Date:	Wednesday, September 16, 2020
Time:	8:00-10:30 am (USC)
	8:30 pm to 11:00 pm, (IST)
Coordinators:	Cauligi Raghavendra, USC,
	P. Vijay Kumar, IISc
Moderator:	Tiffany Tay, USC
Zoom Webinar Registration Link:	https://tinyurl.com/USCIIScFacultySymposium

AGENDA

A. Opening Remarks

- 8:00 AM to 8:10 AM at USC/8:30 PM to 8:40 PM at IISc
  Yannis Yortsos (Dean, Viterbi School of Engineering, USC)
  Yadati Narahari (Chair, Division of Electrical, Electronics and Computer Sciences, IISc)

B. Technical Session

I 8:10-8:30 AM at USC / 8:40-9:00 PM at IISc
Vijay Chandru, Strand Life Sciences & IISc:
Exponential Technologies and the Perfect Storm for Digital Health

II 8:30-8:50 AM at USC / 9:00-9:20 PM at IISc
Yannis Yortsos, Assad Oberai, and Harisankar Ramaswamy, USC:
A Comprehensive Spatial-temporal Infection Model, with Applications to COVID-19

III 8:50-9:10 AM at USC / 9:20-9:40 PM at IISc
Sashikumaar Ganesan and Deepak Subramani, IISc:
Spatio-temporal Predictive Modeling Framework for Infectious Disease Spread

IV 9:10-9:30 AM at USC / 9:40-10:00 PM at IISc
Bhaskar Krishnamachari, USC:
Update on Digital Contact Tracing and Risk Estimation for COVID-19

V 9:30-9:50 AM at USC / 10:00-10:20 PM at IISc
Cyrus Shahabi, USC:
PREP: Pandemic Risk Evaluation Platform – Beyond Contact Tracing for COVID-19

VI 9:50-10:05 AM at USC / 10:20-10:35 PM at IISc
Rajesh Sundaresan, IISc:
Swabs-to-labs Tool and Serosurvey Designs

VII 10:05-10:20 AM at USC/ 10:35-10:50 PM at IISc
Meher Prakash JNCASR, Santosh Ansumali, JNCASR and Aloke Kumar, IISc:
Different stages, Different Modeling Strategies: Adaptive Strategies for Early Stage, Detailed SAIR Modeling for the Intermediate Stage, Space-Time Analytics for a Mature Stage

VIII 10:20-10:30 AM at USC/10:50-11:00 PM at IISc
Discussion and Closing

Abstracts and Speaker Biographies

I. Exponential technologies and the perfect storm for digital health
by Vijay Chandru, Strand Life Sciences, & IISc

Abstract

A brief overview of translational research and technology innovation aimed at dealing with the COVID-19 pandemic and taking place in Karnataka, will be provided. An emphasis will be on the role of digital technologies in the context of testing, tracing and treating the patients in the state.

Speaker Bio: Vijay Chandru is an academic and an entrepreneur. His academic career in decision sciences has spanned over four decades at Purdue University and at the Indian Institute of Science. A fellow of academies of science and engineering in India, he is an adjunct professor in Interdisciplinary Research at the Indian Institute of Science. At Strand Life Sciences, India's first example of academic entrepreneurship, Chandru served as co-founder and executive chairman from inception in 2000 till 2018. A technology pioneer of the World Economic Forum, he has served on the Industry Agenda Council on the the Future of the Health sector.

II. A comprehensive spatial-temporal infection model with applications to COVID-19

by Yannis Yortsos, Assad Oberai, and Harisankar Ramaswamy, USC

Abstract

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. The talk on September 16th represents follow-up work on this topic.

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.

III. Spatio-temporal predictive modeling framework for infectious disease spread by Sashikumaar Ganesan and Deepak Subramani, Department of Computational and Data Sciences, IISc

Abstract

A novel predictive modeling framework for the spread of infectious diseases using high dimensional partial differential equations [1] will presented in this talk. In the proposed model, the evolution of the infected population is described by a high-dimensional population balance equation. Further, new infections are introduced among the susceptible population from non-quarantined infected population based on their interaction, adherence to distancing norms, hygiene levels and any other societal interventions. Moreover, recovery, death, immunity and all aforementioned parameters are modeled on the high-dimensional space. To epitomize the capabilities and features of the proposed framework, prognostic estimates of Covid-19 spread using a six-dimensional (time, 2D space, infection severity, duration of infection, and population age) PBE will be presented. Further, a few scenario analysis will also be presented for different policy interventions and population behavior, throwing more insights into the spread of infections across the disease age, the intensity and the age of population. These insights could be used for science-informed policy planning.

[1] S. Ganesan, D. Subramani: Spatio-temporal predictive modeling framework for infectious disease spread. arXiv, (2020) arXiv:2006.15336v1

Speaker Bio: Prof. Sashikumaar Ganesan is an Associate Professor in Department of Computational and Data Sciences, IISc. He was a Postdoc at Imperial College London and Alexander von Humboldt Postdoc fellow at WIAS Berlin before Joining IISc. His research areas include Finite Element Analysis, Hybrid Parallel Algorithms, Data-Driven Modeling of Complex Systems, Machine Learning & Neural Networks for Estimation of Physical and Numerical Parameters, Data-Driven Approaches for Prognostic Estimates and Scenario analysis.

IV. Update on Digital Contact Tracing and Risk Estimation for COVID-19

by Bhaskar Krishnamachari, Ming Hsieh Department of Electrical and Computing Engineering, USC

Abstract

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. The talk on September 16th represents follow-up work on this topic.

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.

V. PREP: Pandemic Risk Evaluation Platform - Beyond Contact Tracing for COVID-19, by Cyrus Shahabi, USC

Abstract

Digital contact-tracing, along with testing, is pretty much the only solution offered to gradually relax stay-at-home orders, allowing us to get back to work and normal life. A recent effort by Apple and Google to collect co-location data, which would enable large-scale contact-tracing and in real-time using Bluetooth-based proximity detection, is a step at the right direction. However, in order to really stop the pandemic in its tracks, we need a nuanced risk assessment that takes many factors into consideration, including people's mobility patterns. Therefore, in this talk, I present our envisioned platform, dubbed Pandemic Risk Evaluation Platform (PREP) which includes contact mapping and risk analysis that are complementary to any contact-tracing app. For contact-mapping, we're working with USC student health to develop a dashboard for human contact tracers to query and visualize the traces collected by (any) contact-tracing app. Our initial work on risk-analysis and privacy is already funded under an NSF RAPID grant and uses ML tools to estimate both individual and location risk scores. These risk scores can in turn be fed into a spatiotemporal spread simulator that can be used by policy makers to study the spread as they implement various interventions. Finally, we discuss some of the privacy implications of PREP and offer both basic and advanced solutions from the fields of encryption and differential privacy.

Speaker Bio: Cyrus Shahabi is a Professor of Computer Science, Electrical Engineering and Spatial Sciences; Helen N. and Emmett H. Jones Professor of Engineering; the chair of the Computer Science Department; and the director of the Integrated Media Systems Center (IMSC) at USC's Viterbi School of Engineering. He was co-founder of two USC spin-offs, Geosemble Technologies and Tallygo, which both were acquired, in July 2012 and March 2019, respectively. He received his B.S. in Computer Engineering from Sharif University of Technology in 1989 and then his M.S. and Ph.D. Degrees in Computer Science from the University of Southern California in May 1993 and August 1996, respectively. He authored two books and more than three hundred research papers in databases, GIS and multimedia with more than 12 US Patents. Dr. Shahabi has received funding from several agencies such as NSF, NIJ, NASA, NIH, DARPA, AFRL, NGA and DHS as well as several industries such as Chevron, Google, HP, Intel, Microsoft, NCR, NGC and Oracle. He was an Associate Editor of IEEE Transactions on Parallel and Distributed Systems (TPDS) from 2004 to 2009, IEEE Transactions on Knowledge and Data Engineering (TKDE) from 2010-2013 and VLDB Journal from 2009-2015. He is currently the chair of ACM SIGSPATIAL for the 2017-2020 term and also on the editorial board of the ACM Transactions on Spatial Algorithms and Systems (TSAS) and ACM Computers in Entertainment. He is the founding chair of IEEE NetDB workshop and also the general co-chair of SSTD'15, ACM GIS 2007, 2008 and 2009. He chaired the founding nomination committee of ACM SIGSPATIAL for its first term (2011-2014 term). He has been PC co-chair of several conferences such as APWeb+WAIM'2017, BigComp'2016, MDM'2016, DASFAA 2015, IEEE MDM 2013 and IEEE BigData 2013, and regularly serves on the program committee of major conferences such as VLDB, SIGMOD, IEEE ICDE, ACM SIGKDD, IEEE ICDM, and ACM Multimedia.

VI. Swabs-to-labs tool and sero-survey designs by Rajesh Sundaresan, ECE, IISc

Abstract

In this talk, I will briefly discuss two engagements with the local authorities on handling the COVID-19 pandemic. One is a prediction and an allocation tool that moves swabs to labs in order to ensure full utilisation of the available daily testing capacity. The other involves a sero-survey design for estimating the COVID-19 burden.

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.

VII. Different stages, Different modeling strategies: Adaptive Strategies for Early Stage, Detailed SAIR modeling for the Intermediate Stage, Space-Time Analytics for a Mature Stage

BY

Meher K. Prakash, Theoretical Sciences Unit, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR); VNIR Biotechnologies Pvt Ltd

Santosh Ansumali, JNCASR & Aloke Kumar, IISc

Abstract

As much as the world still continues to be challenged by the COVID-19, the knowledge about the containment and management has improved over the months. The result is lower rates of spread of infections and mortality compared to February. As the pandemic evolved from the early stages to the current stage where many metros, countries are finishing the 1st wave of infections, the modeling challenges take different shapes. We addressed the challenges from three different phases as follows - In the early stage with very few infections, the challenge was one of estimating the rates of infections and the critical care requirements in the exponential phase. As the pandemic advanced and more data was obtained, the questions about asymptomatic fractions, herd immunity and the peak of infections arose. These were answered by developing a COVID-19 specific SAIR model, which also allowed us to extract the driving parameters. We addressed a different challenge at the mature stage when the 1st wave is about to end, by extracting the various underlying parameters from time-varying reproduction number, recovery and death rates from metros to smaller cities which are less prepared to deal with the pandemic. The analytics performed on this data is meant to develop an understanding for how the crisis developed in space-time over the last 6 months. The models from the three different phases are not meant as an academic exercise on the 1st wave data, but rather as a possible preparation for similar phases that may arise in the 2nd wave.

References:

[1] Meher K. Prakash, Shaurya Kaushal, Soumyadeep Bhattacharya, Akshay Chandran, Aloke Kumar, and Santosh Ansumali, Minimal and adaptive numerical strategy for critical resource planning in a pandemic, Phys. Rev. E 102, 021301(R)

[2] Shaurya Kaushal, Abhineet Singh Rajput, Soumyadeep Bhattacharya, M. Vidyasagar, Aloke Kumar, Meher K. Prakash, Santosh Ansumali, Estimating Hidden Asymptomatics, Herd Immunity Threshold and Lockdown Effects using a COVID-19 Specific Model, https://arxiv.org/abs/2006.00045

Speaker Bio: Meher Prakash is an Assistant Professor at the Jawaharlal Nehru Centre for Advanced Scientific Research, and has co-founded VNIR Biotechnologies Pvt Ltd as a spin-off. He has obtained his PhD in Applied Physics from Caltech, working on Chemical Kinetics. Following this, he has had experience of working on large scale biomolecular simulations and the epidemiology of colon-cancer, and the efficacy of screening interventions for the same. His main research interest is in antibiotic resistance, starting from molecular level origins through mutations, to societal level because of poor adherence to the prescribed drugs, using stochastic, agent-based and molecular level models.