Abstracts and Speaker Biographies

USC-IISc Faculty Research Mini-Symposium on COVID-19 (Online)

June 11, 8-10:30 am (USC)/8:30-11 pm (IISc)

USC-IISc Faculty Research Mini-Symposium on COVID-19

Date: **Thursday, June 11, 8:30-11:00 PM (all times are IST)**
Coordinators: **Cauligi Raghavendra, USC and P. Vijay Kumar, IISc**
Moderator: **Tiffany Tay**

Technical Program

Opening Remarks
8:30-8:40 pm
Yannis Yortsos (Dean, USC Viterbi School of Engineering)
Yadati Narahari (Chair, Division of Electrical, Electronics and Computer Sciences, IISc)

Technical Talks
8:40-9:00 pm
Yannis Yortsos and Assad Oberai, USC:
A comprehensive spatial-temporal infection spreading model, with applications to COVID-19

9:00-9:20 pm
Viktor Prasanna, USC:
Machine Learning to Track the Spread of COVID-19

9:20-9:40 pm
Yogesh Simmhan and Tarun Rambha, IISc:
GoCoronaGo: Privacy-respecting Contact Tracing for COVID-19

9:40-10:00 pm
Bhaskar Krishnmachari, USC:

Privacy-sensitive Mobile-based Contact Tracing for Epidemics

10:00-10:20 pm

Rajesh Sundaresan, **IISc:**
The IISc-TIFR City-scale Agent-based Simulator and its Use in Comparing Unlockdown Strategies

10:20-10:40 pm
Sriram Ganapathy, Prasanta Ghosh and R. Nirmala, IISc:
Does COVID-19 Leave a Sound Trail?

10:40-11:00 PM at IISc
Discussion and Closing

A Comprehensive Spatial-temporal Infection Spreading Model, with Applications to COVID-19.

Yannis C. Yortsos and Assad Oberai

USC Viterbi School of Engineering

Epidemics involve fundamentally infections, which in the particular COVID-19 case are transmitted by human-to-human contact. By treating susceptible and infected individuals as "reacting molecules", infection as a "chemical reaction" and infection rates as "chemical reaction rates", it is possible to cast the problem of the spread of epidemics and contagions as an equivalent problem in an advection-diffusion-reaction system. In this talk we provide such a description. We put specific emphasis to what we believe are the key variables of areal concentrations of individuals, namely number/area, whether infected, susceptible or recovered. These, as well as the overall population density, namely total number/area, are the key variables, as they crucially affect spatial distancing and hence the rate of infections. We solve the resulting partial differential equations and provide some illustrative examples.

Speaker Bio: Yannis C. Yortsos is the Dean of the USC Viterbi School of Engineering and the Zohrab Kaprielian Chair in Engineering, a position he holds since 2005. He received a BS (Diploma) degree in Chemical Engineering from the National Technical University of Athens, Greece, and MS and PhD degrees from the California Institute of Technology, all in chemical engineering. His research area is in fluid flow, transport and reaction processes in porous media with specific application to the subsurface.

He was elected to the National Academy of Engineering in 2008, where he has also served as secretary, vice-chair and chair of Section 11. Since July 2017, Yortsos serves as a member of the NAE Council. In 2011 he was awarded the distinction of honorary member of the AIME, in 2013 he was elected as Associate member of the Academy of Athens, in 2014 he received the Ellis Medal of Honor and since 2017 he holds an honorary degree from Tsinghua University.

Machine Learning to Track the Spread of COVID-19

Viktor Prasanna
Ming Hsieh Department of Electrical and Computing Engineering, USC

The recent outbreak of COVID-19 and the world-wide panic surrounding it calls for urgent measures to contain the epidemic. Predicting the spread of infectious diseases like COVID-19 is essential for preparedness and better management of available resources. It is also essential for simulating scenarios with different policies to reopen the economy. In this talk, we will present heterogeneous infection rate model with human mobility, which is an extension of our prior DARPA Challenge winning work during the Chikungunya epidemic. The model accounts for variable infection rates, inter-region mobility, and a forgetting factor to accommodate rapidly changing infection trends. The model has demonstrated accurate predictions for US state-level and country-level predictions. Through changing of the parameters over time, the model enables the assessment of how various regions have responded to the epidemic. In future work, city- and neighborhood-level predictions will be performed. Based on the predictions, resource allocation problems will be formulated and solved to identify how to distribute resources (masks, testing kits, potential vaccines) among hospitals. Various social distancing strategies will also be formulated and evaluated, informed by the forecasting model. We will also highlight the development of a tool for predicting the global spread of the COVID-19 epidemic.

Speaker Bio: Dr. Prasanna holds the Charles Lee Powell Chair in Engineering and is a professor of electrical engineering and a professor of computer science. His research interests include high performance computing, parallel and distributed systems, reconfigurable computing, cloud computing and smart energy systems. He received his bachelor's degree in electronics engineering from the Bangalore University, master's degree from the School of Automation, Indian Institute of Science and Ph.D. in computer science from the Pennsylvania State University. Prasanna received the W. Wallace McDowell Award from the IEEE Computer Society in 2015 for his contributions to reconfigurable computing. He received an Outstanding Engineering Alumnus Award from the Pennsylvania State University in 2009. He received a 2019 Distinguished Alumnus Award from the Indian Institute of Science (IISc). He is a Fellow of the IEEE, the Association for Computing Machinery (ACM) and the American Association for Advancement of Science (AAAS).

GoCoronaGo: Privacy-respecting Contact Tracing for COVID-19

Yogesh Simmhan, Computational and Data Sciences,
Tarun Rambha, Civil Engineering and CiSTUP,
IISc

This talk will discuss the GoCoronaGo (GCG) digital contact tracing app developed at IISc for COVID management. GCG is a privacy-respecting contact tracing app designed for institutional use within a campus. It uses Bluetooth advertisements and scanning, similar to other contact tracing apps world-wide like TraceTogether and Aarogya Setu. GCG collects the contact data in the backend servers of the institution periodically, builds a contact network, and uses it to perform analytics on various proximity risk scores and non-biological COVID risks. These are used to inform the Institution users about possible safety precautions they need to take. We use centrality measures over the temporal graph and epidemiological models to compute these scores. In the event of a COVID case being detected on campus, it can be used to rapidly identify the first, second and third level contacts from that individual using the contact graph. This can then be shared with the campus health center and government officials for quarantining, etc. GCG can also be deployed across campuses and institutions in a federated manner. Here, data from a campus is collected at each institution and the anonymized partial contact graph shared with a neutral and trusted data broker (such as IISc), which integrates the different partial contact graphs into a global one on which analytics are performed. Risk scores are pushed back to the institutions to be forwarded to their members.

Speaker Bio: Yogesh Simmhan is an Assistant Professor in the Department of Computational and Data Sciences and a Swarna Jayanti Fellow at the Indian Institute of Science, Bangalore. His research explores abstractions, algorithms and applications on distributed systems. These span Cloud and Edge Computing, Distributed Graph Processing Platforms and Elastic Stream Processing to support emerging Big Data and Internet of Things (IoT) applications. He has published over 90 peer-reviewed papers and won the Best Paper Award at IEEE International Conference on Cloud Computing (CLOUD) 2019, IEEE TCSC SCALE Challenge Award in 2019 and 2012, the Distinguished Paper award at EuroPar 2018, and the IEEE/ACM Supercomputing HPC Storage Challenge Award in 2008. He is an Associate Editor-in-Chief of the Journal of Parallel and Distributed Systems (JPDC), and earlier served as an Associate Editor of IEEE Transactions on Cloud Computing and a member of the IEEE Future Directions Initiative on Big Data. Yogesh has a Ph.D. in Computer Science from Indiana University, Bloomington, and was previously a Research Assistant Professor at the University of Southern California (USC), Los Angeles, and a Postdoc at Microsoft Research, San Francisco. He is a Senior Member of the IEEE and the ACM.

Privacy-sensitive Mobile-based Contact Tracing for Epidemics

Bhaskar Krishnamachari

Ming Hsieh Department of Electrical and Computing Engineering, USC

Contact tracing offers a way to proactively help individuals know if they may be at higher risk due to exposure to infection so that they can take relevant measures such as getting tested or taking additional safety precautions. I will describe two protocols for privacy-sensitive contact logging developed at USC Viterbi that are based on the exchange of anonymous information via short-range Bluetooth contacts. This work and those of other academic researchers are connected to the recent announcement by Apple and Google that they are collaborating on an interoperable API for such "exposure notification" apps.

Speaker Bio: Bhaskar Krishnamachari is a Professor of Electrical and Computer Engineering at USC Viterbi. He works on algorithms for the internet of things and distributed systems. He has co-authored more than 300 papers, and 2 textbooks, collectively cited more than 25000 times. He has been a co-recipient of several best paper awards including at ACM MobiCom and ACM/IEEE IPSN.

The IISc-TIFR City-scale Agent-based Simulator and its Use in Comparing Unlockdown Strategies

Rajesh Sundaresan
Electrical Communication Engineering, IISc

We will provide a brief description of the IISc-TIFR city-scale agent-based framework for comparing various "unlockdown" strategies. We will then discuss some outcomes of our studies on Mumbai and Bengaluru, e.g., graded openings of offices, graded opening of train services in Mumbai, importance of compliance, and the impact of different containment strategies.

Speaker Bio: Rajesh Sundaresan is a professor at the Indian Institute of Science. He is currently associated with the Department of Electrical Communication Engineering, the Robert Bosch Centre for Cyber-Physical Systems, and the Centre for Networked Intelligence at the Indian Institute of Science. He received his PhD in Electrical Engineering from Princeton University in 1999, built communication modems at Qualcomm Inc. until 2005, and has been at the Indian Institute of Science since 2005, except for brief visitations to Qualcomm Inc., the University of Illinois at Urbana-Champaign, and the Toulouse Mathematical Institute. His current research interests are in cyber-physical systems, cyber-social systems, and aspects of information exchange in such systems.

Does COVIDUSC -19 Leave a Sound Trail ?

Sriram Ganapathy, Electrical Engineering,
Prasanta Ghosh, Electrical Engineering,
R. Nirmala, Health Center,
IISc

The current gold standard method for COVID-19 detection is the reverse transcription polymerase chain reaction (RT-PCR) testing. However, this method is expensive, time-consuming, and violates social distancing. Also, as the pandemic is expected to stay for a while, there is a need for an alternate diagnosis tool which overcomes these limitations and is deployable at a large scale. The prominent symptoms of COVID-19 include cough and breathing difficulties. Some early efforts show that respiratory sounds, when analyzed using machine learning techniques, can provide useful insights, enabling the design of a diagnostic tool. Towards this, the talk describes our early efforts in creating (and analyzing) a database, called Coswara, of respiratory sounds, namely, cough, breath, and voice. The sound samples are collected via worldwide crowdsourcing using a website application https://coswara.iisc.ac.in/. We believe that insights from analysis of Coswara can be effective in enabling sound-based technology solutions for point-of-care diagnosis of respiratory infection, and in the near future this can help to diagnose COVID-19.

Speaker Bio: Sriram Ganapathy is a faculty member at the Department of Electrical Engineering, Indian Institute of Science, Bangalore and leads the activities of the learning and extraction of acoustic patterns (LEAP) lab, IISc. Previously, he was a research staff member at the IBM Watson Research Center. He received his PhD from the Center of Language and Speech Processing, Johns Hopkins University. His research interests include signal processing and deep learning applied to speech recognition, speaker recognition and auditory neuroscience. He is a member of the ISCA, a Senior Member of the IEEE and Subject Editor for Elsevier Speech Communications.