Jacob P. Kimball

Graduate Research Assistant
Georgia Institute of Technology
Department of Electrical and Computer Engineering
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Research Interests

- Machine Learning and bio-signal processing
- Noninvasive physiological sensing systems
- Detection, monitoring and triage of trauma and sepsis
- Longitudinal health monitoring, including mental health

Education

PhD | ***Electrical Engineering*** Aug. 2017 –
Georgia Institute of Technology Atlanta, GA

Thesis: Continuous Estimation of Blood Volume Status Using Wearable Sensing and Machine Learning
Advisor: Dr. Omer T. Inan, PhD

Master of Science | ***Electrical Engineering*** Aug. 2017 – May 2020
Georgia Institute of Technology Atlanta, GA

Bachelor of Science | ***Major: Electrical Engineering, Minor: Mathematics*** Aug. 2011 – Apr. 2017
Brigham Young University Provo, UT

Honors and Awards

Nominated for the Georgia Institute of Technology Cleaver Award May 2021
The Colonel Oscar P. Cleaver Awards are given to the Ph.D. students who presented the most outstanding Ph.D. dissertation proposals in the previous year.

Blended and Online Learning Design (BOLD) Graduate Fellowship Jan. 2021 – May 2021
An open education initiative aimed at enabling and empowering graduate students to become knowledge producers through developing open educational resources for blended and online learning.

Georgia Institute of Technology President's Fellowship Aug. 2017 – May 2021
Fellowship for PhD students with exemplary levels of scholarship and innovation

Best Undergraduate Poster Award 2016
IEEE Eta Kappa Nu Poster Session at Brigham Young University

Heritage Scholarship 2011–2017
Merit-based scholarship; full tuition for 8 semesters at Brigham Young University

Carl M. Hansen Foundation Engineering Scholarship 2011
Merit-based scholarship from the Washington Society of Professional Engineers

Research Experience

Graduate Research Assistant | ***Inan Research Lab*** May 2018 –
Georgia Institute of Technology Atlanta, GA

- Designed and led an intensive large animal study involving 6 pigs in collaboration with a private preclinical testing facility
- Developed novel methods for cardio-mechanical signal analysis
- Utilized machine learning algorithms to estimate blood volume decompensation status from noninvasive biosignals
- Worked closely with my advisor during the last two years of my program in contributing to grant proposals and renewals.

Faculty-Supervised Research | ***Inan Research Lab*** Jan. 2018 – May 2018
Georgia Institute of Technology Atlanta, GA

- Investigated control strategies for noninvasive physiological sensors-driven neuromodulation
- Assisted in data analysis for study involving transcutaneous vagal nerve stimulation

Faculty-Supervised Research | ***GT-Bionics Lab*** Aug. 2017 – Dec. 2017
Georgia Institute of Technology Atlanta, GA

- Designed and built a prototype device with independent heat sources and temperature sensors to investigate control strategies for the thermal management of implantable medical devices

Research Assistant | ***Electro-Holography Laboratory*** Aug. 2014 – Apr. 2017
Brigham Young University Provo, UT

- Fabricated acousto-optic and electro-optic modulators for use towards holographic video and optogenetics applications
- Specialized in photolithography techniques and machines for other fabrication processes
- Optimized processes and recipes for improved prototyping and quick turnaround
- Trained other students in research techniques including design and fabrication processes

Teaching & Mentoring Experience

Guest Lecturer Feb. 2021
Georgia Institute of Technology Atlanta, GA

- **Course:** ECE 4782 Biosystems Analysis
- **Lecture Topic:** Practical Machine Learning Basics for Biosystems Analysis

Blended and Online Learning Design (BOLD) Graduate Fellowship Jan. 2021 – May 2021
Georgia Institute of Technology Atlanta, GA

- Developed a set of open source Jupyter notebooks to assist in teaching the basics of machine learning applied to physiological sensing systems.

Tech to Teaching Certificate Program Jan. 2021 –
Georgia Institute of Technology Atlanta, GA

- Attended interactive workshops on inclusive and effective teaching practices
- (Future) Complete a capstone experience to practice and evaluate my teaching skills

Opportunity Research Scholar (ORS) Mentor Aug. 2020 – May 2022
Georgia Institute of Technology Atlanta, GA

- Led program-wide workshop on research documentation and literature review for undergraduate students
- Mentored a research team of undergraduate students
  Students: Aditya Singh, Katherine Weatherwax, Ugonna Nwankwo, Mory Fode Traory
  Research Project: Finite Element Method Modeling of the Heart to Determine Generative Factors of the Seismocardiogram

Graduate Teaching Assistant Aug. 2017 – May 2018
Georgia Institute of Technology Atlanta, GA

- **Course:** ECE 3550 Feedback Control Systems (2 separate semesters)
- **Professors:** Dr. Erik Verriest, PhD and Dr. Richard Causey, PhD
- **Responsibilities:** Held weekly office hours, graded homework and held review sessions for tests

Publications and Patents

Journal Articles

1. D. Lin, **J. P. Kimball**, J. S. Zia, V. Ganti, and O. T. Inan, Reducing the impact of external vibrations on fiducial point detection in seismocardiogram signals, Transactions on Biomedical Engineering (*In Press*).
2. **J. P. Kimball**, J. S. Zia, S. An, C. Rolfes, J-O. Hahn, M. N. Sawka, and O. T. Inan, Unifying the estimation of blood volume decompensation status in a porcine model of relative and absolute hypovolemia via wearable sensing, IEEE Journal of Biomedical and Health Informatics (*In Press*).
3. H. Jung, **J. P. Kimball**, T. Receveur, E. D. Agdeppa, and O. T. Inan, Accurate ballistocardiogram based heart rate estimation using an array of load cells in a hospital bed, IEEE Journal of Biomedical and Health Informatics (2021).
4. J. S. Zia, **J. Kimball**, C. J. Rozell, and O. T. Inan, Harnessing the manifold structure of cardiomechanical signals for physiological monitoring during hemorrhage, Transactions on Biomedical Engineering (2020).
5. J. Zia*, **J. Kimball***, C. Rolfes, J.-O. Hahn, and O. T. Inan, Enabling the assessment of trauma-induced hemorrhage via smart wearable systems, Science Advances **6** (2020), *** these authors contributed equally to this work**.
6. J. Zia, **J. Kimball**, S. Hersek, and O. T. Inan, Modeling consistent dynamics of cardiogenic vibrations in low-dimensional subspace, IEEE Journal of Biomedical and Health Informatics **24**, 1887–1898 (2020).
7. J. Zia, **J. Kimball**, S. Hersek, Md. H. Shandhi, B. Semiz, and O. T. Inan, A unified framework for quality indexing and classification of seismocardiogram signals, IEEE Journal of Biomedical and Health Informatics **24**, 1080–1092 (2019).
8. S. Gneiting, **J. Kimball**, A. Henrie, S. McLaughlin, T. DeGraw, and D. E. Smalley, Characterization of anisotropic leaky mode modulators for holovideo, Journal of Visualized Experiments **109** (2016).

9. D. E. Smalley, S. McLaughlin, C. Leach, **J. Kimball**, V. M. Bove Jr., and S. Jolly, Progress on characterization and optimization of leaky mode modulators for holographic video, Journal of Micro/Nanolithography, MEMS, and MOEMS **14** (2015).

Conference Proceedings

1. Y. Chalumuri, **J. Kimball**, A. Mousavi, J. Zia, C. Rolfes, J. Parreira, , O. T. Inan, and J-O. Hahn, Classification of blood volume state via wearable physiological sensing and machine learning, in *2021 IEEE EMBS International Conference on Biomedical Health Informatics (BHI)* (IEEE, 2021).
2. **J. P. Kimball**, J. S. Zia, S. An, C. Rolfes, J-O. Hahn, M. N. Sawka, and O. T. Inan, Preclinical evaluation of wearable sensors and artificial intelligence for continuous estimation of hypovolemic status: Towards closed-loop combat casualty care, in *2021 Military Health System Research Symposium (MHSRS)* (United States Army Medical Research and Development Command (USAMRDC), *under review*).
3. A. Ildefonso, **J. P. Kimball**, J. D. Cressler, and D. McMorrow, Using machine learning to mitigate single-event upsets in RF circuits and systems, in *2021 IEEE Nuclear and Space Radiation Effects Conference (NSREC)* (IEEE NPSS, 2021) p. **Chosen for oral presentation**.
4. H. Jung, **J. Kimball**, T. Receveur, E. D. Agdeppa, and O. T. Inan, Quantification of posture-induced changes in bed-based ballistocardiogram, in *Computing in Cardiology (CinC)* (CinC, 2020) pp. 1–4. **Chosen for oral presentation**.
5. J. Zia, **J. Kimball**, J-O. Hahn, and O. T. Inan, Mitigating hypovolemia-induced miscalibration of photoplethysmogram-derived blood pressure, in *42nd Annual IEEE Engineering in Medicine and Biology Conference (EMBC)* (IEEE, 2020) pp. 5288–5291.
6. J. Zia, **J. Kimball**, and O. T. Inan, Localizing placement of cardiomechanical sensors during dynamic periods via template matching, in *42nd Annual IEEE Engineering in Medicine and Biology Conference (EMBC)* (IEEE, 2020) pp. 473–476.
7. **J. Kimball**, J. Zia, C. Rolfes, J-O. Hahn, and O. T. Inan, Preliminary evaluation of a noninvasive approach for monitoring severe hemorrhagic shock based on wearable technology in a porcine model, in *43rd Annual Conference on Shock* (Shock Society, 2020) pp. 71–71.
8. J. Zia, **J. Kimball**, M. H. Shandhi, and O. T. Inan, Automated identification of persistent time-domain features in seismocardiogram signals, in *2019 IEEE EMBS International Conference on Biomedical Health Informatics (BHI)* (IEEE, 2019).
9. S. Gneiting, D. E. Smalley, K. Qaderi, A. Henrie, B. Haymore, S. McLaughlin, **J. Kimball**, C. Leach, and T. DeGraw, Optimizations for robust, high-efficiency waveguide based holographic video, in *2016 IEEE 14th International Conference on Industrial Informatics (INDIN)* (IEEE, 2016).

Articles Under Review

1. A. Ildefonso, **J. P. Kimball**, A. Khachatrian, Y. Mensah, J. W. Teng, G. N. Tzintzarov, S. G. Rao, A. Moradinia, J. D. Cressler, and D. McMorrow, Using machine learning to mitigate single-event upsets in RF circuits and systems, IEEE Transactions on Nuclear Science (*Submitted*).
2. H. Jung, **J. P. Kimball**, T. Receveur, A. Gazi, E. D. Agdeppa, and O. T. Inan, Estimation of tidal volume using load cells on a hospital bed, IEEE Journal of Biomedical and Health Informatics (*Submitted*).

Book Chapters

1. **J. P. Kimball**, A. H. Gazi, G. C. Ozmen, H. Jung, Md. M. H. Shandhi, S. Mabrouk, S. Gharehbaghi, V. G. Ganti, and O. T. Inan, Noninvasive multimodal physiological sensing systems: Design, implementation and validation, in *Encyclopedia of Sensors and Biosensors*, edited by R. Jafari (Elsevier, under review).

Patent Applications

1. H. Jung, **J. P. Kimball**, O. T. Inan, T. J. Receveur, and E. D. Agdeppa, Estimation of tidal volume using load cells on a hospital bed (), U.S. Patent Application 63/216,798, Filed June 2021 by Hillrom.
2. H. Jung, **J. P. Kimball**, O. T. Inan, T. J. Receveur, and E. D. Agdeppa, Bed-based ballistocardiogram apparatus and method (), U.S. Patent Application 63/086,724, Filed Mar. 2020 by Hillrom.
3. J. Zia, O. T. Inan, and **J. P. Kimball**, Automated localization and misplacement correction for wearable cardiac monitoring systems measuring precordial acceleration, U.S. Patent Application 62/877,404, Filed Feb. 2020 by the Georgia Institute of Technology.

Invited Presentations

Preclinical Evaluation of Wearable Sensors and Machine Learning for Continuous Estimation of Hypovolemic Status — July 2021
Special Session: Opportunities for Machine Learning and Noninvasive Sensing to Impact Emergency Cardiovascular Care
IEEE BHI 2021

Wearable Technologies for Pre-Hospital Trauma Care — July 2021
Special Session: Wearable Sensing for Detecting and Monitoring Shock
IEEE BSN 2021

Professional Affiliations and Activities

Special Session Organizer — 2021
Opportunities for Machine Learning and Noninvasive Sensing to Impact Emergency Cardiovascular Care
IEEE International Conference on Biomedical and Health Informatics (IEEE BHI-BSN 2021)

Student Member, IEEE (Institute for Electrical and Electronic Engineers) — 2018–

Article Reviewer

- IEEE Engineering in Medicine and Biology Society Conference (EMBC)
- Georgia Clinical and Translational Science Alliance Conference (Georgia CTSA)

Industry Experience

Research and Development Intern May 2021–Aug. 2021
Hillrom Cary, NC

- Developed software (in Python) for multiple proof-of-concept stages for enhanced functionality of existing products
- Developed sepsis prediction models from the MIMIC-IV dataset (Physionet.org)

Product Development Intern May 2017–Aug. 2017
The Church of Jesus Christ of Latter-day Saints Riverton, UT

- Automated software acquisition processes utilizing ServiceNow
- Assisted in enterprise adoption and training of the Microsoft Suite, Office 2016 and 365

Community Involvement

Volunteer Full-time Representative Sep. 2012– Aug. 2014
The Church of Jesus Christ of Latter-day Saints Los Angeles, CA

- Supervised and trained 120 other full-time representatives
- Taught semiweekly ESL classes over a period of 8 months
- Trained large groups of leaders to improve capability and performance, with an emphasis on goal setting, planning and motivation.
- Worked in and led teams of people from many different cultures and backgrounds

Professional References

Dr. Omer T. Inan, PhD
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Additional references are available upon request.