



**FIFTH  
CARNEGIE MELLON  
FORUM ON  
BIOMEDICAL  
ENGINEERING**

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September 22, 2023

**Carnegie Mellon University**



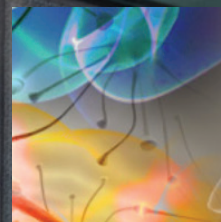
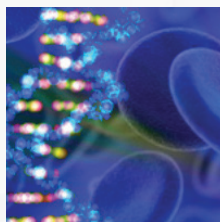
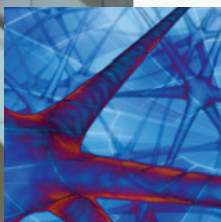
# Explore Frontiers in Biomedical Engineering!

The Carnegie Mellon Forum on Biomedical Engineering serves as a platform for fostering discussions and identifying grand challenges within the fields of biomedical engineering research, education, and translation.

As a new addition this year, BME Forum committee introduces a career section, inviting BME alumni to share their professional journeys from CMU graduates to their current employment.

We are also delighted to announce the introduction of the Best Abstract Award. The individual who submits the most outstanding abstract will have the opportunity to present their work live via Zoom to all attendees.

Students, postdocs, or residents working at the intersection of engineering, medicine, and health will have the chance to participate in a pre-recorded slide competition, where they can showcase their research and compete for recognition as the best presenter. This competition is open to presenting and first authors.



# Program

## Friday, September 22 Carnegie Mellon Forum on Biomedical Engineering

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09:00 – 09:15 AM

### Welcome Remarks

**Dr. Keith Cook**

The David Edward Schramm Professor and Head  
Biomedical Engineering  
Carnegie Mellon University

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09:15 – 09:45 AM

### Keynote Talk: Transforming Transplant

**Dr. Burcin Taner**

Chair, Department of Transplant  
Chair, Transplant Specialty Council  
Professor of Surgery  
Mayo Clinic

**Moderator:**

**Dr. Keith Cook**

The David Edward Schramm Professor and Head  
Biomedical Engineering  
Carnegie Mellon University

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09:45 – 10:15 AM

### Keynote Talk: Advancing Equity in Optical Diagnostic Devices with Regulatory Science

**Dr. Joshua Pfefer**

Biomedical Research Engineer  
Food and Drug Administration

**Moderator:**

**Dr. Jana Kainerstorfer**

Associate Professor  
Biomedical Engineering  
Carnegie Mellon University

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10:15 – 10:30

### BREAK

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10:30 – 11:00 AM

### Keynote Talk: Tackling grand biomedical challenges - The power of teamwork

**Dr. Tzahi Cohen-Karni**

Professor, Biomedical Engineering and  
Materials Science & Engineering  
Carnegie Mellon University

**Moderator:**

**Dr. Keith Cook**

The David Edward Schramm Professor and Head  
Biomedical Engineering  
Carnegie Mellon University

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11:00 – 11:30 AM

### Keynote Talk: Microphysiological systems to probe immune cell and extracellular vesicle trafficking

**Dr. Steven C. George**

Edward Teller Distinguished Professor and Chair  
University of California, Davis

# Program continued

**Moderator:**  
**Dr. Phil Campbell**  
Research Professor  
Biomedical Engineering  
Carnegie Mellon University

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**11:30 – 11:50 PM**      **Alumni Talk: My Career Journey: From CMU to NASA**  
**Dr. Piyumi Wijesekara**  
Postdoctoral Scientist  
NASA Ames Research Center

**Moderator:**  
**Dr. Charlie Ren**  
Associate Professor  
Biomedical Engineering  
Carnegie Mellon University

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**11:50 – 12:50 PM**      **LUNCH BREAK**

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**12:50 – 1:10 PM**      **Best Abstract Talk**  
**Sommer Anjum, BE**  
Department of Bioengineering  
University of Pittsburgh

**Moderator:**  
**Dr. Jaci Bliley**  
Postdoctoral Research Associate  
Biomedical Engineering  
Carnegie Mellon University

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**1:10 – 1:40 PM**      **Keynote Talk: Reverse engineering neural circuits**  
**Dr. Karel Svoboda**  
Vice President and Executive Director  
Allen Institute for Neural Dynamics

**Moderator:**  
**Dr. Steve Chase**  
Professor  
Biomedical Engineering  
Carnegie Mellon University

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**1:40 – 2:10 PM**      **Keynote Talk: Multi-physics modeling for treatment planning in congenital heart disease**  
**Dr. Alison Marsden**  
Douglass M. and Nola Leishman Professor of Cardiovascular Disease Professor of Pediatrics and Bioengineering, and by courtesy of Mechanical Engineering  
Stanford University

**Moderator:**  
**Dr. Noelia Grande Gutierrez**  
Assistant Professor  
Carnegie Mellon University

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**2:10 – 3:45 PM**      **Pre-recorded Slide Presentations**

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**3:45 – 4:00 PM**      **Announcement of Awards**

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### **Dr. Tzahi Cohen-Karni**

Professor

Biomedical Engineering and Materials Science & Engineering  
Carnegie Mellon University

Tzahi Cohen-Karni is a Professor at the Departments of Biomedical Engineering and Materials Science engineering in Carnegie Mellon University, Pittsburgh PA USA. He received both his B.Sc. degree in Materials Engineering and the B.A. degree in Chemistry from the Technion Israel Institute of Technology, Haifa, Israel, in 2004. His M.Sc. degree in Chemistry from Weizmann Institute of Science, Rehovot, Israel, in 2006 and his Ph.D. in Applied Physics from the School of Engineering and Applied Sciences, Harvard University, Cambridge MA, USA, in 2011. He was a Juvenile Diabetes Research Foundation (JDRF) Postdoctoral Fellow at the Massachusetts Institute of Technology and Boston Children's Hospital at the labs of Robert Langer and Daniel S. Kohane from 2011 to 2013. Dr. Cohen-Karni received the 2012 International Union of Pure and Applied Chemistry Young Chemist Award. In 2014, he was awarded the Charles E. Kaufman Foundation Young Investigator Research Award. In 2016, Dr. Cohen-Karni was awarded the NSF CAREER Award. In 2017, Dr. Cohen-Karni was awarded the Cellular and Molecular Bioengineering Rising Star Award, The Office of Naval Research Young Investigator Award and The George Tallman Ladd Research Award. In 2018, Dr. Cohen-Karni was awarded the Cellular and Molecular Bioengineering Young Innovator Award. In 2019, Dr. Cohen-Karni was awarded the Carnegie Institute of Technology (CIT) Dean's Early Career Fellowship.



### **Dr. Keith Cook**

The David Edward Schramm Professor and Head  
Biomedical Engineering  
Carnegie Mellon University

Dr. Cook is the David Edward Schramm Professor and Department Head of Biomedical Engineering at Carnegie Mellon University (CMU). At CMU, he also serves as the Director of the Bioengineered Organs Initiative and the Transforming Transplant initiative. Prior to his appointment at CMU, Dr. Cook was a Research Associate Professor in Biomedical Engineering and Surgery at the University of Michigan. As a student, Dr. Cook obtained a BSE in both Mechanical Engineering and Engineering Science from Michigan and an MS and Ph.D. in Biomedical Engineering from Northwestern University. Dr. Cook's research focuses on the application of biomedical engineering to the treatment of lung disease. His primary research focus is the development of permanent replacement lungs for destination therapy. This work extends into computational modeling and device design, development of novel biomaterials and new drug approaches to reduce blood coagulation within these devices, and in-vitro and in-vivo biomaterials and artificial lung testing. His research also focuses on design and biofabrication of tissue-based lungs. Dr. Cook is a fellow of the American Institute for Medical and Biological Engineering (AIMBE).



### **Dr. Steven C. George**

Edward Teller Distinguished Professor and Chair  
Department of Biomedical Engineering  
University of California, Davis

Steven C. George, M.D., Ph.D. is the Edward Teller Distinguished Professor and Chair of the Department of Biomedical Engineering at the University of California, Davis. He received his bachelors degree in chemical engineering in 1987 from Northwestern University, M.D. from the University of Missouri School of Medicine in 1991, and Ph.D. from the University of Washington in chemical engineering in 1995. He was on the faculty at the University of California, Irvine for 19 years where he pursued a range of research interests including pulmonary gas exchange, lung mechanics, vascularizing engineered tissues, and microphysiological systems. The NIH FIRST award in 1998 and the CAREER and Presidential Early Career Award for Scientists and Engineers (PECASE) from the National Science Foundation in 1999 have previously recognized his work. While at UCI, he served as the William J. Link Professor and founding Chair of the Department of Biomedical, the founding Director of the Edwards Lifesciences Center for Advanced Cardiovascular Technology, and was the founding PI on a T32 predoctoral training grant from the National Heart Lung and Blood Institute entitled "Cardiovascular Applied Research and Entrepreneurship". In 2014 he transitioned to become the Elvera and William Stuckenberg Professor and Chair of Biomedical Engineering at Washington University in St. Louis, and in 2017 moved to the UC Davis. He became Chair of the department in January 2019. He was elected a fellow in the American Institute of Medical and Biological Engineering in 2007, a fellow of the Biomedical Engineering Society in 2017, a fellow of the International Academy for Medical and Biological Engineering in 2021.

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### **Dr. Alison Marsden**

Douglass M. and Nola Leishman Professor of Cardiovascular Disease  
Professor of Pediatrics and Bioengineering, and by courtesy of Mechanical Engineering  
Institute for Computational and Mathematical Engineering  
Stanford University



Alison Marsden is the Douglass M. and Nola Leishman Professor of cardiovascular disease in the departments of Pediatrics, Bioengineering, and, by courtesy, Mechanical Engineering at Stanford University. From 2007-2015 she was a faculty member in the Mechanical and Aerospace Engineering Department at the University of California San Diego. She graduated with a bachelor's 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 and Pediatric Cardiology 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. She is a fellow of the American Institute of Medical and Biological Engineers, the Society for Industrial and Applied Mathematics, the American Physical Society, and the Biomedical Engineering Society. She received the UCSD graduate student association faculty mentor award in 2014 and MAE department teaching award at UCSD in 2015 and the Van C. Mow Medal from the ASME in 2023. Her work focuses on the development of numerical methods for cardiovascular blood flow simulation, medical device design, application of optimization to large-scale fluid mechanics simulations, and application of engineering tools to impact patient care in cardiovascular surgery and congenital heart disease.



## INVITED SPEAKERS



### **Dr. Joshua Pfefer**

Biomedical Research Engineer  
Food and Drug Administration

Dr. Joshua Pfefer received his PhD in Biomedical Engineering from the University of Texas at Austin in 1999, where he performed research on laser ablation, computational modeling and optical-thermal light-tissue interactions relevant to urology and dermatology. He then spent a postdoctoral year at Harvard Medical School performing research at Massachusetts General Hospital on endoscopic detection of gastrointestinal cancers with laser-induced-fluorescence. In 2000, he joined FDA where he is currently a Biomedical Research Engineer and leads the Optical Spectroscopy and Spectral Imaging program. His group has performed Regulatory Science research on a wide variety of topics in Biomedical Optics, including Optical Coherence Tomography, Photoacoustic Imaging, Thermography, Fluorescence imaging and Oximetry. Currently, his lab's efforts are focused on phantom-based test methods and the effect of skin pigmentation on optical device performance. Dr. Pfefer has published a total of over 90 journal articles and book chapters, and in 2018 he was named a Fellow of SPIE for contributions to Biophotonics.



### **Dr. Karel Svoboda**

Vice President and Executive Director  
Allen Institute for Neural Dynamics

Karel Svoboda is the Vice President and Executive Director of the Allen Institute for Neural Dynamics. Before joining the Allen Institute, he was a Senior Group Leader at HHMI's Janelia Research Campus. Svoboda's work is at the intersection of neuronal biophysics and cognition. His goal is to identify core principles underlying information processing in mammalian neural circuits at the level of the whole brain. Svoboda has developed several widely-used methods to interrogate neural structure and function in intact brains. Notable contributions include microscopy methods to image synapses over times of weeks in the intact brain during learning; engineered sensitive fluorescent protein sensors for noninvasive imaging of neural activity; microscopes with very large fields of view that enable imaging multiple brain regions with single neuron resolution. Svoboda is an advocate for open and reproducible science. He is a founder of the Neurodata Without Borders and ScanImage projects. Svoboda was born in Prague, then part of Czechoslovakia, and grew up in West Germany. He graduated from Cornell University with a BA in Physics (1988) and from Harvard University with a PhD in Biophysics (1994). He was a member of technical staff at Bell Laboratories (until 1997) and a principal investigator at Cold Spring Harbor Laboratory (until 2006). Svoboda was awarded the Society for Neuroscience Young Investigator Award (2004) and the Brain Prize from the Lundbeck Foundation (2015). He is a member of the National Academy of Sciences (USA).

## INVITED SPEAKERS



### **Dr. C. Burcin Taner**

Chair, Department of Transplant  
Chair, Transplant Specialty Council  
Professor of Surgery  
Mayo Clinic

Burcin Taner, M.D., is a consultant and serves as chair for the Department of Transplant at Mayo Clinic in Florida and as the Mayo Clinic Enterprise Director for Transplant. Dr. Taner joined the staff of Mayo Clinic in 2007 and holds the academic rank of Professor of Surgery. In this role he oversees all practice, research and education activities of transplant programs at Mayo Clinic's 3 destination campuses. Dr. Taner earned his M.D. at Hacettepe University Medical School, Ankara, Turkey. He completed a residency and chief residency in surgery at Mayo Clinic. He subsequently completed a fellowship in transplantation surgery, also at Mayo Clinic. Dr. Taner's clinical interests are liver, kidney and pancreas transplantation; process improvement; and resource utilization in transplant surgery. His research focuses on liver transplant outcomes, ischemia reperfusion injury and early allograft dysfunction after liver transplantation, and liver transplantation using donation after cardiac death liver grafts. He consistently publishes in high-impact scientific journals and has held reviewer responsibilities for prominent publications. In addition to his clinical and research activities, Dr. Taner is active in education, and he has provided mentorship to many research and surgical fellows, among others. Dr. Taner's memberships with professional organizations include the American Association for the Study of Liver Diseases, American Society of Transplant Surgeons, American Society of Transplantation, and the International Liver Transplantation Society.



### **Dr. Piyumi Wijesekara**

Postdoctoral Scientist  
NASA Ames Research Center

Dr. Piyumi Wijesekara is a postdoctoral scientist in the Radiation Biophysics Laboratory, Space Biosciences Research Branch at NASA Ames Research Center. She is a multidisciplinary researcher with experience in tissue and organ engineering and regenerative medicine. She received her B.S. in Bioengineering from the University of California San Diego in 2015 and her M.S. and Ph.D. in Biomedical Engineering from Carnegie Mellon University in 2017 and 2022, respectively. While pursuing her Ph.D. at Carnegie Mellon University, she focused on stem cell and organ engineering, with a particular emphasis on lung engineering, to investigate human respiratory pathophysiology. Her main research interest at NASA Ames Research Center includes developing technologically advanced, high-throughput, and three-dimensional human tissue models for investigating the effects of spaceflight stressors, such as ionizing radiation, lunar regolith, microgravity, and high CO<sub>2</sub>, on the human respiratory system with the eventual goal of applying them to ensure the health and safety of astronauts during upcoming lunar and Mars missions.



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**Mission:** Captis Diagnostics' mission is to commercialize innovative liquid biopsy technologies. The core competency is its rapid development of nanomaterials and nanotechnologies for enriching the circulating cancer biomarkers, such as extracellular vesicles (EVs) and circulating tumor cells.

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## Pre-recorded Slide Presentations

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*J. Wen, A. L. Smoulder, H. Miyata, S. Borgognon, P. Marino, A. P. BatisTA, S. M. Chase; Carnegie Mellon University, University of Pittsburgh*

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*Sommer Anjum, Llaran Turner, Youmna Atieh, George Eisenhoffer, Lance; University of Pittsburgh, University of Texas, Anderson Cancer Center*

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*Sivakumar R, Anirudh E R, Sai Viswanth Reddy Y, Rahul Soangra; Vellore Institute of Technology (India), Chapman University*

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*Arielle M. D'Elia, Olivia L. Jones, Christopher B. Rodell; Drexel University*

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**CMU BME Research Areas:**

- Biomaterials & Nanotechnology
- Cardiopulmonary Engineering
- Cell & Tissue Engineering
- Computational Biomedical Engineering
- Medical Devices & Robotics
- Neural Engineering

**BME Academic Programs at CMU**

**Graduate Programs Overview**

**Ph.D. Program**

The Ph.D. program is designed to nurture the next generation of leaders in biomedical engineering for the university and industry. Flexible degree requirements allow the student to balance breadth and depth, and to develop a research plan best suited to his/her career goal.

Ph.D. students start thesis research soon after matriculation. A rigorous review system monitors the progress to facilitate timely completion in 4-5 years for students without an M.S. degree, and in as short as 3 years for students with a relevant M.S. degree. All Ph.D. students are supported with full financial aid that covers tuition and stipend. The Department also participates in a joint M.D.-Ph.D. Program with the University of Pittsburgh School of Medicine.

**M.S. Program**

The M.S. program, built upon the interdisciplinary, collaborative culture of Carnegie Mellon University, provides an ideal opportunity for career advancement in biomedical engineering or transitions from other disciplines into biomedical engineering.

The large degree of flexibility and a wide choice of research advisors allow M.S. education to be tailored according to the student's professional goals, from R&D in biotechnology, healthcare, to university faculty.

Students may choose between the traditional BME M.S. - Research program and the accelerated BME M.S. - Applied Study program. If choosing the BME M.S. - Applied Study program, a practicum course can provide opportunities for clinical exposure at local hospitals.

It may also be combined with programs in Engineering & Technology Innovation Management to form a dual M.S. program. Students wishing to enter Carnegie Mellon's Ph.D. program in Biomedical Engineering must reapply and compete with the general pool of Ph.D. applicants.

M.S. Program students may choose between the traditional **BME M.S. – Research** and the accelerated **BME M.S. – Applied Study**.

**Undergraduate Programs Overview**

**Major in Biomedical Engineering**

Biomedical engineering education at Carnegie Mellon University reflects the belief that a top biomedical engineer must be deeply trained in both a traditional engineering practice and biomedical sciences. The unique



additional major program leverages extensive collaborations with sister departments in the College of Engineering and with major medical institutions in Pittsburgh. This collaborative approach, combined with a rigorous engineering education, confers unique depth and breadth to the education of Biomedical Engineering graduates.

**Online Graduate Certificate in 3D Bioprinting & Biofabrication**

This program's unique, credit-bearing, transcripted curriculum teaches the fundamentals of fabricating 3D tissues, so you can bring actionable knowledge back to your organization. The Certificate is offered online to allow physicians and other biomedical professionals to fit this cutting-edge program into their busy professional lives. Live, weekly, online classes are held in the evening and complemented by videos and activities that you will complete on your own time, at your own pace. In addition, you will have the opportunity to attend an optional, on-campus, week-long lab session over the summer to immerse yourself in the techniques and collaborate with other like-minded professionals. When you finish the certificate program, you will have the information and tools needed to create structurally complex 3D tissues.

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