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Keywords: Human Motion Analysis, Computational Modeling, Biomaterials, Biomechanics,
Assistive Devices, Robotics, Machine Learning

EDUCATION

Ph.D. Rutgers University (Formerly: University of Medicine and Dentistry of New Jersey).
Newark, NJ, USA. Biomedical Engineering, April 2008

Ph.D. Dissertation: *The Role of Local Growth Factor Delivery on Bone Fracture Healing: Recombinant Human Platelet Derived Growth Factor and Insulin.*

M.S. New Jersey Institute of Technology (NJIT). Newark, NJ, USA.
Biomedical Engineering, May 2004

Master Thesis: *Mathematical Modeling and Simulation of Human Motion using a 3-Dimensional, multi-Segment Coupled Pendulum System: Derivation of a Generalized Formula for Equations of Motion.*

B.S. Jordan University of Science and Technology (JUST). Irbid, Jordan.
Electrical and Electronics Engineering, June 2000

RESEARCH OBJECTIVES:

- To find optimal movement patterns for ballistic-like motor tasks (walking, overhead throwing, ... etc.), and to estimate joints net muscular forces required to produce those movements at a finite but adjustable number of discrete times during the motion.
- To develop a diagnostic tool for human motion analysis laboratories capable of finding optimal movement patterns that prevent injury and improve performance.
- To develop a well funded research program in musculoskeletal biomechanics and rehabilitation engineering that complement and build upon existing capacities and strengths through collaboration and interdisciplinary research.
- To develop robust methods for obtaining structural and material properties of plant tissues and to study the factors influence the accuracy and reliability of those methods.
- To develop experimental and computational models for analyzing stress distributions in plant tissues, characterizing various plant pathologies and for the design of plants handling and processing machines.
- To develop engineering-based predictors for crops breeding and phenotyping studies.

TEACHING PHILOSOPHY SUMMARY:

In all my courses, I demonstrate to my students that engineering is interesting, relevant, and fun. I believe that when teaching the 21 century engineers, the emphasis should be on integrative approach , multidisciplinary collaboration, creative design, problem solving, and above all on critical thinking. I recognize the strategic importance of online learning to address global needs for education.

PROFESSIONAL DEVELOPMENT:

Academic Development:

Associate Professor of Biomedical Engineering (*August 2018- till now*)
School of Engineering, University of Mount Union, Alliance, OH, USA.

Visiting Research Scientist: Biomechanics (*September 2016 – August 2018*)
Plant Biomechanics Laboratory, Engineering Division, New York University Abu Dhabi, Abu Dhabi, United Arab Emirates.

Associate Professor of Biomedical Engineering (*December 2013- August 2016*)
Biomedical Engineering Department, The Hashemite University, Zarqa, Jordan.

Assistant Professor of Biomedical Engineering (*June 2008- November 2013*)
Biomedical Engineering Department, The Hashemite University, Zarqa, Jordan.

Laboratory Instructor/Technician: AutoCad Drawing (*January 2001- January 2003*)
Visual communication laboratory, Faculty of Engineering, The Hashemite University, Zarqa, Jordan.

Administrative Development:

Chair of the Biomedical Engineering Department (*September 2014 - September 2015*)
Biomedical Engineering Department, The Hashemite University, Zarqa, Jordan.

Assistant Dean of Engineering for Industrial Outreach (*September 2011- September 2013*)
Faculty of Engineering, The Hashemite University, Zarqa, Jordan.

Professional Memberships:

Jordan Engineering Society: member since 2000.

Orthopedics Research Society: active member since 2008.

Jordan Biomedical Engineering Society: founder and member since 2011.

IEEE: member since 2014.

American Society of Agricultural and Biological Engineers: member since 2017.

Awards:

Department for Graduate Students Outstanding Academic Achievement Award of Biomedical Engineering. New Jersey Institute of Technology, Newark, NJ, USA. 2004.

Patents:

Sheldon Sutton Lin, Ankur Gandhi, James Patrick O'Connor, **Loay A. Al-Zube**, Joseph Benevenia, J. Russell Parsons. Localized insulin delivery for bone healing. US Patent no. US7763582 B2, assigned to the University of Medicine and Dentistry of New Jersey, Newark, NJ, USA.

GRANTS and AWARDS

As a Principle Investigator:

2011 **Mathematical Modeling and Simulation of Human Motion Using a 3-Dimensional, Multi-Segment Coupled Pendulum System: Technology for children with disabilities.** *Awarded amount: \$ 150,000.* Date Ended: May 2016.

2009 **Characterization of Calcium Salts as Delivery Vehicles for Insulin in Osseous Repair.** *Awarded amount: \$ 35,000.* Date Ended: July 31, 2012.

Funding Agency: Jordan Scientific Research Fund

As a Co-investigator:

2006 **Role of Growth Factor Augmentation upon Osteoporosis.** Lin S.S.; Ankur G.; Al-Zube L.; O'Connor B. *Awarded Amount: \$60,000*

Funding Agency: Biomimetic Therapeutics

PUBLICATIONS

Loay Al-Zube, Wenhuan Sun, Daniel Robertson, and Douglas Cook. ***The Elastic Modulus of Maize Stems.*** Plant Methods. 2018 February; 14:11 (DOI: 10.1186/s13007-018-0279-6)

Loay Al-Zube, Daniel Robertson, Jean Edwards, Wenhuan Sun, and Douglas Cook. ***Measuring the Compressive Modulus of Elasticity of Pith-filled Plant Stems.*** Plant Methods. 2017 November; 13:99 (DOI: 10.1186/s13007-017-0250-y).

Christopher. J. Stubbs, Navajit. S. Baban, Daniel J. Robertson, Loay Alzube and Douglas Cook. ***Bending Stress in Plant Stems: Models and Assumptions.*** In A. Geitmann and J. Grill, editors. ***Plant Biomechanics.*** Springer (*In press*).

Loay A. Al-Zu'be, Thakir D. Al-Momani, Bilal M. Al-Trabsheh , Modhafar Z. Al-Zoubi. ***Knowledge of the Use and Benefits of Applying Biotechnology and Cell Based Therapy in Orthopaedics in JORDAN: Questionnaire Survey and Regulation Assessment.*** Jordan Journal of Biological Sciences. 2013 June; 6(2): 5-10.

Loay A. Al-Zu'be, Thakir D. Al-Momani, Osama M. Al-Bataineh, and Lubna H. Tahtamouni. ***In vitro Characterization of Calcium Salts as Delivery Vehicles for Insulin.*** Journal of Biomimetics Biomaterials and Tissue Engineering. 2013 June; 17: 53-58.

Park AG, Paglia DN, Al-Zube L, Hreha J, Vaidya S, Breitbart E, Benevenia J,O'Connor JP, Lin

SS. ***Local Insulin Therapy Enhances Fracture Healing in a Rat Model.*** J Orthop Res. 2013 May; 31(5): 776-782.

David N. Paglia, Aaron Wey, Eric A. Breitbart, Jonathan Faiwizewski, Siddhant K. Mehta, Loay Al-Zube, Swaroopa Vaidya, Jessica A. Cottrell, Dana Graves, Joseph Benevenia, J. Patrick O'Connor, Sheldon S. Lin. ***Effects of Local Insulin Delivery on Subperiosteal Angiogenesis and Mineralized Tissue Formation during Fracture Healing.*** J Orthop Res. 2013 May; 31(5): 783-791.

Loay A. Al-Zu'be, Asma A. Al-Tamimi, Thakir D. Al-Momani, Ayat J. Alkarala, Maryam A. Alzawahreh. ***Modeling and Simulating Human Arm Movement using a 2 Dimensional 3 Segments Coupled Pendulum System.*** World Academy of Science, Engineering and Technology 71 (2012): 1321-24.

Thakir D. AlMomani, Sarah C. Vigmostad, Keshav V. Chivukula, Loay Al-Zube, Othman Smadi, Suleiman BaniHani. ***Red Blood Cell Flow in The Cardiovascular System: A fluid Dynamics Perspective.*** Critical Reviews in Biomedical Engineering 2012; 40(5): 427-440.

AlMomani T, Al-Zu'be L, Bataineh O. ***Assessment of Medical Wastes Management Protocols in Jordanian Healthcare Institutions.*** International Journal of Environment and Waste Management. 2013; 11(3): 323-334.

Eric A. Breitbart, Sharonda Meade, Vikrant Azad, Sloane Yeh, Loay Al-Zube, Yee-Shuan Lee, Joseph Benevenia, Treena Livingston-Arinzeh, Sheldon Lin. ***Mesenchymal Stem Cells Accelerate Bone Allograft Incorporation in the Presence of Diabetes Mellitus.*** J Orthop Res. 2010 July; 28(7): 942-949.

Vikrant Azad, Eric Breitbart, Loay Al-Zube, Sloane Yeh, Ann Marie Simon, J. Patrick O'Connor, Sheldon Lin. ***rhBMP-2 enhances the bone healing response in a diabetic rat segmental defect model.*** J Orthop Trauma. 2009 Apr; 23(4):267-76.

Al-Zube, Loay; Breitbart, Eric A.; O'Connor, J. Patrick; Parsons, J. Russell; Bradica, Gino; Hart, Charles E.; Lin, Sheldon S. ***Recombinant Human Platelet-Derived Growth Factor BB (rhPDGF-BB) and Beta-Tricalcium Phosphate/Collagen Matrix Enhance Fracture Healing in a Diabetic Rat Model.*** J Orthop Res. 2009 Aug; 27(8):1074-81.

Jacobsen K.; Szczepanowski K.; Al-Zube L. A., Kim J., and Lin S. S., 2007. ***The Role of Intraoperative Bone Marrow Aspirate Stem Cell Concentration as a Bone Grafting Technique.*** Techniques in Foot & Ankle Surgery. 2008 June; 7(2):84-89.

PRESENTATIONS and POSTERS:

Loay A. Al-Zu'be, Asma A. Al-Tamimi, Thakir D. Al-Momani, Ayat J. Alkarala, Maryam A. Alzawahreh. ***Modeling and Simulating Human Arm Movement using a 2 Dimensional 3-Segments Coupled Pendulum System.*** Talk Presented in the 33rd International Conference on Biomedical Engineering (ICEB 2012), Paris, France. 2012.

Al-Zube, Loay; Thakir D. Al-Momani, Osama M. Al-Bataineh, and Lubna H. Tahtamouni. ***In vitro Characterization of Calcium Salts as Delivery Vehicles for Insulin in Osseous Repair.*** Talk Presented in the 27th Southern Biomedical Engineering Conference (SBEC2011), Arlington, TX, USA. 2011.

Al-Zube, Loay; Breitbart, Eric A.; Simon, Ann Marie; Young, Conan S.; Bradica, Gino; O'Connor, J Patrick; Hart, Charles E.; Lin, Sheldon S. ***Stimulation of Fracture Healing by Recombinant Human Platelet-Derived Growth Factor BB (rhPDGF-BB) Combined with Beta-Tricalcium Phosphate/Collagen matrix in a Diabetic Rat Fracture Model.*** Poster Presented in the 54th annual Orthopaedic Research Society, San Francisco, CA, USA. 2008.

Meade, Sharonda; Azad, Vikrant; Lee, Yee-Shaun; Breitbart, Eric A.; Yeh, Sloane; Al-Zube, Loay; Arinzeh, Treena; Lin, Sheldon S. ***Mesenchymal Stem Cell Augmentation upon Allograft incorporation in Diabetic Rodents.*** Poster Presented in the 54th annual Orthopaedic Research Society, San Francisco, CA, USA. 2008.

Azad, Vikrant; Breitbart, Eric A.; Yeh, Sloane; Al-Zube, Loay; Lin, Sheldon S. ***Effects of rhBMP-2 on New Bone Formation in Diabetic Non Critical Size Rat Femoral Defect Model.*** Poster Presented in the 54th annual Orthopaedic Research Society, San Francisco, CA, USA. 2008.

COURSES TAUGHT:

Rehabilitation Engineering	Prosthetic Systems	Artificial Organs
Clinical Engineering	Applied Mathematics	Biomechanics (I)
Engineering Drawing (AUTOCAD)	Fundamentals of Tissue Engineering	Biomaterials
Modeling & Simulation of Biomedical Systems	Engineering Workshop	Ethics & Technical Writing

SKILLS and ASSAYS:

Assessment of human performance

- Acquisition & analysis of surface Electromyographic (EMG) signals using a 32channels TMSi system and TMSi Polybench software.
- Acquisition & analysis of 3-dimensional kinematics measurements of human motion using Natural Point OptiTrack system.
- Acquisition & analysis of postural control, postural sway and weight bearing distribution measurements using an AMTI force-plate system.

Computing skills

- MATLAB, MATHEMATICA, Adobe Illustrator, C/C++, SIMULINK, LABVIEW, 3D-Max Studio & AUTOCAD.
- Statistical analysis.
- Webpage design and development.

Experimental small animal surgery models

- Breeding and handling of small animals (rodents)
- Femoral fracture model in rats (*in vivo*)
- Critical and non-critical femoral defects in rats (*in vivo*)

Histology assays preparation

- Cell proliferation, histomorphometry, and Protein immunohistochemistry

Molecular biology assay preparation

- Protein isolation and ELISA assays

Cellular separation and sorting

- Cell separation using ficol and cell counting.
- Stem cells labeling using micro-beads and magnetic separation.
- Cellular culturing, passages, trypsinization, cell freezing, and thawing.

Technical writing

- Preparing scientific research proposals and manuscripts
- Preparing IACUC protocols for clinical and experimental studies