

# Zhongqing Han

SOFTWARE ENGINEER · SIMULATION RESEARCH ENGINEER

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“Change before you have to.”

## Education

### Rensselaer Polytechnic Institute (RPI), Center for Modeling, Simulation, and Imaging in Medicine (CeMSIM)

Troy, NY

PH.D. IN MECHANICAL ENGINEERING, SUPERVISED BY PROF. SUVRANU DE. GPA 3.95/4.0

Expected, Jul. 2018

- THESIS: Real-time simulation of Electrosurgical procedures

### University of Science and Technology of China (USTC)

China

M.S. IN MECHANICAL ENGINEERING

Jun. 2012

### University of Science and Technology of China

China

B.S. IN MECHANICAL ENGINEERING

Jun. 2009

## Projects

### Characterization of mechanics of electrosurgical cutting for liver tissue

Troy, NY

RESEARCH ASSISTANT AT CEMSIM

Dec. 2017 - present

- Performing ex vivo tissue experiments to determine fracture toughness of liver tissue
- Developing an inverse optimization model to characterize the mechanics of electrosurgical cutting

### Reduced Order Modeling for Electrosurgery

Troy, NY

RESEARCH ASSISTANT AT CEMSIM

Nov. 2017 - present

- Developing proper generalized decomposition (PGD) based reduced order model for large scale multiphysics simulation in electrosurgery
- Building a RNN using tensorflow for analysis on the evolution of reduced basis

### Multi-physics Model for Electrosurgical Cutting of Soft Tissue

Troy, NY

RESEARCH ASSISTANT AT CEMSIM

Jul. 2016 - Oct. 2017

- Developed deflation based block preconditioner for solving large scale multi-physics problem that resulted in linear increase in computational cost with increase in number of degrees of freedom
- Proposed cellular level micromechanical model to describe thermo-mechanical response of soft tissue
- Developed level set method to tissue fracture driven by second law of thermodynamics

### Electromagnetic Simulations (Current Pathway) on AustinMan Voxel Model

Troy, NY & Boston, MA & Carrboro, NC

RESEARCH ASSISTANT AT CEMSIM & ALLIED HEALTH PROFESSIONAL MEMBER AT CARL J. SHAPIRO SIMULATION &

SKILLS CENTER & LONG-TERM VISITOR AT KITWARE

Sep. 2015 - Jun. 2016

- Developed an immersive and interactive GUI (QT, VTK) in zspace, later transferred to HTC Vive with Leap Motion
- Demonstrated current flow through virtual human based on Maxwell's equations and how dispersive electrode protects the patient
- Designed several clinically relevant abnormal scenarios due to any abnormal associated conditions (excessive body hair, previous scarring, implants)
- Performed pilot study at Carl J. Shapiro Simulation & Skills Center and face validation at SAGES learning center

### Development of the Virtual Electrosurgery Skill Trainer (VEST) for Monopolar Electrosurgical Tasks

Troy, NY & Boston, MA

RESEARCH ASSISTANT AT CEMSIM

Jan. 2014 - Jun. 2015

- Developed the monopolar electrosurgery interactions that include cutting, coagulation and fulguration in VEST
- Controlled the power settings and modes of operation by a virtual electrosurgical unit

- Presented a real-time and physically realistic simulation of electrosurgery, by modeling the electrical, thermal and mechanical properties as three iteratively solved finite element models
- Proposed a dynamic triangulation algorithm based on isotherms to provide sub-finite element graphical rendering of vaporized tissue
- Utilized block compressed row storage (BCRS) structure for computationally efficient changes in the tissue topology
- Transitioned the techniques to a virtual laparoscopic adjustable gastric banding (LAGB) surgical simulator

## Experience

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### Professional Experience

- Visiting Allied Health for **SAGES** (Society of American Gastrointestinal and Endoscopic Surgeons) 2017 Annual Meeting, Houston, Texas, March 2017
- Faculty of Workshop - VEST at the 9th Annual **ACS-AEI** (Division of Education of the American College of Surgeons and the Program for Accreditation of Education Institutes) Postgraduate Course, Carl J. Shapiro Simulation & Skills Center, Beth Israel Deaconess Medical Center, Boston, Massachusetts, September 2016
- Visiting Allied Health for **SAGES** (Society of American Gastrointestinal and Endoscopic Surgeons) 2016 Annual Meeting, Boston, Massachusetts, March 2016
- Long-term visitor at **Kitware**, Carrboro North Carolina, May 2016 - Present
- **IDEAS** (Innovation, Design and Emerging Alliances in Surgery: Virtual Surgery) workshop, Carl J. Shapiro Simulation & Skills Center, Beth Israel Deaconess Medical Center, Boston, Massachusetts, November 2013

### Teaching Experience

- Teaching assistant for the undergraduate Vibrations class, Aug. 2014 - Dec. 2014
- Teaching assistant for the undergraduate Introduction to Manufacturing Planning class, Jan. 2013 - May 2013
- Teaching assistant for the undergraduate Introduction to Engineering Analysis class, Aug. 2012 - Dec. 2012

## Publications

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### Journals

- **Z. Han**, Rahul, and S. De, PGD acceleration of coupled problems in electrosurgery, prepared for *Comput. Methods Appl. Mech. Engrg.*, 2018
- M. Dombek, C. A. López, **Z. Han**, D. B. Jones, J. Olasky, S. Schwaitzberg, C. Cao, S. De, FUSE certification enhances performance on an immersive virtual reality based simulator for dispersive electrode placement, accepted by *Surgical Endoscopy*, 2018
- **Z. Han**, Rahul, and S. De, A multiphysics model for radiofrequency activation of soft hydrated tissues, submitted to *Comput. Methods Appl. Mech. Engrg.*, 2017
- Z. Lu, V. S. Arikatla, **Z. Han**, B. F. Allen, and S. De, A physics-based algorithm for real-time simulation of electrosurgery procedures in minimally invasive surgery, *Int. J. Med. Robot.*, 10(2014), 495-504
- L. Sun, J. Wand, **Z. Han**, and C. Zhu, Active Vibration Suppression Based on Intelligent Control for a Long-range Ultra-precise Positioning System, *Applied Mechanics and Materials*, 87(2011), 123-128

### Proceedings

- **Z. Han**, Rahul and S. De, An efficient solution approach for multiphysics modeling of electrosurgery, *13rd World Congress on Computational Congress (WCCM 2018)*, 2018
- **Z. Han**, Rahul, C. A. López, and S. De, A fast Krylov subspace-based method for multi-physics modeling of electrosurgical cutting of soft tissue, *VII International Conference on Coupled Problems in Science and Engineering*, Invited Sessions, 2017
- M. Dombek, C. A. López, **Z. Han**, D. B. Jones, J. Olasky, S. Schwaitzberg, C. Cao, S. De, The virtual electrosurgical skill trainer (VEST)- Face validation of a dispersive electrode placement module, Poster presentation at SAGES 2017 Annual Meeting; 2017 Mar. 22-25; Houston, TX.
- M. Dombek, C. A. López, **Z. Han**, D. B. Jones, J. Olasky, S. Schwaitzberg, C. Cao, S. De, The virtual electrosurgical skill trainer (VEST)- Principles of current pathway, Poster presentation at SAGES 2016 Annual Meeting; 2016 Mar. 16-19; Boston, MA.
- **Z. Han**, V. S. Arikatla, and S. De, A local level set-based approach for modeling electrosurgical tissue cutting, *13rd National Congress on Computational Mechanics*, Minisymposia, 2015
- **Z. Han**, V. S. Arikatla, and S. De, GPU-based parallel algorithms for simulation of Electrosurgery procedures in real-time, *13rd National Congress on Computational Mechanics*, Minisymposia, 2015
- X. Chen, S. Yang, and **Z. Han**, etc., Real-time, 3-dimensional scanning imaging system using tunable lens for dynamic precess, *Intelligent computation and Bio-Medical Instrumentation (ICBIM)*, *International conference on IEEE*, 2012

## Professional Skills

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- 1 **Operating Systems**, Windows, Linux
- 2 **Programming**, C++/C, Matlab, Python, CUDA, WebGL, QT, VTK
- 3 **Game Engines**, Unity, Unreal