Summer 2020

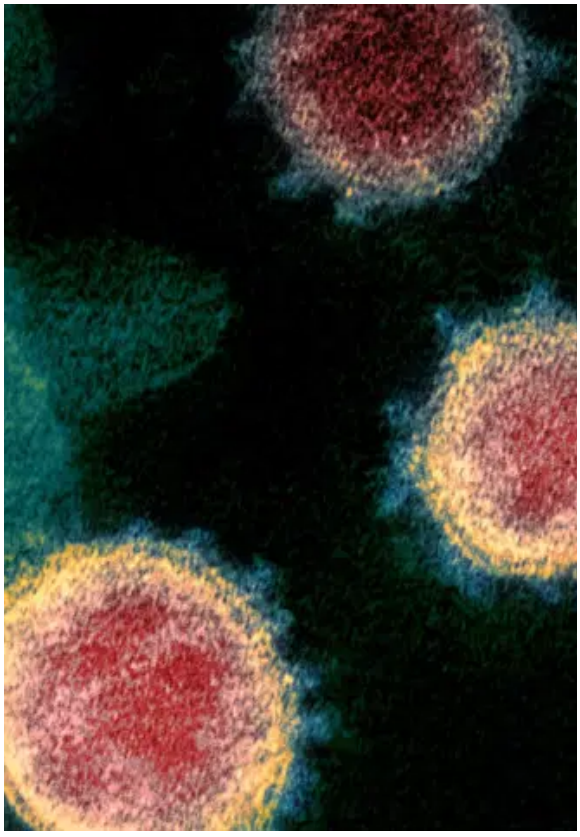
CENTER FOR Machine-Integrated Computing & Security

Summer News

COVID-19 PROJECTS & INITIATIVES

A Controlled Response to COVID-19

Professor Massimo Franceschetti and Professor Behrouz Touri are proposing a generalization of the Susceptible Infectious Recovered (SIR) model for inhomogeneous population. Using tools from optimal control and nonlinear control and based on the proposed mean-field model, they are finding the optimal-cost containment policy to meet the local health-care provider's care capacity.



Distributed Control and Hierarchical Decision Making for Ventilated Patients

Ph.D Student Michael Barrow with Dr. Ryan Kastner and Dr. Shanglei Liu (former UC San Diego resident, now fellow at the Mayo Clinic) are developing a low-cost telemedicine system that allows clinicians to simultaneously manage a large number of patients on ventilators.

Privacy-Preserving COVID-19 Discovery

Professor Farinaz Koushanfar and her team are working on privacy preservation for the protection of COVID-19 researchers and patients alike. They provide one-of-a-kind provable privacy-preserving methodologies, based on verified cryptographic protocols, which enable collaboration among the various entities in the encrypted domain. The platform removes several critical obstacles in the global-scale study of COVID-19, and, in turn, will accelerate the process of finding new recovery mechanisms.

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Real-Time Phylogenetic Inference and Transmission Cluster Analysis of COVID-19

P.I. Niema Moshiri and Co-P.I. Tajana S. Rosing's project goal is to develop a user-friendly, scalable, and modular workflow for conducting a computational phylogenetic analysis of assembled viral genomes.

Robust AI for Automated and Accelerated Literature and Trend COVID-19 Systemization of Knowledge

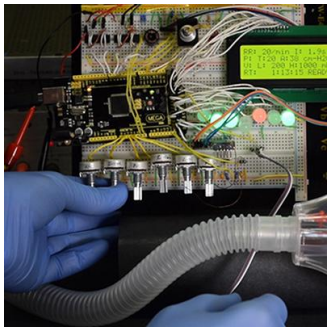
Professor Farinaz Koushanfar and her team are developing novel, robust, and safe accelerated methodologies, based on natural language processing (NLP) to systemize the knowledge discovery and trends in the COVID-19 domain.

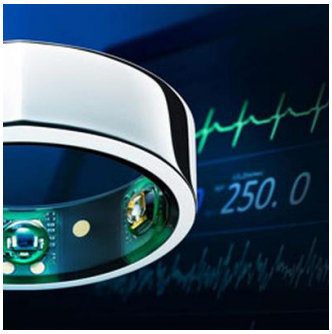
[Technical University Darmstadt & UC San Diego] Privacy-Preserving COVID-19 Bluetooth Contact Tracing App

Professor Farinaz Koushanfar has partnered with collaborators in San Diego and at the Technical University Darmstadt in Germany to develop a fully anonymous contact tracing app, TraceCORONA, with user privacy and security as the primary priority. The app has been released for beta testing on Android and can be downloaded at https://tracecorona.net/download-tracecorona/. An iOS version will follow.

UV-Drone: Mobile Disinfection Platform for Community Facilities with Minimum Human Exposure

Tara Javidi and the DetecDrone Team, leverages Professor Javidi's existing **DetecDrone** research platform developed at UC San Diego to significantly improve on the process of UV based disinfection. Learn more **here**.





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MICS Faculty Spotlight

Duygu Kuzum

"I think my interest in science and engineering began in childhood. I remember breaking apart my toys and trying to repair them out of sheer curiosity about their inner mechanisms," Duygu Kuzum recalled, when she looked back on how her career in electrical and computer engineering began. As she continued on to her Ph.D in conventional digital electronic devices, she became aware of the ceiling technology advancement was going to hit.

Duygu Kuzum is a Professor of Electrical and Computer Engineering at UC San Diego with a background in semiconductor device physics. She and her team are currently working on harnessing the interesting physics of nanomaterials to develop next generation transformative nanoelectronic device technologies for neuromorphic computing. Kuzum says that their " goal is to achieve orders of magnitude improvements in resilience, energy efficiency and integration density at the system level, while achieving maximum accuracy for new AI algorithms." Energy efficiency plays a major role in today's face-paced world of technology, especially for edge computing. Kuzum's work will bring innovation to data intensive computation in fields beyond electrical engineering.

Despite the hard work she invests into her research, Duygu still takes time to step away from technology and go on hikes. If heading up north to Yosemite isn't feasible, she spends her time listening to her daughter learn to play violin.

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Michael Barrow

MICS Student Spotlight

World traveler and Ph.D candidate Michael Barrow strives to re-imagine medical technology to be more affordable and accessible for everyone. Before coming to UC San Diego, Barrow studied Computer Engineering at Bournemouth University in England before flying across the globe to earn his M.Sc. in Electronic Engineering at the Hong Kong University of Science and Technology.

He was inspired to pursue Computer Engineering after attending a lecture from Dr. Sonia Ramamoorthy, his Ph.D co-adviser, on the technical problems she faced in her operating room. From there, he pivoted his research towards helping people with the full support of his P.I., Dr. Ryan Kastner, and Dr. Ramamoorthy. His thesis, titled "Efficient Data Driven Patient Specific Image Guidance in Liver Surgery", proposes technology that enables a "superhero-like see-through vision" for surgeons that is more efficient and accurate than current systems.

Michael has been recently working on a telehealth platform for COVID-19 which you can find out more about here.

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STUDENT AWARDS & ACHIEVEMENTS

Dr. Sadegh Riazi receives Jacobs Graduate Council Award and William S.C. Chang Best Ph.D. Dissertation Award for his dissertation, titled "Towards a Private New World: Algorithm, Protocol, and Hardware Co-Design for Large-Scale Secure Computation."

Dr. Riazi has been working with Prof. Koushanfar in the Electrical and Computer Engineering Department. His research focus is a new set of technologies that enable computation on encrypted data.

Now, more than ever in the past, there is a need to consolidate data privacy requirements and the ability to utilize data. Traditional encryption mechanisms such as Advanced Encryption Standard (AES) allow data to be securely communicated from point A to point B. However, the encrypted (unintelligible) data cannot be used for any computation and has to be decrypted once it's needed.

Dr. Riazi's Ph.D. dissertation proposed novel methodologies that enable computation on encrypted data at an unprecedented scale and performance. His thesis introduces new algorithms, protocols, and hardware architectures to increase the efficiency and scalability of computing on encrypted data by one to two orders of magnitude in each of these categories. Such advances open new doors for privacy-preserving machine learning, secure cloud computing, and personal genomics while protecting individuals' privacy.

Dr. Riazi proposes a new framework in which hospitals can encrypt medical records and allow AI companies to process the data without learning and having access to the raw data. The proof-of-concept implementation of the system for four diagnosis tasks, i.e., breast cancer, diabetes, liver disease, and Malaria, shows less than one second processing time while guaranteeing the privacy of the patients.

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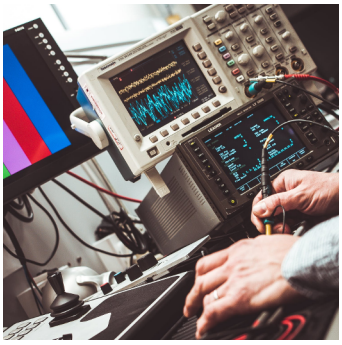
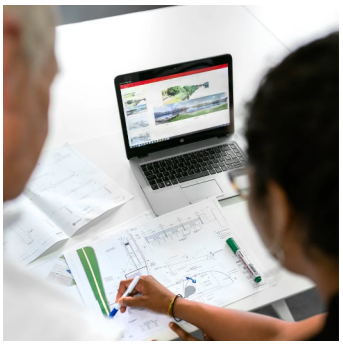


MICS LATEST NEWS

Center for Machine-Integrated Computing and Security has received 13 exceptional proposals from our Faculty this round. We will be able to support five industry selected mini-projects and are pleased to announce their upcoming projects. We greatly appreciate your support of the MICS Center and are looking forward to the continued success for our community of researchers.

Machine Learning for SOC Design Automation— led by MICS Faculty Andrew Kahng

Feature Matching— led by MICS Faculty Truong Nguyen

Homomorphic Encryption in PIM— led by MICS Faculty Tajana Rosing

WasmBox: Automatic, Robust Library Sandboxing for All— led by MICS Faculty Deian Stefan

Neural program translator for ML Compilers— led by MICS Faculty Jishen Zhao

UPCOMING EVENTS

2020 EVENTS

- MICS Partner Signature Recruiting Internship Event - Fall 2020
- MICS Board Meeting and Research Summit - November 4th
- MICS Alumni/Faculty/Industry Mixer - December 2020

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Message from the Directors

The Machine-Integrated Computing & Security (MICS) Center at UC San Diego's Jacobs School of Engineering was founded in late 2018 with the vision of pulling together a multidisciplinary community of scholars, innovators, and industry partners focused on the holistic co-development of hardware and software with privacy and security built in at the core. In less than two years this mission has drawn over 16 faculty members and our distinguished cohort of industry partners working to bring this vision to reality. In this time we have launched Center-sponsored mini-projects to spur innovation, have collaborated with our partners on transformative joint-proposals, and most importantly developed an incredible group of more than 60 graduate students.

Our faculty members are currently undertaking a host of exciting, multidisciplinary projects with a broad application space. Our work and expertise ranges from fundamental studies grounded in semi-conductor physics to real-time data analytics, privacy, and efficient hardware/software. The integrated approach that we take to the co-design of hardware and software bridges the basic and the applied and is a unique strength of the MICS Center. We are a collaborative group that is committed to inclusive excellence and this is reflected in our faculty and students.

The work that is the focus of research within the MICS Center touches every industry and has daily implications in the quality of human life in the digital age. Our work aims to empower clinicians with personalized medicine via new deep learning insights while safeguarding patients, it helps precision agriculture produce healthier foods at scale via remote monitoring and smarter resource allocation based on realtime data, it seeks to help our computation capacity to grow while honoring our responsibility to conserve energy. The opportunities to engage in the mission of the MICS Center are innumerable and our collaborative environment is producing breakthrough ideas and new technologies. We hope you take the time to review our research and we look forward to engaging with you.

Sincerely,
Tara Javidi & Farinaz Koushanfar
MICS Faculty Directors

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