, amongst other unknown variables contributing to individual unsatisfying outcomes. Further studies involving larger number of subjects are needed to address these issues.

CELECOXIB REDUCES NEONATAL SYSTEMIC LIPOPOLYSACCHARIDE-ENHANCED ADULT VULNERABILITY OF NIGROSTRIATAL DOPAMINERGIC SYSTEM TO ROTENONE NEUROTOXICITY
University of Mississippi Medical Center, MS, USA
bwfan@umc.edu

Chronic neuro-inflammation has been proposed to play an important role in the development of neurodegenerative disorders. Our previous study showed that perinatal lipopolysaccharide (LPS) exposure induced a chronic neuro-inflammation that could persist into adulthood. For example, a chronic activation of cyclooxygenase-2 (COX-2) cells were found to be associated with increased vulnerability of dopamine neurons to rotenone, a commonly used pesticide. Therefore, the
objective of this study was to test whether celecoxib, a selective COX-2 inhibitor, attenuates LPS-induced motor behavioral dysfunction and LPS-enhanced susceptibility to rotenone toxicity later in life. LPS (2 mg/kg) or saline was Intrapitoneal (i.p.) injected to postnatal day 5 (P5) Sprague-Dawley male rats. On P70, rats were challenged with rotenone through subcutaneous mini-pump infusion (1.25 mg/kg per day for 14 days), and celecoxib (20 mg/kg) or vehicle were administered (po) daily for 14 days. Motor behavioral tests were carried out from P70 to P98 and brain injury was examined on P98. Our results showed that celecoxib ameliorated neurobehavioral impairments, brain injury, and microglial activation in the substantia nigra upon LPS+rotenone double hit challenge. Our study suggests that celecoxib has protective effects against perinatal brain inflammation-enhanced adult susceptibility to environmental toxin-induced neurodegenerative disorders by blocking cyclooxygenase-2 (COX-2)-activation.

(Supported by NIH grant NH/NINDS R01NS080844 and NIH-NIGMS-P20GM121334-MSCEPR-COBRE, and Newborn Medicine Funds from the Department of Pediatrics, University of Mississippi Medical Center)

NEONATAL SYSTEMIC EXPOSURE TO LIPOPOLYSACCHARIDE ENHANCES ADULT VULNERABILITY TO THE NEURODEGENERATIVE DISORDER INDUCED BY PARAQUAT
Lir-Wan Fan, Silu Lu, Jonathan W Lee, Yi Pang, Shuying Lin, Norma B Ojeda, Michelle A Tucci, Nilesh Dankhara, and Lu-Tai Tien
University of Mississippi Medical Center, MS, USA
lwfan@umc.edu

We have previously shown that neonatal intracerebral injection of lipopolysaccharide (LPS) increases the risk of rotenone (a commonly used pesticide)-induced dopaminergic damage in adult rats. This study was designed to further test whether neonatal systemic LPS exposure also increases the vulnerability of adult dopaminergic neuron to paraquat, a widely used herbicide. LPS (2 mg/kg) was administered intraperitoneally into postnatal day 5 (P5) rats. On P70, rats were challenged with paraquat through subcutaneous mini-pump infusion at a dose of 0.3 mg/kg per day for 14 days. This paraquat treatment regimen ordinarily does not produce toxic effects on behaviors in normal adult rats. However, LPS pre-exposed rats developed Parkinson’s disease-like motor neurobehavioural impairments after paraquat treatment, including bradykinesia (prolongation of the movement time), akinesia (prolongation of the reaction time), and rigidity (increase in muscle tone or magnitude of stretch reflexes). Structural examination of the nigrostriatal pathway revealed that neonatal LPS exposure enhanced paraquat neurotoxicity to cause a significant loss of tyrosine hydroxylase immunoreactive neurons in the substantia nigra, and a decrease in retrogradely labeled nigrostriatal projection. Our results indicate that perinatal brain inflammation may cause the nigrostriatal system in the adult brain to become more vulnerable to damage by environmental toxins at an ordinarily non-toxic or sub-toxic dose, leading to the development of Parkinson’s disease-like motor dysfunction and pathological features.

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Session 2: Radiology/Signals and Sensors

ASSESSMENT OF ASYMMETRY IN BILATERAL STATIC FRONTAL BREAST THERMOMGRS USING DIFFERENCE IMAGE AND RADIOMIC FEATURES
Vijaya Madhavi M and T. Christy Bobby
East Point College of Engineering and Technology, Bengaluru, India
vijayamadhavihv79@gmail.com

Asymmetry analysis of bilateral thermogram images is an important preliminary approach for breast cancer detection. The purpose of this work is to develop an automated algorithm to detect and classify symmetric and asymmetric bilateral static frontal breast thermograms (N=63). The images are pre-processed using anisotropic diffusion filter for removal of noise. Further, segmentation of complete breast region is carried out using level set segmentation without re-initialization. The bifurcation point is computed from the intersection point of interior inflammamatory curves attained using polynomial curve fitting on the boundary pixels. The obtained breast region is sliced vertically along this bifurcation point to obtain right and left breast sections. Image subtraction is performed between right breast image and flipped left breast image to obtain the difference image. The obtained difference image is sharpened and 144 texture features such as first-order statistical, co-occurrence, run length and laws energy features are extracted and Absolute Difference (AD) between symmetric and asymmetric subjects for each feature is computed. The features for which the value of AD is greater than 0.1 is considered as substantial features. Twenty four substantial features are obtained and are given as an input to Least Square Support Vector Machine (LSSVM) to automate the classification. The results shows that the maximum segmentation overlap measure obtained is 98.3%. The classification accuracy obtained using LSSVM with Radial Basis Function (RBF) is 95.65% and sensitivity, specificity and Area Under the Curve (AUC) are 100%, 90.9% and 0.9545 respectively. Thus the proposed methodology appears to be effective in detecting asymmetric heat patterns and hence can be deployed in thermal screening systems.

ANALYSIS OF MEDIASTINUM IN TUBERCULOSIS CHEST RADIOGRAPHIC IMAGES USING LEVEL SET SEGMENTATION AND SHAPE CHARACTERIZATION
Sukanta Kumar Tulo, Satyavartan Govindarajan, Palaniappan Ramu, Ramakrishnan Swaminathan
Indian Institute of Technology Madras, Chennai, India
sukant.99@gmail.com

Mediastinum is considered as one of the substantial anatomical regions for the gross diagnosis of several chest related pathologies. The geometric variations of the mediastinum in Chest Radiographs (CXRs) could be utilised as potential image markers in the early detection of Tuberculosis (TB). This study attempts to segment mediastinum in CXRs using level sets for the shape characterization of TB conditions. The CXR images for this study are considered from a public database. An edge-based distance regularized level set evolution is employed to segment the lungs followed by a region-based Chan-Vese model that extracts mediastinum region. Features such as mediastinum area and lungs area are extracted from the segmented images. Further, mediastinum to lungs area ratio is calculated. Statistical analysis is performed on the features to differentiate normal and TB images. Results show that the proposed segmentation approach is able to segment the lungs and extract the mediastinum in CXRs. It is found that features namely mediastinum area and mediastinum to lungs area ratio are statistically significant in the differentiation of TB. Larger mediastinum area is observed in TB images as compared to normal. The performance of lung field segmentation is also observed to be in line with the literature. The mediastinum segmentation approach in CXRs obtains to be a novel method as compared to the existing methods. As the proposed approach based on mediastinum image analysis provides better shape characterization, the study could be clinically useful in the differentiation of TB conditions.

RADIOIMICS BASED BREAST MALIGNANCY INDEX TO DIFFERENTIATE PATHOLOGICAL CHANGES DUE TO NEOADJUVANT CHEMOTHERAPY
Priscilla Dinkar Moyya, Mythili Asaithambi, Anandh Kilpattu Ramanikan
Vellore Institute of Technology, India
priscilladinkar@gmail.com

The leading cause of deaths among women in the world is Breast Cancer. Neoadjuvant chemotherapy (NAC) offers effective treatment results, thus reducing tumor aggression and allowing treatment monitoring. The Dynamic Contrast Enhanced (DCE) MRI plays a vital role in assessing the treatment response due to NAC. However, quantifying the treatment response in low-grade tumours is visually challenging. Radiomics is an evolving field of medical imaging that reflects the histopathological variations in breast tissues. Integrating radiomics with breast DCE-MRI provides clinically useful measures in
evaluating the NAC response. In this work, we have formulated an index called Radiomics based Breast Malignancy Index (RBMI) using texture and Haar wavelets to differentiate the radiological differences of breast tissue due to NAC. The statistically significant radiomic features extracted from 20 DCE-MR images obtained using TCIA database were used in the calculation of RBMI. Results show that, RBMI could statistically differentiate (p=0.007) the treatment response between visit-1 & 2 due to NAC with mean and standard deviation values of 334706.59 ± 93952.51 and 296354.97 ± 7710.61 respectively. Hence, RBMI seems to be a clinically adjunct measure in evaluating the treatment response of breast cancer due to NAC.

RADIOMICS BASED SINGLE AND MULTI-CLASS GLIOMA CLASSIFICATION USING SUPPORT VECTOR MACHINE VARIANTS
Seema P. D., Christy Bobby T and Anandh K.R.
Ramathal University of Applied Sciences, India
seenap66@gmail.com

The common type of primary brain tumor is glioma. The mortality rate of glioma patients is high due to delayed diagnosis, incorrect grading and treatment planning. Traditionally, gliomas were classified into Low Grade (grade-I and grade-II) and High Grade (grade-III and grade-IV). However, World Health Organization has insisted to classify the grades into grade-I(G-I), grade II(G-II), grade III(G-III) and grade IV(G-IV) individually to aid the physicians in clinical decision-making. Although there are limited number of studies reported to differentiate individual grades, the classification accuracy was low. Consequently, in this work single-class (G-II vs. G-III, G-II vs. G-IV and G-III vs. G-IV) and multi-class (G-II vs. G-III+IV, G-III vs. G-II+IV and G-IV vs. G-II+III) analysis was performed using specific region of tumor and whole brain as Regions of Interest(ROI) by extracting radiomic features. The images for this study (N=75) were obtained from The Cancer Imaging Archive. Further, the statistically significant features were used in the classification of individual grades by implementing variants of Support Vector Machine (SVM) algorithm: SVM, Linear-SVM and Least-Squared SVM. Among these, Linear-SVM resulted in the highest classification accuracy (>80%) with average sensitivity, specificity and AUC values of >70%. The comparative analysis of whole brain versus tumor ROI showed that the latter yielded better classification accuracy.

ROTATIONAL MOMENT SHAPE FEATURE EXTRACTION AND DESICION TREE BASED DISCRIMINATION OF MILD COGNITIVE IMPAIRMENT CONDITIONS USING MR IMAGE PROCESSING
Ravi Dadseu, Deboleena Sadukhan and Ramakrishnan Swaminathan
Indian Institute of Technology Madras, India
ravidaseu34@gmail.com

Mild Cognitive Impairment (MCI) is the preclinical, asymptomatic stage for Alzheimer’s condition, which affects a large amount of the aging population around the world. Detection of MCI condition can ensure timely intervention needed for handling the disease severity. Morphological alterations of the Lateral Ventricle (LV) are considered a significant biomarker for diagnosing MCI conditions. This work aims at analyzing the shape alterations of LV from brain Magnetic Resonance (MR) images using Rotational moment shape features and differentiating MCI conditions using Decision Tree (DT) based classification. Trans-axial brain MR images are obtained from a publicly available OASIS database. Segmentation of LV is performed using the Reaction Diffusion level set, and the results are validated against Ground Truth. Rotational moment shape features are extracted from the segmented LV images. DT is implemented for the differentiation of control and MCI subjects. Results show that Rotational moment shape features are able to capture the alterations of LV in control and MCI subjects (p<0.05). The classification model achieves a high detection accuracy of 96.73% and an F-measure of 96.82%. Hence, the proposed method can be used as an automated diagnostic tool to predict and monitor the cognitive decline in MCI subjects and can aid in disease management.

Friday, April 9, 2021
Session 3: Biosensors
FRACATL ANGLE BASED DIFFERENTIATION OF TERM PREGNANCIES USING UTERINE ELECTROMYOGRAPHIC SIGNALS
P. Vardhini and S. Ramakrishnan
Indian Institute of Technology Madras. India
nivardhini@gmail.com

Uterine Electromyography (uEMG) is a non-invasive technique that provides quantitative measure of uterine activity from the abdominal surface. In this work, an attempt has been made to investigate Term (gestational age > 37 weeks) uEMG signals using Adaptive Fractal Analysis (AFA). For this, the signals obtained during second and third trimesters are subjected to AFA. The fluctuation function is computed and the corresponding linear scaling regions are identified based on coefficient of determination and standard error of slope. Angle-based features from multiple scaling regions namely, inter-fractal angle, short-term (uHs) and long-term (uHL) fractal angles are extracted and are used for further analysis. Results show that AFA is able to characterize Term signal fluctuations during varied gestational ages. All features show significant differences (p < 0.05) in both groups. Feature values suggest that the third trimester signals possess smoother fluctuations than second trimester signals. This is attributed to the increased coordination of uterine contractions as delivery approaches. Hence, it appears that the proposed adaptive angle-based fractal features could be potential biomarkers in analyzing the muscle contractions during Term pregnancies.

VARIATION OF INSTANTANEOUS SPECTRAL CENTROID ACROSS BANDS OF SURFACE ELECTROMYOGRAPHIC SIGNALS
Divya Bharathi Krishnamani, Karthick P.A., Ramakrishnan Swaminathan
Indian Institute of Technology Madras, India
divyakoO93@gmail.com

Surface electromyography (sEMG) is a technique which noninvasively acquires the electrical activity of muscles and is widely used for muscle fatigue assessment. This study attempts to characterize the dynamic muscle fatigueing contractions with frequency bands of sEMG signals and a geometric feature namely the instantaneous spectral centroid (ISC). The sEMG signals are acquired from biceps brachii muscle of fifty-eight healthy volunteers. The frequency components of the signals are divided into low frequency band (10-45Hz), medium frequency band (55-95Hz) and high frequency band (95-400Hz). The signals associated with these bands are subjected to a Hilbert transform and analytical shape representation is obtained in the complex plane. The ISC feature is extracted from the resultant shape of the three frequency bands. The results show that this feature can differentiate the muscle nonfatigue and fatigue conditions (p<0.05). It is found that the values of ISC is lower in fatigue conditions irrespective of frequency bands. It is also observed that the coefficient of variation of ISC in the low frequency band is less and it demonstrates the ability of handling inter-subject variations. Therefore, the proposed geometric feature from the low frequency band of sEMG signals could be considered for detecting muscle fatigue in various neuromuscular conditions.

FEATURES SELECTION FOR FACIAL EMOTION RECOGNITION IMPROVEMENT FROM FACIAL ELECTROMYOGRAPHY
National Institute of Technology, Tiruchirappalli, India
desouzanto@gmail.com

The research on facial Electromyography (EMG) based emotion recognition plays a significant role in myoelectric control systems. In this work, an attempt has been made to recognize the emotions from the time-domain features of facial EMG signals. For this research, the signals recorded from the Zygomaticus major muscle of 32 subjects are analysed. These signals are collected from publicly available DEAP database. In this work, the effective dimensions, namely valence and arousal, are analysed and categorized into positive and negative classes based on the participant ratings. The features,
Alzheimer’s Disease (AD) is an irreversible, progressive neurodegenerative disorder affecting a large population worldwide. Automated diagnosis of AD using Magnetic Resonance (MR) imaging-based biomarkers plays a crucial role in disease management. Compositional changes in cerebrospinal fluid due to AD might induce textural variations in Lateral Ventricles (LV) of the brain. In this work, an attempt has been made to differentiate Alzheimer’s condition by quantifying the textural changes in LV using Kernel Density Estimation (KDE) technique. Reaction-Diffusion level set method is used to segment the LV from T1-weighted trans-axial brain MR images obtained from a publicly available database. Spatial KDE is used to analyze the local intensity variations within the segmented LV. The optimal kernel function and bandwidth are selected for KDE. The statistical features such as mean, median, standard deviation, variance, kurtosis, skewness and entropy, representing the distribution of KDE values within LV, are evaluated. The extracted KDE-based statistical features show significant discrimination between normal and AD subjects (p<0.01). An accuracy of 86.20% and sensitivity of 96% are obtained using SVM classifier. The results indicate that KDE seems to be a potential tool for analyzing the textural changes in brain, and thus can be clinically relevant for diagnosis of AD.

Session 4: Neurobiology

LATERAL VENTRICLE TEXTURE ANALYSIS IN ALZHEIMER BRAIN MR IMAGES USING KERNEL DENSITY ESTIMATION
Deboleena Sadhukhan, Amrutha Veluppul, Anandh Kilpattu Ramanan, and Ramakrishnan Swaminathan
Institute of Technology, Madras, Chennai, India
deboleena.rainbow@gmail.com

Alzheimer’s Disease (AD) is an irreversible, progressive neurodegenerative disorder affecting a large population worldwide. Automated diagnosis of AD using Magnetic Resonance (MR) imaging-based biomarkers plays a crucial role in disease management. Compositional changes in cerebrospinal fluid due to AD might induce textural variations in Lateral Ventricles (LV) of the brain. In this work, an attempt has been made to differentiate Alzheimer’s condition by quantifying the textural changes in LV using Kernel Density Estimation (KDE) technique. Reaction-Diffusion level set method is used to segment the LV from T1-weighted trans-axial brain MR images obtained from a publicly available database. Spatial KDE is used to analyze the local intensity variations within the segmented LV. The optimal kernel function and bandwidth are selected for KDE. The statistical features such as mean, median, standard deviation, variance, kurtosis, skewness and entropy, representing the distribution of KDE values within LV, are evaluated. The extracted KDE-based statistical features show significant discrimination between normal and AD subjects (p<0.01). An accuracy of 86.20% and sensitivity of 96% are obtained using SVM classifier. The results indicate that KDE seems to be a potential tool for analyzing the textural changes in brain, and thus can be clinically relevant for diagnosis of AD.

SEGMENTATION OF CORPUS CALLOSUM AND LATERAL VENTRICLE STRUCTURES IN ALZHEIMER MR IMAGES USING SPATIAL FUZZY CLUSTERING BASED LEVEL SET
S Reelakshmi and S Ramakrishnan
Indian Institute of Technology Madras, India
lakshminair.here@gmail.com

Alzheimer’s Disease (AD) is an irreversible neurodegenerative disorder that affects brain structures. Corpus Callosum (CC) atrophy and Lateral ventricle (LV) enlargement are useful structural biomarkers in distinguishing the preclinical stages of AD. The shape of CC appears to be homogeneous from normal controls to AD images and LV shows shape dissimilarity across subjects. Therefore, effective methods to segment CC and LV are essential to characterize the magnitude of morphometric changes. In this study, an attempt has been made to segment CC and LV from MR brain images using the Spatial Fuzzy Clustering based Level Set (SFC-LS) method. For this, T1-weighted MR images of AD, Mild Cognitive Impairment (MCI), and normal controls are obtained from a public database. Spatial fuzzy clustering forms the initial contour for the level set and regularizes the evolution of curve. The segmented images are validated against ground truth using standard measures. Results indicate that SFC-LS is able to segment CC and LV with automated contour initialization. The final contours obtained are sharp and distinct with a high validation performance of accuracy and specificity greater than 97% for normal controls, MCI, and AD. A dice score of 83% and 84% is achieved in segmenting CC and LV respectively. As structural changes in CC and LV have the potential to predict the early stages of AD, the proposed approach seems to be clinically significant.

CORTICAL INTEGRATIVE THERAPY EFFECTIVENESS IN THE TREATMENT OF POST-CONCUSSION SYNDROME AND MILD TRAUMATIC BRAIN INJURY
Victor M. Pedro1,2 and Elena Oggero1,4
1International Institute for the Brain, New York, NY
2Director of Rhode Island Integrated Medicine, Cranston, RI
3Electrical and Computer Engineering Department, University of Wyoming, Laramie, WY
4Vestibular Technologies, LLC, Cheyenne, WY
vpedro@ibraininfo.org

Post-Concussion Syndrome (PCS) is a relatively prevalent condition that emerges after sustaining a head injury. Individuals with PCS experience prolonged impairments and distress associated with the injury which can impact the individuals’ quality of life experiences. In this retrospective chart review of refractory adult patients diagnosed with PCS and mild Traumatic Brain Injury (mTBI), the effectiveness of Cortical Integrative Therapy (PedroCIT®) was investigated by comparing measures of postural stability, brain sequencing and timing, and self-reports of physical and psychosocial symptoms of PCS obtained before and after PedroCIT®. Multivariate and Repeated Measures General Linear Models showed improvements across the measures from before to after treatment in all subjects. The improvement in postural stability, brain sequencing and timing, and self-reported symptoms for patients affected by PCS and mTBI, and treatment outcomes were largely not contingent upon the severity of the condition at the beginning of treatment. Altogether, this prospective study suggests that refractory individuals affected by PCS and mTBI can benefit from undergoing PedroCIT® and their treatment outcomes may not be related to the degree of impairment presented at the beginning of treatment.

NEONATAL LIPOPOLYSACCHARIDE EXPOSURE INTERFERES WITH REM SLEEP AND HOMEOSTATIC RESPONSES TO SLEEP DISTURBANCES IN ADOLESCENT RATS
University of Mississippi Medical Center, MS, USA
lwfan@umc.edu

Inflammation may play an important role in the association between sleep disturbances and PD development. Our previous study showed that perinatal lipopolysaccharide (LPS) exposure induced chronic neuroinflammation, which was associated with enhanced adult susceptibility to develop neurodegenerative disorders triggered by environmental insults. The objective of the current study was to examine whether perinatal systemic LPS exposure results in chronic inflammation, neurodegeneration, and related sleep disturbances later in life. Intraperitoneal (i.p) injections of LPS (2 mg/kg) or saline was performed on postnatal day 5 (P5) Sprague-Dawley male rat pups, and surgery/sleep recording electrode implantation was conducted on P39. A sleep baseline recording was started on P46 for 24 hours, sleep disturbances were conducted on P47 consisting of automatically, remotely shaking the recording cage for 1-1.5s every 5 min for 24 hours, and recovery sleep was recorded on P48 for 24 hours. The brain inflammation and neuronal damage were examined at P49. Our results showed that neonatal LPS treatment interfered with REM sleep and sleep homeostatic responses (recovery sleep) to sleep disturbance in adolescent rats (P49). Neonatal LPS treatment also induced chronic
microglia activation (Iba1+) and brain damage including the loss of TH+ neurons in the locus coeruleus of the P49 rat brain. These data suggest that neuroinflammation initiated at early development persists in adolescent age, which may contribute to neurodegeneration and sleep disturbances by disrupting sleep homeostatic responses, namely, recovery sleep. Our results underscore the importance of studying the sleep biological mechanisms involved in the pathogenesis in locus coeruleus TH+ neuronal injury induced by infection/inflammation, which could lead to development of potential therapeutics to improve degraded sleep in inflammatory-driven PD models. (Supported by NIH grant NIH/NINDS R01NS080844 and NIH-NIGMS-P20GM121334-MSCEP-COBRE, Brain Wellness Constellation (BWC) Neuroscience Summer Research Education Program, University of Mississippi, and Newborn Medicine Funds from the Department of Pediatrics, University of Mississippi Medical Center)

INTRANASAL INSULIN REDUCES IMPAIRED NEUROBEHAVIORAL OUTCOMES AND BRAIN INFLAMMATION FOLLOWING LIPOPOLYSACCHARIDE EXPOSURE IN NEONATAL RATS
University of Mississippi Medical Center, MS, USA
lwfan@umc.edu

Inflammation and oxidative stress play important roles in neonatal brain damage. Previous studies from our lab showed that systemic administration of lipopolysaccharide (LPS) induces brain damage and neurobehavioral dysfunction in neonatal rats, which is associated with the production of pro-inflammatory cytokines and oxidative stress. Recent studies suggest that intranasal insulin treatment could be a neuroprotective agent in adult animals. Therefore, the objective of this study was to determine whether intranasal insulin treatment reduces LPS-induced brain inflammation and oxidative stress, and neurobehavioral dysfunction in neonatal rats. LPS (2 mg/kg) or sterile saline were Intraperitoneal (i.p.) injected to postnatal day 5 (P5) Sprague-Dawley pups, and recombinant human insulin (25 μg) or vehicle was administered to each nostril 5 min after LPS injection. Sensorimotor behavioral tests were carried out 24 hours after LPS exposure and brain tissues were collected to determine pro-inflammatory cytokine interleukin-1β (IL-1β) and lipid peroxidation on P6. Our results showed that the intranasal insulin reduced LPS-induced sensorimotor disturbances, indicated by improvement in righting reflex, negative geotaxis, wire hanging, and hind limb suspension tests at P6. Intranasal insulin also reduced LPS-induced increase in levels of IL-1β and thiobarbituric acid reactive substances (TBARS) contents, suggesting anti-inflammatory and anti-oxidative effects. Our study suggests that intranasal insulin afford a broad neuroprotection by targeting multiple signaling pathways including inflammation and oxidative stress.

(INTRASURAL INSULIN REDUCES IMPAIRED NEUROBEHAVIORAL OUTCOMES AND BRAIN INFLAMMATION FOLLOWING LIPOPOLYSACCHARIDE EXPOSURE IN NEONATAL RATS)

EVIDENCE-BASED, EFFICIENT MODEL OF SPEECH THERAPY AND PARENT EDUCATION SERVICE PROVISION IN THE SCHOOL SETTING FOR PARENTS OF CHILDREN WITH TRAUMATIC BRAIN INJURY
Katandria L. Johnson1, Victor M. Pedro1,2 and Elena Oggero1,4
1International Institute for the Brain, New York, NY, USA
2Director of Rhode Island Integrated Medicine, Cranston, RI
3Electrical and Computer Engineering Department, University of Wisconsin, Laramie, WY
4Vestibular Technologies, LLC, Cheyenne, WY, USA

Speech-language pathologists play a pivotal role in determining service delivery methods for students with speech, language, communication, and literacy challenges. Odd to the conventional service delivery methods within the public arena, one of such public service work independently through individual or small-group treatment sessions. However, the contemporary collaborative whole language approaches emphasize evidence-based practices to design and deliver a range of service delivery models that facilitate student participation, inclusion, social interaction, and parent education. Educating families of children with special healthcare needs has been an ongoing, evolving area. How to operationalize such education in a meaningful yet objective way brings it own challenges. Evidence-based research, a SWOT analysis, provider and parent inputs allows the iBRAIN speech department to identify its areas of growth and define an evidence-based model of speech therapy, and parent education services within the school setting for parents of children with traumatic brain injury. Speech materials, resources and brochures were developed to educate families through evidence-based counseling, Motivational Interviewing, provider authored data tracking forms and therapy materials. This program allowed iBRAIN speech department to implement an innovative methodology for meeting students’ needs for speech services at school and home.

Session 5: Bioinstrumentation

HUMAN FACTORS LEARNING CURVE FOR NOVEL FIREARM DESIGN USING GYROSCOPIC FEEDBACK INSTRUMENTATION
David Paulus Washington State University, WA, USA davidpaulus@hotmail.com

Researchers interested in evaluating the biomechanics and human factors associated with using a new product recognize that skill development with the novel design is time-dependent. A learning curve is a plot that shows the time to complete a task using the product decreases as the number of training repetitions increases. A novel thumb-operated trigger system (Iron Horse, Blackwater Worldwide™) has been developed for the AR-15 style rifle with the intent to shorten the learning curve. The purpose of this research effort is to quantify the learning curve for the new device and to compare it to that of a standard mil-spec (AR-15 style) trigger system. A previously-trained shooter dry-fire trained with both rifle systems for twenty consecutive days alternating lower receivers each day. The rifles were equipped with a gyroscopic instrument (Mantis X™) that tracked the movement of the firearm during the trigger pull process. The instrument has a timer to record the reaction time to an auditory signal for each shot, records the magnitude and direction of movement of the firearm, and calculates an accuracy score. There was not a significant difference (p>0.05) between the thumb operated and mil-spec triggers’ cycle times. However, the accuracy scores with the thumb operated trigger were significantly higher (p<0.05) than those with the mil-spec trigger.

VERIFICATION OF A BIOSENSOR DESIGN USED FOR DETECTING CHANGES IN PERMITTIVITY OF AQUEOUS MATERIALS DURING RADIO FREQUENCY WAVE EXPOSURE
Mary Pearson, Daniel Ewert, Ryan Striker, Benjamin Braaten North Dakota State University, ND, USA mary.pearson@ndsu.edu

The advancing field of biosensor design continues pushing for smaller, inexpensive, yet accurate sensor designs. A subset of biosensors operating in the radio frequency (RF) range of electromagnetic (EM) waves, called RF biosensors, offer appeal as a non-destructive, non-invasive form of sensing. A novel RF biosensor is proposed which detects changes in scattering parameter measurements of a microtube, aqueous material under test (MUT) held within a well adjacent to a microstrip transmission line. This sensing design measures scattering parameter data and changes in these measurements offer insight into the effects of RF wave exposure on dielectric materials within the well. The following paper describes design considerations and the sensing technique of the proposed RF biosensor. Simulations were run in incremental steps to first, establish the simulation design of a 50-ohm microstrip transmission line using two software packages ADS and Ansys HFSS. Next, experimental measurements were collected by milling the RF biosensor, first using air and then distilled water as the MUT, and finally comparing to simulations to establish validity of the novel sensing device. Next, experimental S-parameter measurements were obtained and compared between the two test cases to determine if a difference could be detected. Both simulated and experimentally
obtained measurements suggest the designed RF biosensor can detect changes in the MUT loaded inside its etched well and therefore can be used as a sensing device.

**MACHINE LEARNING BASED ON CT RADIOMIC FEATURES PREDICTS RESIDUAL TUMOR IN HEAD AND NECK CANCER PATIENTS TREATED WITH CHEMORADIOThERAPY**


Department of Radiology, 2Department of Radiation Oncology and, 3Department of Data Science, University of Mississippi Medical Center, Jackson, MS 39216, USA
eflorez@umc.edu

Surveillance imaging of HNSCC in patients treated with chemoradiotherapy suffers from difficulty in differentiating residual disease from radiation changes and inflammation. Thus, this study assessed ML models based on RadFs extracted from standard CT images pre- and post-chemoradiation to predict HNSCC treatment response. A retrospective analysis of HNSCC patients treated with definitive chemoradiotherapy at our institution between 2006 and 2015 was performed. Thirty-six patients with residual disease on CT scans of the soft tissue of the neck at a two-month interval- either in the primary site, nodal stations, or both- were enrolled. GTV contours from the treatment planning CT (CT1), post- treatment CT (CT2), and CT portion of the PET/CT (CT3) of the neck were exported to MatLab®, where 2D and 3D RadFs were extracted using different methods. Finally, ML models were used to identify the RadFs that predict changes and progression in HNSCC patients treated with chemoradiotherapy. SVM models using 2D RadFs, extracted from CT2, were associated with residual disease on PET/CT exams (AUC = 0.702). 2D RadFs extracted from PET/CT had moderate predictive ability to predict positive pathology for residual tumor (AUC = 0.667). NN and RF models of 3D RadFs extracted from CT2 and PET/CT had good and moderate predictive ability to predict positive pathology for residual tumor (AUC = 0.718 and 0.678, respectively). ML models using 2D and 3D RadFs derived from pre- and post-treatment CT data show promise for predicting residual tumor from radiation changes and inflammation in a small group of HNSCC cancer patients treated with chemoradiotherapy.

**CHARACTERIZING DRIVER TAKE-OVER ACCURACY: EFFECT OF AGE, SEX, STARTLE, AND SECONDARY TASK**

Valentina Graci, Meta Austin, Madeline Griffith, Rahul Akkem, Jalaj Maheshwari, Thomas Seearist, Kristy B. Arbogast

Center for Injury Research and Prevention, Children’s Hospital of Philadelphia, Philadelphia, PA, USA
GraciTV@chop.edu

The Acoustic Startling Pre-stimulus (ASPS, i.e. a loud sound preceding a physical perturbation) was previously found to accelerate take-over actions in adults but not teens in autonomous vehicle scenarios. It is not clear if the ASPS also influences the accuracy of the take-over response across ages and sexes. Therefore, the aims of this study are to characterize take-over accuracy across age/experience and sex and to examine the effect of the ASPS and a secondary task on steering wheel alignment in autonomous vehicle take-over scenarios. Fourteen adult (7 males) and 13 teenage (6 males) drivers volunteered for this study. Participants were instructed to align a marker on the steering wheel with a marker on a lateral post as fast as they could, when a sled perturbation started. Two of the conditions included the ASPS. Two of the conditions involved mobile text messaging while the sled started moving. The angle between the steering wheel and the lateral post was used to quantify overshooting, undershooting, or correct alignment during steering. Results showed that adult female subjects reached correct alignment slightly more frequently than any other group, while male adult drivers decreased their alignment error after the first trial. Both female and male adult drivers had a reduced alignment angle when the first trial had an ASPS compared to when the first trial had no ASPS while teen drivers performed similarly with ASPS or without. This study showed that take-over accuracy and steering control are influenced by sex, age/experience, and a startle-based warning.

**COMORBIDITY CHARACTERISTICS OF ADULT PATIENTS WITH REPORTED NECK AND LOW BACK COMPLAINTS-AN OUTPATIENT CLINICAL POPULATION BASED COHORT**

Victor M. Pedro and Elena Oggero

1International Institute for the Brain, New York, NY, USA
2Director of Rhode Island Integrated Medicine, Cranston, RI
3Electrical and Computer Engineering Department, University of Wyoming, Laramie, WY, USA
4Vestibular Technologies, LLC, Cheyenne, WY, USA
vedroo@ibrainny.org

In clinical practice, a comprehensive history and examination often includes questionnaires covering all systems. Physical examination is augmented by functional assessment using subjective (neck and lumbar disability indexes, NDI and LBDI respectively) and objective measures (computerized dynamic posturography, CDP). In this retrospective chart review of patients with complaints of postural instability and neck or low back pain, the presence and number of comorbidities and their classification were analyzed by age, gender, and severity of the disability. In general subjects showed higher disability in the NDI than in the LBDI (with more significant impact of the proximal vs. distal pain, joint and receptor dysfunction); they had a wide range of CDP results (the more difficult the test, the higher the number of subjects that were not able to complete it and the lower the number that had healthy balance); and on average 3.84 comorbid conditions were present, with 21 subjects presenting with 5 or more, 3 with 10 or more, and one reporting 15 comorbidities. No statistically significant differences were found for age, BMI and LBDI, sex and NDI affected metabolic comorbidities; certain tests of the CDP affected the Musculoskeletal and Other type of comorbidities. It was difficult to detect strong correlation trends that could be easily explained. Complex subjects cases complicate the possibility of doing practice based clinical research, but more importantly they create a challenge for the clinician in deciding the best course of action for treating the patient. New algorithmic assessments and integrated approaches are needed.

**SESSION 6: COMPUTATIONAL BIOENGINEERING I**

**INVESTIGATION OF SYNCHRONIZED ACQUISITION OF ELECTROCARDIOGRAM AND PHONOCARDIOGRAM SIGNALS TOWARDS ELECTROMECHANICAL PROFILING OF THE HEART**

Devanshi N. Damani, Divaakar Siva Sundaram, Shivam Damani, Anoushka Kapoor, and Shivaram P. Arunac

1,2Division of Cardiovascular & Interventional Radiology, Mayo Clinic, Rochester, WI, USA
damani.devanshi@mayo.edu

Cardiac diseases are the leading cause of death in the world. Electrocardiogram (ECG) and Phonocardiogram (PCG) signals play a significant role in the diagnosis of various cardiac diseases. Simultaneous acquisition of ECG and PCG signals can open new avenues of signal processing approaches for electromechanical profiling of the heart. However, there are no standard approaches to ensure high fidelity synchronous data acquisition to enable the development of such novel technologies. In this work, the authors report results on various data capture positions that could lead to standardization of simultaneous ECG and PCG data collection. Presence of lung sounds, variations in posture, depth and frequency of breathing can lead to differences in the ECG-PCG signals recorded. This necessitates a standard approach to record and interpret the data collected. The authors recorded ECG-PCG simultaneously in six healthy subjects using a digital stethoscope to understand the differences in signal quality in various recording positions (prone, supine, bending, semi recumbent, standing, left lateral and sitting) with normal and deep breathing conditions. The collected digitized signals are processed offline for signal quality using custom MATLAB software for SNR. The results indicate minimal differences in signal quality across different recording positions. Validation of this technique with larger dataset is required. Future work will investigate changes in characteristic ECG and PCG features due to position and breathing patterns.
DEEP LEARNING BASED DISCRIMINATION OF PHONOCARDIOGRAM SIGNAL WITH NORMAL HEART SOUNDS AND MURMUR: FEASIBILITY STUDY
Divakar Siva Baala Sundaram, Devanshi N. Damani, Anoushka Kapoor, Suganthi Shivaram and Shivaram P. Arunachalam
Mayo Clinic, Rochester, WI, USA
PojjaArunachalam.Shivaram@mayo.edu

Phonocardiogram (PCG) signal contains vital information regarding the heart condition of diagnostic importance. Several time series based algorithms are reported to obtain characteristic features of PCG signals to facilitate prognostication and diagnosis of various heart diseases with limited accuracy in classifying various heart sounds. Recently, machine learning based classification of PCG signals is gaining importance that can enable discriminating normal and diseased heart conditions. In this work, it was hypothesized that a deep learning model can discriminate normal heart sound and murmurs. 30 samples each of normal PCG and heart sound signals with murmurs from Peter Bentley Heart Sounds Database sampled at 44.1 kHz were used for analysis. A 4th order Butterworth low pass filter with cutoff frequency at 200 Hz was used to remove high frequency noise as suggested by the database. The spectrum of each PCG signal was obtained to train a convolutional neural network (CNN) model for classification. The dataset was divided into 60% training, 20% validation and 20% testing. Accuracy of 77% was achieved using the test data in classifying the PCG based on the spectrum. Validation of this technique with a larger dataset is required. The results motivate the analysis and comparison of normal PCG's with different cardiac conditions for cardiac disease diagnosis.

NON-HEADER IMPACT EXPOSURE AND KINEMATICS OF MALE YOUTH SOCCER PLAYERS
Declan A. Patton, Colin M. Huber, Susan S. Margulies, Christina M. Master, Kristy B. Arbogast
Center for Injury Research and Prevention, Children's Hospital of Philadelphia, Philadelphia, PA, USA
pattonda@chop.edu

Previous studies have investigated the head impact kinematics of purposeful heading in youth soccer; however, less than a third of all head injuries in youth soccer have been found to involve ball contact. The aim of the current study was to identify the head impact kinematics and exposure not associated with purposeful heading of the ball in male youth soccer. Headband-mounted sensors were used to monitor the head kinematics of male junior varsity and middle school teams during games. Video analysis of sensor-recorded events was used to code impact mechanism, surface and site. Junior varsity players had non-header impact rates of 0.28 per athlete-exposure (AE) and 0.37 per player-hour (PH), whereas middle school players had relatively lower non-header impact rates of 0.16 per AE and 0.25 per PH. Such impact rates fell within the large range of values reported by previous studies, which is likely affected by sensor type and recording trigger threshold. The most common non-header impact mechanism in junior varsity soccer was player contact, whereas ball-to-head was the most common non-header impact mechanism in middle school soccer. Non-header impacts for junior varsity players had median peak kinematics of 31.0 g and 17.4 rad/s. Non-header impacts for middle school players had median peak kinematics of 40.6 g and 16.2 rad/s. For non-header impacts, ball impacts to the rear of the head the highest peak kinematics recorded by the sensor. Such data provide targets for future efforts in injury prevention, such as officiating efforts to control player-to-player contact.

BREAST CANCER SEGMENTATION OF MAMMOGRAPHIC IMAGES USING GENERATIVE ADVERSARIAL NETWORK
Swathi N. and T. Christy Bobby
Ramaiyah University of Applied Sciences, India
swathi02murthy@gmail.com

Segmentation of breast cancer tumor plays an important role in identifying the location of the tumor, to know the shape of tumor and hence the stage of breast cancer. This paper deals with the segmentation of tumor from whole mammographic mass images using Generative Adversarial Network (GAN). A mini dataset was considered with mammograms and their corresponding ground truth images. Pre-processing like image format conversion, enhancement, pectoral muscle removal and resizing was performed on raw mammogram images. GANs have two neural nets called generative and discriminative networks that compete against each other to obtain the segmentation output. PI2PIX is a conditional GAN variant which has U-Net as the Generator network and a simple deep neural net as the discriminator. The input to the network was pair of pre-processed mass image and the associated ground truth. A binary image with highlighted tumor was obtained as output. The performance of GAN was evaluated by plotting Generator and discriminator loss. The segmented output was compared with corresponding ground truth. Metrics like Jaccard index, Jaccard distance and Dice-coefficient were calculated. A Dice-coefficient and Jaccard index of 90% and 88.38% was achieved. In future, higher accuracy could be achieved by involving larger dataset to make the system robust.

RECOGNITION OF EMOTIONS FROM TIME AND TIME-FREQUENCY FEATURES USING FACIAL ELECTROMYOGRAPHY SIGNALS
J. Shiva, N. Makaram, P. A. Karthick, R. Swaminathan
National Institute of Technology Tiruchirappalli, India
jayendhrashiva@gmail.com

The recognition of emotions plays a crucial role in healthcare and human-computer interaction. This paper reports an attempt to classify the emotional states using Facial Electromyography (facial EMG) using the affective dimensional approach. For this purpose, the facial EMG signals recorded from the zygomaticus major muscle are obtained from the publicly available DEAP database. These signals were collected from thirty-two healthy subjects, and participant ratings were recorded based on the affective dimensions. In this work, the two orthogonal dimensions, namely, valence and arousal, are considered for the analysis. The facial EMG signals are categorised into positive and negative classes in valence, and high and low classes in arousal dimensions based on the participant ratings. These signals are subjected to Short-Time Fourier transform, the mean and median frequencies are extracted from the instantaneous power spectrum. The statistical variations, namely mean and standard deviation of these features are computed. In addition, the time domain feature, root mean square of the facial EMG signal is extracted. The results indicated that most of the features could differentiate the two classes in both dimensions (p<0.05). The model developed using support vector machine achieved an accuracy of 67.24% and 60.08% for valence and arousal dimensions, respectively.

Poster Session
EXPERIMENTAL INVESTIGATION OF MASK USAGE ON PREVENTING PM 2.5 RELATED DISEASES IN THE CARDIOVASCULAR SYSTEM
Travis Huff1, Brianna Faull, Davis Payne1, Lillian Brown, and Peter Wahman1
1College of Engineering, North Dakota State University, Fargo, ND
2College of Engineering, University of North Dakota, Grand Forks, ND

Particulate matter PM 2.5 in air pollution presents a great concern to the health of an individual, specifically within the cardiovascular system. When PM 2.5 is inhaled, it can increase the likelihood of cardiovascular diseases. The goal of this project is to determine the effectiveness of face mask material in filtering PM 2.5. Research on how PM2.5 affects the cardiovascular system has been performed, but there is minimal research on how face masks aid in reducing PM2.5 inhalation. Most research is focused on how PM2.5 affects the pulmonary system, but the number one cause of death from air pollution is ischemic heart disease (34% of deaths). Our team has designed an experiment apparatus using rats to test the effectiveness of face masks in filtering PM2.5. The experiment includes an enclosure containing rats that has one hole on both ends. One end where PM2.5 is pumped into the enclosure after passing through a barrier consisting of face mask material. The other end contains a vacuum which will create airflow.
Pedicle screw fixations are commonly used in the treatment of spinal pathologies. For effective treatment, stable anchorage between the screw and bone is necessary. In this study, the influence of proximal and distal half angle of the screw, on the displacement of fixation and stress transfer are simulated using a 2D axisymmetric finite element model. A parametric study was performed by varying the proximal half-angle between 0° and 60° in steps of 10° and the distal half angles are considered as 30° and 40°. The material properties and boundary conditions are applied based on previous studies. Frictional contact is considered between the bone and screw. Results show that, displacement of fixation is observed to be minimum at a proximal half angle of 0° and maximum at an angle of 60°. High stress concentration is observed in first few threads with highest maximum von Misses stress at an angle of 60°. High stress transfer was obtained for proximal half-angles of 40° and 50°. It is observed that, this method might aid to develop better pedicle screws for treatment of Scoliosis

TRANSCEPTIVE ELECTRIC STIMULATION DECREASES NEUROPATHIC PAIN IN CHRONIC CONSTRICTION INJURY RAT MODEL
Xiaoli Dai; Lit-Wan Fan, Michelle Tucci; Min Huang, University of Mississippi Medical Center, MS, USA xldai@umc.edu

Purpose/Hypothesis: Neuropathic pain is one of the most suffered conditions in medical disciplines. Thus, management of neuropathic pain represents an emerging therapeutic challenge in clinical practice. A growing body of research evidence indicates that transcutaneous electric nerve stimulation (TENS) can be an effective modality in alleviating pain in a varieties of medical conditions including neuropathic pain. However, there is lack of quantitative research information regarding the effect of TENS on neuropathic pain. Therefore, the main purpose of this study was to determine whether TENS can reduce neuropathic pain in chronic constriction injury (CCI) rat model. Number of Subjects: Experiments were conducted in 12 adult Sprague Dawley (SD) rats. The rats were divided into two groups: control group (C, n=6) and TENS treatment group (TENS, n=6).

Materials/Methods: All rats were anesthetized in an induction chamber using 5% isoflurane in O2, then deliver 2% isoflurane while showering or performing other aquatic activities. The resultant acceleration was filtered using high and low pass Butterworth filters to determine dynamic and stationary activities. As a result, it was found that healthy young subjects performed significantly more dynamic activities (13.7%) when compared to PD subjects (7%) in contrast PD subjects (92.9%) had significantly more stationary activities than young healthy subjects (86.8%).

IN VITRO ANALYSIS OF UNIVERSALLY UTILIZED IMPLANT RESTORATIVE DENTAL MATERIAL’S IMPACT ON THE ARCHITECTURAL STABILITY OF GINGIVAL FIBROBLASTS IN THE PRESENCE OF A COMMON ENDOTOXIN
Angela D. Garner, Michelle A. Tucci, Hamed A. Benghuzzi University of Mississippi Medical Center, MS, USA adegarner@umc.edu

Dental implants have been utilized in the last several decades to replace missing teeth. Various factors may result in the loss of teeth. The most common causes of tooth loss are often caries or periodontal disease. The use of a dental implant restored with a porcelain fused to metal crown is often the standard. The purpose of this study was to assess the architectural integrity of gingival fibroblasts at the cellular level when exposed to universally utilized restorative dental material; porcelain, in the presence of a periodontal pathogen, Porphyromonas gingivalis lipopolysaccharide (LPS-PG). Human gingival fibroblasts were exposed to Porcelain (1 g) in combination with LPS-PG (10 µL), at 24, 48, and 72 hour durations. When assessing for cellular metabolic activity and viability, no significant differences were noted between the control and experimental groups. Contrastingly, when assessing for oxidative stress, the experimental groups were statistically significantly different from the control at the 48 and 72 hour phases (P<0.001). H&E staining of the experimental groups showed irregular shaped cells with loss of density, vacuolization, coarse cytoplasm, and hyperchromatic nuclei.
THE IMPACT OF MOTORCYCLE HELMET USE TO REDUCE TRAFFIC FATALITIES
Ham Benghuzzi, Chris Powe, Dennis Watts and Todd Barrett
Global Training Institute, Flowood, MS, USA

Introduction: The federal government estimates that per mile traveled in 2018, the number of deaths on motorcycles was nearly 27 times the number in cars. In the United States there is no universal helmet law. In twenty-two states, motorcycle helmets are entirely optional, while in nineteen states and the District of Columbia universal motorcycle helmets laws requiring helmets for all riders regardless of age are implemented and nine states only require younger motorcycle riders to wear a helmet, with varying age limits. Objectives: The overall objectives of this study were to evaluate the following: (1) number of fatalities (with and without helmet use), (2) mortality rate per motorcycle registration, (3) fatality percentage with age, (4) percent fatality due to alcohol impairment, and (5) location of collision impact to the rider in two southern states (Mississippi and Alabama) where helmet laws are established compared with a southern state (Florida) that only requires riders less than 20 years of age to be helmeted. Methods: Data from 2015-2018 were obtained from the National Highway Transportation Safety Administration Reporting System (FARS) and supplemented with state related and CDC data. Results: In all three states, the most common collision was a front-end impact. Mississippi had the highest percentage of motorcycle fatalities even with >80% of riders helmeted when the fatal accident occurred, followed by Florida motorcyclist who are only 50% of the time helmeted. In all three southern states similar percentage of fatalities were seen in each age group with higher fatalities associated with age range of 30-39 years. Conclusions: Variables such as helmet type, distance from a level 1 trauma center, poor roads, weather conditions, and visibility of the rider may also be factors that contribute to a higher incidence of fatality and need to be further investigated to improve motorcycle safety.

Saturday, April 10, 2021

Session 7: Computational Bioengineering I

EMOTION ANALYSIS USING SIGNAL AND IMAGE PROCESSING APPROACH BY IMPLEMENTING DEEP NEURAL NETWORK
S. Sushma, Christy Bobby and S. Malathi
Ramaiyah University of Applied Sciences, Bengaluru, India

Emotion recognition is important in human communication and to achieve a complete interaction between humans and machines. In medical applications, emotion recognition is used to assist the children with Autism Spectrum Disorder (ASD) to improve their socio-emotional communication, helps doctors with diagnosis of diseases such as depression and dementia and also helps the caretakers of older patients to monitor their well-being. This paper discusses the application of feature level fusion of speech and facial expressions of different emotions such as neutral, happy, sad, angry, surprise, fearful and disgust. Also, to explore how best to build the deep learning networks to classify the emotions independently and jointly from these two modalities. VGG-model is utilized to extract features from facial images, and spectral features are extracted from speech signals. Further, feature level fusion technique is adopted to fuse the features extracted from the two modalities. Principal Component Analysis (PCA) is implemented to choose the significant features. The proposed method could achieve a maximum score of 90% on training set and 82% on validation set. The recognition rate in case of multimodal data improved greatly when compared to unimodal system. The multimodal system gave an improvement of 9% compared to the performance of the system based on speech. Thus, result shows that the proposed multimodal emotion recognition (MER) outperform the unimodal emotion recognition system.

ANALYSIS OF CORTICOMUSCULAR COHERENCE BETWEEN CORTICAL AND LOWER LIMB MUSCLE ACTIVITIES
K. Arunaganes, N. Sivakumaran, S. Kumaravel, and P.A. Karthick
National Institute of Technology Tiruchirappalli, Tamilnadu, India

Stroke is one of the most common neurological disorders where the evaluation of functional connection between the motor cortex and muscle is essential. This corticomicuscular control is usually determined by measuring coherence in the simultaneously recorded electromyography (EMG) and electroencephalography (EEG) activities. In this work, an attempt has been made to estimate the EEG-EMG coherence using Magnitude Squared Coherence function. For this purpose, the simultaneous EEG-EMG activities of ten healthy subjects during standing, level walking, stair descending, stair ascending, ramp descending, and ramp ascending are considered. The EEG signals associated with the motor cortex region and EMG signal of Tibialis Anterior (TA) are subjected to magnitude squared coherence function. In addition, the interaction of conventional frequency bands of EEG, namely, alpha (8-12 Hz) and beta (14-30 Hz) spectral components with EMG signals are also analyzed. The results show that there exists notable coherence between the electrical activities of brain and muscular system during various activities. In addition, the frequency band interactions are also found to be distinct for different activities. Therefore, it seems that the analysis could be extended for the evolution of corticomicuscular functions in patients with stroke.

DIFFERENTIATION OF DICHTOMOUS EMOTIONAL STATES IN ELECTRODERMAL ACTIVITY SIGNALS USING HIGHER-ORDER CROSSING FEATURES AND PARAMETRIC CLASSIFIERS
Yedukondala Rao Veeranki*, Nagarajan Ganapathy, Ramakrishnan Swaminathan
Indian Institute of Technology Madras, India

Prediction and recognition of happy and sad emotional states play important roles in many aspects of human life. In this work, an attempt has been made to classify them using Electrodermal Activity (EDA). For this, EDA signals are obtained from a public database and decomposed into tonic and phasic components. Features, namely, Hjorth and higher-order crossing, are extracted from the phasic component of the signal. Further, these extracted features are fed to four parametric classifiers, namely, linear discriminant analysis, logistic regression, multilayer perceptron, and naive bayes for the classification. The results show that the proposed approach can classify the dichotomous happy and sad emotional states. The multilayer perceptron classifier is accurate (85.7%) in classifying happy and sad emotional states. The proposed method is robust in handling the dynamic variation of EDA signals for happy and sad emotional states. Thus, it appears that the proposed method could be able to understand the neurological, psychiatrical, and biobehavioural mechanisms of happy and sad emotional states.
higher dimensional space to find out the geometrical properties. Features, namely the center of gravity and perimeter of the boundary space, are used to quantify the changes in the geometrical properties of the signal, and the features are subject to the Wilcoxon rank-sum test for statistical significance. Different electrodes in the frontal region under the same audio-visual stimulus showed similar variations in the geometry of the boundary in higher-dimensional space. Further, the electrodes, Fp1 and F3, showed a statistical significance of p < 0.05 in differentiating arousal states, and the Fp1 electrode showed a statistical significance in differentiating valence emotional state. Thus, the topological features extracted from the frontal electrodes in theta band could differentiate arousal and valence emotional states and be of significant clinical relevance.

DETECTION OF SEIZURE TYPES FROM THE WAVELET ENERGY OF SCALP EEG

Joseph Mathew, N. Sivakumaran, P.A. Karthick National Institute of Technology, Tiruchirappalli, India
ichackompally@gmail.com

Epilepsy is a disabling and devastating neurological disorder, characterized by recurrent seizures. These seizures are caused by the abrupt disturbance of the brain and are categorized into various types based on the clinical manifestations and localization. Seizures with clinical manifestations require immediate medical attention. In this work, an attempt has been made to differentiate the seizures with and without clinical manifestations using wavelet energy of scalp EEG signals. For this purpose, scalp EEG records from the publicly available Temple University Hospital (TUH) database are considered in this work. The first four seconds of scalp EEG during seizure is subjected to seven-level Daubechies (db4) wavelet decomposition and energy is extracted from the resultant coefficients. These features are used to develop k-Nearest Neighbor (k-NN) classification model for the detection. The results show that the energy associated with most of the sub-bands exhibits significant difference (p<0.05) in these two types of seizures. It is found that the machine learning model based on k-NN achieves an accuracy of 87.6% and precision of 87.3%. Therefore, it appears that the proposed approach could aid in detecting life-threatening seizures in clinical settings.

CYTOPATHOLOGY EDUCATION TRAINING ASPECTS OF DEVELOPING AN ON-LINE TRAINING PROGRAM

Zelma Cason
Mississippi Academy of Sciences, MS, USA
zcason1@icloud.com

Cervical cancer prevalence, incidence and death rate in developing countries and low-income countries worldwide is increasing. This is partially due to lack of the availability of screening programs and cyto/technologist/pathologist. Liquid-Based or Conventional (slide) Pap Test (and high-risk HPV co-testing as appropriate) is the standard screening test for cervical cancer and precancerous cervical lesions. Our purpose is to develop a simulation education program using digital imaging to train inexperienced personnel to detect high-risk lesion using rapid pattern recognition of high-grade squamous intraepithelial lesions or higher (HSIL+) skills and locational skills to find HSIL. The training components consisted of didactic, preclinical and clinical practice sessions. The didactic components consisted of 10,000 images –HSIL+ and lower (benign cells, endometrial cells, squamous metaplasia, and repair) and six didactic one-half hour lectures based on daily performance. Canvas platform was used for testing procedure and rapid diagnoses of banked digital images. A modified Likert scale of 0 (unconfident) to 5 (confident) were used. Simulation principles, such as immediate feedback, increasing difficulty levels and deliberate practice of numerous representative images were used. Selected participants had no experience examining cytologic smear and were able to gain proficiency in a short time period using rapidly developed digital images. Although large-scale volume of image review improves novice subject performance, substantial improvement in both sensitivity and specificity of HSIL+ image detection was seen in our subjects. Our data indicate that some individuals may highly benefit from rapid image examination, although the some of the subjects may require a different form of educational training to separate lesion from non-lesional cells. Our data also indicate that some subjects may be rapidly trained for select tasks, such as HSIL+ detection, a needed skill in underserved parts of the world.

CRICOTHYROTOMY SIMULATION USING CADAVER MODEL:IMPACT ON AWARENESS, RECEPTEIVENESS AND ATTITUDE AMONG HEALTHCARE PROVIDERS

Christopher Powe, Hamed Benghuzzi, Dennis Watts, EricZoog, Rickie Smith, , John Carlisle, Craig Menefee
Global Training Institute, Flowood, MS, USA
chris@globaltraining.institute

Cricothyrotomy also known as thyrocricotomy is an intervention clinical methodology to establish a patent airway during certain life-threatening medical conditions. These include massive facial trauma, angioedema and airway obstruction by infecting agents such as Covid-19. Several available standard methods failed to adequately ventilate and oxygenate the airways during unexpected emergency situations such as the overwhelming spread of Covid-19 in limited healthcare access. The specific objectives of this preliminary study were to investigate cricothyrotomy simulation using the cadaver model for the first time and to elucidate the impact of this method might have on awareness, receptiveness and attitude among healthcare providers. A total of 19 healthcare providers participated in this study. The subjects were introduced to the cricothyrotomy techniques using cadavers by three experienced instructors. Briefly, an incision was made through the skin and cricothyroid to mimic the establishment of oxygenation during airway obstruction. The subjects were allowed to perform the process independently and the success rate was 100% according to standard assessment protocol. Upon the completion of the training, each subject was instructed to provide feedback through a structured, self-administered questionnaire that was previously constructed. Data were analyzed using standard quantitative and qualitative protocols. The responses were compared based on level of education to find possible statistical correlation. The results revealed that the majority of respondents (100%) felt the knowledge and skills provided them with significant confidence to perform the procedure in comparison to other standard methods. The use of cadaver alleviated the fear in performing the technique in the practical field. On a scale of 1 (Poor) to 4 (highly effective outcome), a total of 18(19) ranked the learning process pertaining to the relevance to clinical practice with a score of 4 and 1(19) gave it a score of 3. All participants unanimously agreed that healthcare providers should be equipped with the skills in how to perform cricothyrotomy technique and without a doubt such training provides a great confidence in successfully performing emergency cricothyrotomy.

Session 8: Education
TRENDS IN BIOENGINEERING PATENTS GRANTED, 2000-2019

John E Pasek
University of Wyoming, Laramie, WY, USA
jpasek@uwyo.edu

Patent documents contain a wealth of technical information on inventions, often unavailable elsewhere. They are likely underutilized as sources of information about trends in fields of development. Querying patent databases can be challenging, given the inadequacy of keywords and the complex nature of patent classification systems. A collection of Cooperative Patent Classification (CPC) main codes were identified that likely relate to patents in bioengineering and biomedical engineering. These codes were used in queries of the free patent search engine that is available from a Lens.org database. Results were filtered for applications or granted patents by patent families to identify trends in inventions within the field from 2000 to 2019. A patent family represents the collection of documents relating to a single invention given that applications are frequently filed in multiple countries. Although patent applications and unique inventions remained steady, the annual number of patents granted has increased from 2000 to 2016. A decline in numbers of granted patents since 2016 is indicative of the lag time of several years between application filing and a determination of patent status. Applicants with high productivity in obtaining granted patents include large international companies as well as some large universities.
HYPOTHETICAL FEASIBILITY OF USING STRESS BIOMETRICS IN STUDENTS WITH CORTICAL VISUAL IMPAIRMENT
Victor M. Pedro, Juby Mathew and Elena Oggero
1International Institute for the Brain, New York, NY, USA
2Director of Rhode Island Integrated Medicine, Cranston, RI, USA
3Electrical and Computer Engineering Department, University of Wyoming, Laramie, WY, USA
4Vestibular Technologies, LLC, Cheyenne, WY, USA
vpedro@ibrainnyc.org

Cortical Visual Impairment (CVI) is resultant from neurological injury and damage to visual pathways or vision centers in the brain. CVI is sometimes undiagnosed in individuals with brain injuries due to the complexity of the human visual system. The International Institute for the Brain (iBrain) is a specialized school for students ages 5 to 21 who have a brain disorder or an acquired brain injury. They often present with noticeable CVI. While there are various metrics and interventions for the pediatric population, the adequacy has been lacking in terms of the vulnerability of this non-verbal population. Assessing the safety and effectiveness of rehabilitative interventions for this fragile student population can be challenging as most traditional metrics cannot be used. In this methodological review paper, available metrics were investigated and their applicability for this specific population was discussed with the end goal of identifying the best metrics that could be used to determine treatment effectiveness and providing a way for monitoring adverse effects. Combining pulse oximetry, cortisol response sensor, and galvanic skin response as biometrics theoretically offers a comprehensive assessment of autonomic activity and responses and establishes objective measures to identify treatment outcomes and adverse reactions. However, future experimental studies are needed to verify if the proposed protocol is feasible and if it is well tolerated by the iBrain students before it can be implemented to monitor adverse reaction to intervention and as a potential treatment outcome measure for children affected by CVI.

CORTICAL INTEGRATIVE THERAPY FOR THE TREATMENT OF MIGRAINES AND HEADACHES
Nicole C. Lim, Victor M. Pedro and Elena Oggero
1International Institute for the Brain, New York, NY, USA
2Director of Rhode Island Integrated Medicine, Cranston, RI, USA
3Electrical and Computer Engineering Department, University of Wyoming, Laramie, WY, USA
4Vestibular Technologies, LLC, Cheyenne, WY, USA
vpedro@ibrainnyc.org

Migraine is a common neurological disorder that is characterized by a host of symptoms including severe throbbing headaches. In this retrospective chart review, the effectiveness of Cortical Integrative Therapy (PedroCIT®) was examined in adults with migraines. Multivariate General Linear Model (M-GLM) was utilized to determine if the emotional, functional, and overall difficulties, as well as the intensity of pain experienced with headaches decreased from before to after PedroCIT® treatment in individuals with mild to complete disability resulting from headaches. Repeated Measures General Linear Model (RM-GLM) was also used to investigate if postural stability increased from pre- to post-treatment. The results of the M-GLM showed that PedroCIT® was effective in reducing emotional, functional, overall disability, and intensity of pain resulting from headaches. Furthermore, RM-GLM indicated that patients who underwent PedroCIT® improved their postural stability from pre- to post-treatment. Finally, the findings also showed that the duration of the treatment did not have any effect among patients with varied degrees of headache disability. This study illustrates the effectiveness of PedroCIT® in the treatment of headaches and postural instability in migraine patients.

EFFECT OF A BIOACTIVE CALCIUM ALKALI ORTHOPHOSPHATE BONE GRAFTING MATERIAL AS COMPARED TO TRICALCIUM PHOSPHATE ON OSTEOSGENESIS AFTER SINUS FLOOR AUGMENTATION IN PATIENTS
Hana-Ayad Ensr, Tom Knauf, Doaa Adel-Khattab, Alina Bednarek, Imran Tariq, Georg Berger, Renate Gildenhaa Michael Stiller, Christine Knabe
Dept. of Experimental Orofacial Medicine, School of Dental Medicine, Philippus University, Marburg, Germany
knabec@med.uni-marburg.de

Sinus floor augmentation (SFA) has become a well-recognized procedure for site development in the atrophic posterior maxilla prior to dental implant placement. There has been an increasing search for regularly resorbable bone substitutes that enhance bone formation and facilitate bone regeneration with complete replacement by functional bone tissue. This has led to the development of a glassy crystalline silica-containing calcium alkali orthophosphate (Si-CAOP). The specific aim of this study was to assess histologically the effect of this grafting material on osteogenesis and osteogenic marker expression and to compare this effect to that of β-tricalcium phosphate (β-TCP) in human biopsies obtained 6 months after SFA. Cylindrical biopsies, harvested 6 months after SFA, were processed for immunohistochemical analysis of sawed hard tissue sections using primary antibodies specific to osteocalcin (OC), collagen type I (Col I), bone sialoprotein (BSP), and alkaline phosphatase (ALP). Furthermore, the bone and particle area fraction were measured histomorphometrically in all biopsies in order to characterize bone formation and degradation of the bone grafting materials. Both biomaterials facilitated osteoblast differentiation and bone regeneration of resorbed alveolar ridges, resulting in sufficient bone formation for supporting dental implants. Si-CAOP specimens displayed more advanced bone formation and significantly greater particle degradation than TCP sites. This was accompanied by significantly higher expression of OC, Col I, BSP, and ALP in the osteoid in contact with the degrading particles. These promising results indicate that the Si-CAOP material has great potential use for SFA in humans, thereby confirming its superiority to β-TCP. A prospective study involving a larger patient number, a split-mouth design and analysis of angiogenic properties and of cone-beam CT-data for assessing the volume stability of the augmented area is warranted to further confirm the high osteogenic capacity of Si-CAOP for orofacial bone regeneration.

Session 9: Biomechanics

CORRELATIONS BETWEEN PLANTAR PRESSURE AND JOINT KINEMATICS IN FEMALE RECREATIONAL RUNNERS
Janelle A. Cross, Fadumo Mohamud, Carolyn Meinerz, Gerald F. Harris, Cody Dziuk, Jessica M. Fritz
Medical College of Wisconsin, Milwaukee, WI, USA
jacross@mcw.edu

Running provides many health benefits but carries the risk for lower extremity injuries. Previous studies have performed simultaneous assessments of plantar pressure and joint kinematics; however, they have not investigated correlations between these parameters. The goal of this study was to assess relationships between joint kinematics and plantar pressure metrics during stance phase of running. Fifteen female recreational runners participated in this study. Three-dimensional motion analysis and plantar pressure data were collected simultaneously as the subjects ran on an instrumented treadmill. Participants ran at a self-selected speed while maintaining a heart rate (HR) at 70-80% of their maximum HR (max HR = 220 – age). Sagittal and coronal plane motion of the ankle and hip and sagittal plane motion of the knee, along with peak plantar pressure, peak ground reaction force (GRF), force impulse, and pressure impulse were examined. Spearman rho correlation tests were performed to determine correlations among lower extremity joint kinematics and plantar pressure metrics. Positive correlations were found between peak plantar pressure and ankle dorsiflexion, knee flexion, and ankle inversion as well as between running speed and peak GRF. These correlations gave insight into risk factors for injury based on the relationship between plantar pressure metrics and joint kinematics.
STUDY OF THE BILATERAL ASYMMETRY OF PLANTAR MECHANICAL PROPERTIES AS A BIOMARKER FOR THE DIFFERENTIATION OF DIABETIC CONDITION
Shib Sundar Banerjee, Srivatsa Ananthan, and Ramakrishnan Swaminathan
Department of Applied Mechanics, Indian Institute of Technology Madras, Chennai, India
banerjeeshib2@gmail.com

Diabetes mellitus is a globally prevalent metabolic disease which results in altered plantar mechanical properties and foot ulcer. In this study, the bilateral asymmetry of mechanical properties for plantar soft tissue is investigated in healthy and diabetic conditions. Myotonometric signals are acquired from sub-metatarsal region of the plantar faces of healthy subjects and patients with varied diabetic age. Mechanical parameters such as dynamic stiffness and logarithmic decrement are extracted from the recorded signal. The asymmetry indices between right and left feet are computed. Statistical analysis shows that the spatial pattern of dynamic stiffness and logarithmic decrement varies significantly between healthy and diabetic subjects. The asymmetry index of dynamic stiffness in the fifth sub-metatarsal head can differentiate between healthy subjects and patients with both high and low diabetic age (p<0.05). The asymmetry index of logarithmic decrement is found to vary significantly between the healthy subjects and patients with higher diabetic age (p<0.05). These results indicate that bilateral asymmetry of myotonometric parameters can be exploited as a possible biomarker to differentiate diabetic patients from healthy subjects and can aid in the early detection of foot ulcer.

ANALYSIS OF TRUNK POWER AND JOINT STRESSES BETWEEN PROFESSIONAL AND COLLEGIATE PITCHERS
Maxwell Albiero, Cody Dziuk, Janelle A Cross Medical College of Wisconsin, Milwaukee, WI, USA
malbiero@mcw.edu

The dynamic motion of a baseball pitch generates high elbow and shoulder torques that can result in injury. Previous research has noted the importance of properly transferring energy from the lower extremities through the throwing arm to decrease joint stress. The goal of this study was to compare segmental powers between two levels of pitchers at various moments throughout the pitching cycle and observe their influence on upper extremity torques. Thirteen professional and thirteen collegiate pitchers participated in this study. Forty-seven reflective markers were attached to the subjects at specific landmarks. An 8-camera motion analysis system was set up surrounding an artificial pitching mound, where participants threw 10 fastballs. Data were exported and processed using Visual 3D software. Welch’s T-tests compared the means between groups with a significance set at p < 0.05. Professional pitchers were found to have significantly greater torso power at foot contact, maximum shoulder external rotation, ball release, and overall peak torso power. They also demonstrated significantly greater pitch velocity. Professional pitchers generated similar elbow varus torque and shoulder internal rotation torque compared to collegiate pitchers. These findings suggest professional pitchers more effectively use torso power to help increase pitch speed without increasing overall joint torques.

DYNAMIC RESPONSE OF THE HUMAN HEAD DURING IMPACT WITH A DRYWALL BULKHEAD-SECTION
Michael A. K. Liesbchner and Leroy R. Waite
Rimkus Consulting Group Forensic Engineering Division, Houston, Texas
mliebschner@rimkus.com

Little experimental data has been reported on the biomechanics of head collisions with drywall sections. The dynamics of head collisions with rigid structures are well documented. However, impacts with compliant, composite structures are more difficult to analyze. The study objective was to correlate the severity of a head impact with damage to the drywall. A human head analog was instrumented with a tri-axial accelerometer and a uniaxial load cell was placed along the cervical spine axis. A randomized block design of drop height and head orientation was utilized. The test results indicated a primarily linear correlation between drop height and peak head acceleration, as well as correlation between drop height and the geometry of the indentation to the drywall. Head posture had little influence on wall damage, however, head extension resulted in a stiffer head-spine complex compared to a flexed posture. A two-factor ANOVA determined a statistically significant correlation between damage severity and impact velocity. The results obtained can be used by accident reconstructionists to approximate the impact severity of a head impacting drywall. The study data are limited to drywall sections of known, similar geometry, and does not apply to scenarios with a support beam directly beneath the drywall. Further studies are needed to investigate additional head postures.

BIOMECHANICS OF PENETRATING INJURIES IN GUARDRAIL MOTOR VEHICLE CRASHES
Sri Kumar
Safety Research Institute Atlanta, GA, USA
kumar@srinst.com

The objective of the present study is two-fold. First, the elucidation of the biomechanics of penetrating trauma as a result of guardrail intruding into the occupant compartment. Second, the evaluation of the biomechanical efficacy of hybrid tension-compression guardrails to better protect occupants. The nine fatally guardrail penetrating crashes occurred between 2016 and 2019 were analyzed to study the mechanism of injuries. Four car-to-guardrail crash tests were conducted using a hybrid guardrail that integrated the commonly used W-beam with a new design of tension-based end terminal. The test included the impact of a bogy-type platform, small sedan vehicles, and a pick-up truck at highway speeds onto the guardrail. The impact orientation was varied to simulate the frontal and oblique corner crashes with a speed ranging from 90 to 111 kph. The real-world studies showed that the fatal injuries were due to impaling guardrail regardless of vehicular speed and size. The occupants not in the trajectory of the guardrail in the same vehicle sustained minor injuries despite experiencing a similar energy level. In these cases, the crash severity was survivable without the guardrail penetration. The mean pre-impact speed, change in speed, and vehicular acceleration was 117 kph, 20 kph, and 97 m/sec², respectively. The hybrid guardrail system deflected the vehicle without any penetration into the occupant compartment. The mean peak accelerations in crash tests were below injurious threshold levels. The present research shows that the hybrid guardrail system not only eliminated the intrusion into occupant survival space but also deflected the vehicle.

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CYTOMORPHOLOGICAL EVALUATION OF PANCREATIC CELLS IN RESPONSE TO GLUCOSE CHALLENGE
Lamar Hamil1, Michelle A. Tucci1, Hamed A. Benghuzzi2, Zelam Cason1, Kenneth R. Butler1,2
1University of Mississippi Medical Center, Jackson, MS
2Global Training Institute, Flowood, MS
kbutler@umc.edu

PANC-1 is a human pleiomorphic epithelioid carcinoma of the exocrine pancreas. Previous studies in our laboratory provided evidence that these cells can be manipulated into insulin producing cells by altering the culture medium with increasing amounts of glucose. There is a paucity in the literature regarding cytomorphologic characteristics of PANC-1 cells under normal culture conditions as well as when challenged with increased amounts of glucose. The goal of this experiment was to evaluate the nuclear and cytoplasmic characteristics of PANC-1 cells. Initially cells were grown in flasks with control medium, and then split into four separate groups containing control media or media containing an extra 1%, 2.5% or 5% glucose. Cells from the three cultures were plated (1 x 10³ cells/well) and treated with control, 1%, 2.5%, or 5% glucose for 24, 48, and 72 hours. Cells and supernatants were harvested and cell number and cytomorphology were compared at all phases. Nominal data were analyzed using non-parametric statistics calculating mean ranks for comparison of all four groups using the Kruskal-Wallace H statistic. While we saw statistically significant differences in most variables by glucose concentration at 24-, 48-, and 72-hours, the most telling was the
increasing glucose concentration detected by immunohistochemistry at all three phases rising from baseline, peaking at 2.5% glucose concentration, and rapidly declining to baseline levels indicating an inhibiting or toxic effect at 5% extra glucose (p<.0.05). This pattern was also consistent in the cytomorphologic changes that were observed as glucose concentrations increased and was more apparent by the 72-hour phase. This study contributes valuable quantitative data regarding the viability and function PANC-1 cells as insulin producing cells with increasing glucose challenge and demonstrates that PANC-1 or similar cells can be further engineered into useful components in drug delivery applications.

TN HYDROGELS AS A POTENTIAL ANTI-INFLAMMATORY DRUG DELIVERY SYSTEM TARGETED TO OSTEOARTHRITIC KNEES
Kaitlynn Bussett, Katherine Goebel, Victoria Lee, Lindsey Alumbaugh
Rose-Hulman Institute of Technology, IN, USA
bussetkn@rose-hulman.edu

Arthritis affects 26.3% of adults and approximately 50,000 children in the United States [1]. Hydrogel drug-delivery systems have been considered as a viable option for drug delivery to arthritic articular cartilage in the knee. To determine physiologically relevant loading, a Qualisys motion capture system was used to analyze the gait of college-aged females as they took several steps on a flat surface, then stepped onto a force plate. The motion capture and force plate data was used to determine maximum force exerted on the knee during normal gait. Three different alginate-based hydrogels, where the superior one had a triple interpenetrating graphene oxide network (TN hydrogels), were investigated for use as an anti-inflammatory drug delivery system in a human knee joint. Physiologically relevant cyclic loading was performed to ensure that the TN hydrogel could withstand the force exerted in the knee. The TN hydrogel experienced a change in energy of 50% after cyclic loading (10.6 ± 15.0 Pa) and survived high stresses of 4 kPa, which is 80 magnitudes larger than observable gait forces as measured in this study. From a mechanical perspective, TN hydrogel appears to be mechanically viable for arthritis drug delivery. In addition, based on calculations and Flory-Rehner equations, the pore size of the TN hydrogel is adequate for encapsulating most NSAIDs, which have a molecule size ≤ 5μm.

MAGNETIC NANOPARTICLES BASED DRUG DELIVERY TO ABATE NOXIOUS PAIN
Adithya Mohandass
University of Wyoming School of Pharmacy, WY, USA
amohandas@uwyo.edu

PROBING CLINICAL RELEVANCE: ESTABLISHING THE EFFICACY OF C. NOVYI AGAINST A PANEL OF 2D CULTURED PANCREATIC CANCER CELLS
North Dakota State University, ND, USA
kaitlin.dailey@ndus.edu

Pancreatic cancer presents a unique challenge for the development of effective oncotherapies. The tumor microenvironment (TME) of this type of tumor typically contains a dense desmoplastic barrier composed of aberrant extracellular matrix proteins, as well as an acidic, hypoxic and necrotic core. Additionally, the immune system surrounding this type of tumor has often been suppressed by the TME. Hence, choosing the correct model of the tumor microenvironment within which to test a potential anti-cancer therapy is a critical experimental design decision. While the typical solid tumor contains a complex microenvironment including both phenotypic and genotypic heterogeneity, the methods used to model this disease state often do not reflect this complexity. This simplistic approach may have contributed to stagnant five-year survival rates experienced over the past four decades. Oncolytic bacteria, a class of bacteria with the innate ability to seek and destroy solid tumors has been revived from historical anecdotes in an attempt to overcome these challenges. Regardless of the promise of oncolytic bacteria, accurate assessment of their potential requires choosing the proper tumor model. This study explores the impact of cancer cell lines co-cultured with Wild-Type C. novyi to establish the efficacy of this oncolytic bacteria in a monolayer culture.