Stanford | Institute for Computational & Mathematical Engineering

Xpo 2020 Faculty and Student Speakers

Gianluca Iaccarino

Director of ICME

Professor of Mechanical Engineering

Gianluca is a professor in Mechanical Engineering and Director of the Institute for Computational Mathematical Engineering (https://icme.stanford.edu). He received his PhD in Italy from the Politecnico di Bari in 2005 and has worked for several years at the Center for Turbulence Research (NASA Ames & Stanford) before joining the faculty at Stanford in 2007. Since 2014, he has been the Director of the PSAAP Center at Stanford, funded by the US Department of Energy: a $20M research Center focused on multi-physics simulations, uncertainty quantification and exascale computing (http://exascale.stanford.edu). In 2010, he received the Presidential Early Career Award for Scientists and Engineers (PECASE) award from President Obama. Recently, he received best paper awards from AIAA, ASME IMECE and Turbo Expo Conferences. Over the years, his interests in research and teaching have touched many topics, but always revolved around the use of computing and data to solve problems in energy, biomedicine, aerodynamics, propulsion, design.

Alison Marsden

Professor of Pediatrics and Bioengineering

Alison Marsden is an associate professor in the departments of Pediatrics, Bioengineering, and, by courtesy, Mechanical Engineering at Stanford University. She is a member of the Institute for Mathematical and Computational Engineering. From 2007-2015 she was a faculty member in Mechanical and Aerospace Engineering at UCSD. She graduated with a BSE degree in Mechanical Engineering from Princeton University in 1998, and a PhD in Mechanical Engineering from Stanford in 2005. She was a postdoctoral fellow at Stanford University in Bioengineering from 2005-07. She was the recipient of a Burroughs Wellcome Fund Career Award at the Scientific Interface in 2007, an NSF CAREER award in 2011, and was elected as a fellow of AIMBE and SIAM in 2018. She has published over 100 peer reviewed journal papers and serves on the editorial board of CVET, PLOS Computational Biology, and IJNMBE. Her research focuses on the development of numerical methods for cardiovascular blood flow simulation and application of engineering tools to impact patient care in cardiovascular surgery and congenital heart disease.

Gabriel Maher

ICME PhD Student

Gabriel Maher is a PhD student at the Institute for Computational and Mathematical Engineering at Stanford University and works with Dr. Alison Marsden at the Cardiovascular Biomechanics Computation Lab. For his research Gabriel is applying Deep Learning to the problem of blood vessel detection in volumetric MR and CT medical images. He has further extended these methods to quantiy the effects of geometry uncertainty on cardiovascular fluid dynamics simulations using Bayesian dropout networks.

Acceleration and Geometric Uncertainty Quantification of Patient-Specific Cardiovascular Modeling with Neural Networks

We extend and accelerate a path-planning based patient-specific modeling method commonly used for anatomic model creation for cardiovascular fluid dynamics simulations. We also address a longstanding open question of how realistic patient-specific model geometry variability influences simulation output uncertainty. Model building is accelerated using recently developed deep learning methods and convolutional neural networks to automatically generate vessel surfaces from image data. Quantification of simulation output uncertainty due to geometry variation is enabled by modeling the probability distribution of vessel surfaces using convolutional Bayesian dropout networks.

Julia Palacios

Assistant Professor of Statistics and of Biomedical Data Science

Dr. Palacios is Assistant Professor of Statistics and of Biomedical Data Science. She seeks to provide statistically rigorous answers to concrete, data driven questions in evolutionary genetics and public health . Her research involves probabilistic modeling of evolutionary forces and the development of computationally tractable methods that are applicable to big data problems. Past and current research relies heavily on the theory of stochastic processes, Bayesian nonparametrics and recent developments in machine learning and statistical theory for big data.

Phylodynamics of Covid-19

Molecular sequence data is frequently used to track and characterize infectious diseases spread. Given the importance of the ongoing Covid-19 pandemic, molecular sequences are being collected around the world providing important source of information about the spread and dynamics of the disease. I will show some results around the world and highlight important challenges when analyzing such data.

Sylvia Plevritis

Professor and Chair of Biomedical Data Science and Professor of Radiology

Dr. Sylvia K. Plevritis is Professor and Chair of Biomedical Data Science, Professor of Radiology at Stanford University and Program Director of the Stanford Biomedical Informatics Graduate Training Program. Dr. Plevritis leads a computational biology cancer research program that bridges genomics, imaging and population sciences to decipher properties of cancer progression and treatment response. Dr. Plevritis received her Ph.D. in Electrical Engineering and M.S. in Health Services Research, both from Stanford University, with a focus on cancer imaging physics and modeling cancer outcomes, respectively. She has had a primary authorship role on over 100 scientific cancer-related articles. She is a fellow of the American Institute for Medical and Biological Engineering (AIMBE) and Distinguished Investigator in the Academy of Radiology Research. She serves on the NCI Board of Scientific Advisors, the Program Leadership Committee of the Stanford Cancer Institute and the Leadership Council of the Stanford Bio-X Program. Dr. Plevritis has served on numerous NIH study sections, chaired scientific programs for the several professional societies including the American Association for Cancer Research (AACR) and presented keynote lectures across multiple scales of computational cancer biology. Currently, she is the Program Director of the Stanford Center in Cancer Systems Biology (CCSB) and has been a Principal Investigator with the NCI Cancer Intervention Surveillance Network (CISNET) for over fifteen years. She has served as Program Director of the Stanford Cancer Systems Biology Scholars Program (CSBS), and co-Division Chief of Integrative Biomedical Imaging Informatics at Stanford (IBIIS).

Computational Modeling of Tumor Microenvironment Interactions

The tumor microenvironment is a complex interaction of malignant and stromal cells. Recent technological advances in single-cell RNA sequencing and highly multiplexed in-situ imaging provide a deeper characterization of the tumor microenvironment. In addition, new computational techniques that enable cell-specific deconvolution have been applied to bulk gene expression datasets to produce a pan-cancer landscape of the tumor microenvironment. While the cell-type composition of the tumor microenvironment is being better characterized, more progress needs to be made to reconstruct functional interactions between cell types comprising the tumor microenvironment. I will present a variety of integrative computational approaches that combine imaging, genomic and proteomic data to infer cell-cell functional interactions that are critical to tumor maintenance and progression and may have therapeutic relevance.

Ashwin Rao

VP of Artificial Intelligence at Target Corporation and Adjunct Faculty in ICME

Ashwin Rao is VP of Artificial Intelligence at Target Corporation and Adjunct Faculty in ICME at Stanford University. Previously, Ashwin was a Trading Strategist at Goldman Sachs and a Managing Director of Market Modeling at Morgan Stanley. Ashwin's current research and teaching is in AI for Adaptive Decisioning under Uncertainty, including Reinforcement Learning algorithms. Ashwin holds a B.Tech. in CS from IIT-Bombay and a Ph.D. in Algorithmic Algebra from USC.

Ashish Goel

Professor of Management Science and Engineering

Ashish Goel is a Professor of Management Science and Engineering and (by courtesy) Computer Science at Stanford University. He received his PhD in Computer Science from Stanford in 1999, and was an Assistant Professor of Computer Science at the University of Southern California from 1999 to 2002. His research interests lie in the design, analysis, and applications of algorithms.

Decision Making at Scale

YouTube competes with Hollywood as an entertainment channel, and also supplements Hollywood by acting as a distribution mechanism. Twitter has a similar relationship to news media, and Coursera to Universities. But there are no online alternatives for making democratic decisions at large scale as a society. In this talk, we will describe our work on participatory budgeting, and also outline the moderator bot -- a new videoconferencing platform for civic deliberation that we are building in conjunction with the Center for Deliberative Democracy. This tool uses a mix of Machine Learning and Interface Design techniques to moderate deliberative conversations on civic issues.

Allison Koenecke

ICME PhD Student

Allison Koenecke is a PhD candidate at Stanford's Institute for Computational & Mathematical Engineering. Her research interests lie broadly at the intersection of economics and computer science, and her projects focus on fairness in machine learning and causal inference in the public health space. She has held several data science roles in the Bay Area, and previously specialized in antitrust at NERA Economic Consulting after graduating from MIT with a Bachelor's in Mathematics with Computer Science.

Racial Disparities in Automated Speech Recognition

Automated speech recognition (ASR) systems are now used in a variety of applications to convert spoken language to text, from virtual assistants, to closed captioning, to hands-free computing. By analyzing a large corpus of sociolinguistic interviews with white and African American speakers, we demonstrate large racial disparities in the performance of popular commercial ASR systems developed by Amazon, Apple, Google, IBM, and Microsoft. Our results point to hurdles faced by African Americans in using increasingly widespread tools driven by speech recognition technology. More generally, our work illustrates the need to audit emerging machine-learning systems to ensure they are broadly inclusive.

Alan Gous

Applied Mathematician and Adjunct Faculty in ICME

Alan Gous is an applied mathematician, working in the fields of statistics, networking, and cryptography. He is a member of the ICME faculty at Stanford University, and a principal contributor to the Signet Zero-Trust Project. He was a co-founder of Cariden Technologies, and a principal engineer at Cisco Systems. Alan graduated from the University of Natal, South Africa, and holds a PhD in statistics from Stanford University.

What's the Use of Privacy?

AI and big data are now strongly associated with surveillance and privacy violation. It's interesting to think through why exactly should we care. That is, what are the dangers, besides the most direct ones like hacking and identity theft? If we can understand clearly in what contexts privacy is a good thing for our society, we can better focus legal and technological efforts to strengthen it. I'll suggest some different ways of looking at this problem. I'll also mention some current work on practical tools and methods that can provide much of the benefit of big data analytics, with more privacy.

Peter Glynn

Professor of Management Science and Engineering

Peter W. Glynn is the Thomas Ford Professor in the Department of Management Science and Engineering (MS&E) at Stanford University, and also holds a courtesy appointment in the Department of Electrical Engineering. He received his Ph.D in Operations Research from Stanford University in 1982. He then joined the faculty of the University of Wisconsin at Madison, where he held a joint appointment between the Industrial Engineering Department and Mathematics Research Center, and courtesy appointments in Computer Science and Mathematics. In 1987, he returned to Stanford, where he joined the Department of Operations Research. From 1999 to 2005, he served as Deputy Chair of the Department of Management Science and Engineering, and was Director of Stanford's Institute for Computational and Mathematical Engineering from 2006 until 2010. He served as Chair of MS&E from 2011 through 2015. He is a Fellow of INFORMS and a Fellow of the Institute of Mathematical Statistics, has been co-winner of Best Publication Awards from the INFORMS Simulation Society in 1993 and 2008, was a co-winner of the Best (Biannual) Publication Award from the INFORMS Applied Probability Society in 2009, and was the co-winner of the John von Neumann Theory Prize from INFORMS in 2010. In 2012, he was elected to the National Academy of Engineering.

Analytics When the Data Quality is Bad: COVID-19 Hospital Operations

In early March, hospitals around the US faced the question of how to prepare for the looming COVID-19 pandemic. In this short talk, we will discuss several decision tools that were rapidly developed to support decision-making at the Stanford hospitals, as well as some ongoing tool development to help support hospital operations as some capacity is now reallocated back to normal usage. The design of these tools has been guided by the needs of the end-users, and by the poor data quality that has been a persistent challenge from the start of the pandemic. This work is joint with Jose Blanchet, David Scheinker, Kevin Schulman, and a large group of Stanford PhD and MS students.

Catherine Gorle

Assistant Professor of Civil and Environmental Engineering

Catherine Gorlé is an Assistant Professor of Civil and Environmental Engineering at Stanford University. Her research activities focus on the development of predictive computational fluid dynamics (CFD) simulations to support the design of sustainable buildings and cities. Specific topics of interest are: the coupling of large- and small-scale models and experiments to quantify uncertainties related to the variability of boundary conditions, the development of uncertainty quantification methods for low-fidelity models using high-fidelity data, and the use of data assimilation to improve CFD predictions. Catherine received her BSc (2002) and MSc (2005) degrees in Aerospace Engineering from the Delft University of Technology, and her PhD (2010) from the von Karman Institute for Fluid Dynamics in cooperation with the University of Antwerp. She has been the recipient of a Stanford Center for Turbulence Research Postdoctoral Fellowship (2010), a Pegasus Marie Curie Fellowship (2012), and an NSF CAREER award (2018).

Computational Wind Engineering for Sustainable Buildings and Cities

Computational fluid dynamics can inform the design of buildings and cities for optimal pedestrian wind comfort, air quality, thermal comfort, energy efficiency, and resiliency to extreme wind events. The large natural variability and complex physics that are characteristic of these flow problems can compromise the accuracy of the simulation results, thereby hindering their use in the design process. In this talk I will demonstrate how uncertainty quantification and data assimilation can be leveraged to improve the predictive capabilities of urban flow simulations, and provide a path towards supporting sustainable building design and urban planning.

Rahul Sarkar

ICME PhD Student

Rahul Sarkar is a Ph.D. student in ICME, advised by professors Biondo Biondi and András Vasy. Rahul holds a B.S. and M.S. degree from Indian Institute of Technology Kharagpur, India, as well as an M.S. degree from ICME at Stanford University. His research interests including computational aspects of inverse problems, quantum computing, and applications of machine learning in seismic imaging.

Can a Quantum Computer Help in Creating a Sustainable Future?

In this talk I will discuss what kind of computational problems can a quantum computer help to solve, to usher in a sustainable future. Quantum simulation can vastly expand the current search of better catalysts for CO2 capture, and find more efficient ways of producing nitrogen-fixing fertilizers. One may potentially also accelerate the search for room temperature superconductors, and find more efficient batteries, both of which will have a direct impact on reducing the carbon footprint of our energy usage. Many of these applications will require large scale, error-corrected quantum computers, and in that context, I will also briefly touch upon some of my recent work on quantum stabilizer codes.

Biondo Biondi

Professor of Geophysics

Biondo Biondi is the Barney and Estelle Morris Professor and Chair of the Geophysics at Stanford University. He is director of the Stanford Exploration Project (SEP). SEP is an academic consortium whose mission is to develop innovative seismic imaging methodologies and to educate the next generation of leaders in applied seismology. Biondo and his students devise new algorithms to improve the imaging of active and passive seismic data. Images obtained from seismic data are the main source of information on the structural and stratigraphic complexities in Earth's subsurface and on many subsurface dynamic processes. These images are constructed by processing seismic wavefields recorded at the Earth surface and generated by either active-source experiments, or by natural (ocean waves) and anthropogenic (vehicle traffic) sources. Fiber-optic seismic recording holds the promise of enabling cost-effective continuous seismic monitoring at large scale (e.g. cities, unconventional basins, …). To learn about this new technology Biondo's research group has been continuously recording data under Stanford campus for more than three years using a two fiber-optic arrays (one 2.5 km long and the other 40 km long) and started devising innovative algorithms to process and image these new, but challenging, seismic datasets.

Taking the Pulse of Our Cities by Fiber-Optic Seismology

The capability of turning fiber-optic cables currently used for telecommunication services into seismic sensors enables the collection of datasets that "illuminate" human and natural processes in novel ways. Fiber-optic seismology can produce continuous and densely sampled data recorded from difficult to access locations and at an affordable cost, in particular under cities. In my presentation, I will focus on three examples of applications of these new capabilities. The first is the monitoring of local traffic around Stanford before and after the lockdown imposed by the local authority to combat the COVID pandemic. Compared to mobility information gathered through smartphones, our data provides accurate and high-resolution (temporal and spatial) information; still, it avoids both privacy concerns and sample biases related to cell-phone ownership. The second example is the use of surface waves generated by each vehicle transiting on the road for continuously monitoring subsurface properties. The information derived from the analysis of the surface waves can be used to create high-resolution time-lapse maps useful for civil engineering and geologic-hazards assessment. The third application is the analysis of local seismicity under large cities that are vulnerable to earthquakes, such as the Bay Area. By using a convolutional neural network, we can detect local earthquakes that are not in the USGS catalog. This kind of analysis may enable the mapping of shallow faults with unprecedented resolution. The number of fiber cables installed for telecommunication purposes is exponentially growing, driven by the development of the information economy and the commercial introduction of new technologies (e.g. 5G). This growth, coupled with the continuous decrease of the cost of turning fiber cables into seismometers, will multiply the scope of the technology's practical applications. However, it will also create technical challenges related to the handling and analyzing the massive amount of data generated (up to.5TBytes/km per day). The development of new algorithms based on both the mathematical description of the underlying physics and machine learning is essential for extracting all the value from the data that will be recorded in the field.

Karen Matthys

ICME Executive Director, External Partners

Karen is Executive Director, External Partners at the Stanford Institute for Computational and Mathematical Engineering (ICME). She is responsible for relationships with companies regarding research, curriculum, events and recruiting. Karen was Co-Instructor of the new AI for Good seminar class at Stanford in winter 2020, and was previously an Advisory Board member of the Stanford Catalyst Initiative for inter-disciplinary research. She co-founded and serves as co-Director of the Women in Data Science Conference which every year reaches over 100,000 participants worldwide.Karen has extensive experience as a business executive working at leading-edge technology companies from start-ups to Fortune 500's, including Apple Computer. She has successfully served in various capacities including Management and Leadership, Director of Marketing and Business Strategy, and as an University Lecturer throughout the course of her career. Karen holds an MBA from Stanford University and a BS in Systems Engineering with highest distinction from the University of Virginia.

James Zou

Assistant Professor of Biomedical Data Science

James Zou is an Assistant Professor of Biomedical Data Science and, by courtesy, of Computer Science and Electrical Engineering at Stanford University. Prof. Zou works on a wide range of problems in machine learning (from proving mathematical properties to building large-scale algorithms) and is especially interested in applications in genomics and computational health. He received a Ph.D. from Harvard in 2014 and was a member of Microsoft Research. Before this, he completed math Part III at the University of Cambridge and was a Simons fellow at U.C. Berkeley. Prof. Zou joined Stanford in Fall 2016 and is an inaugural Chan-Zuckerberg Investigator. Prof. Zou is the faculty director of the new university-wide AI for Health program also a part of the Stanford AI Lab.

How to Make AI Forget You? Adventures in Making Algorithms More Grown-Up.

This talk explores what it means to develop "grown-up" machine learning algorithms and why they are critical for applications such as medicine and healthcare. I will illustrate this idea with the latest research at NeurIPS

Ines Chami

ICME PhD Student

Ines Chami is a Ph.D. candidate in ICME where she is advised by Professor Chris Ré. Her research is focused on representation learning for graph-structured data and understanding how non-Euclidean geometries (e.g. hyperbolic geometry), can lead to more expressive representations for some types of relational structures. Her research also spans applications in the field of Computer Vision and Natural Language Processing, such as understanding how objects interact in images or how entities are related in Knowledge Graphs.

Tetiana Parshakova

ICME PhD Student

Tetiana is pursuing a Ph.D. in Computational & Mathematical Engineering at Stanford University. Previously, she obtained a Bachelors and a Master's degree at KAIST.

Junzi Zhang

ICME PhD Student

Junzi Zhang is a fifth-year Ph.D. student in Institute for Computational & Mathematical Engineering (ICME) at Stanford, advised by Prof. Stephen P. Boyd from Stanford Department of Electrical Engineering. Before coming to Stanford, he obtained his B.S. degree in applied mathematics from School of Mathematical Sciences, Peking University, where he conducted his undergraduate research under the supervision of Prof. Zaiwen Wen and Prof. Pingwen Zhang. His current research is focused on the design and analysis of optimization algorithms and software, as well as the applications in the fields of machine learning, causal inference, and decision-making systems (especially reinforcement learning). His current research is partly supported by Stanford Graduate Fellowship. He has also been the co-president of Association of Chinese Students and Scholars at Stanford (ACSSS), and had contributed to enhance the cooperation between the Chinese community and the Stanford school authority, as well as boosting the influence of the Chinese culture in the community of international students. More information can be found on his personal website at http://web.stanford.edu/~junziz/