Mayank Kumar, PhD

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Career Objective To be a leader in technology that touches human lives

Education

Ph.D. Electrical and Computer Engineering, Rice University 2018
Advised by Dr. Ashutosh Sabharwal and Dr. Ashok Veeraraghavan

M.S. Electrical and Computer Engineering, Rice University 2015
GPA: 4.04/4.00

B.Tech. Electrical Engineering, Indian Institute of Technology, Delhi 2010
GPA: 8.96/10.00

Leadership Experience

Director of Research, Gauss Surgical Inc., Menlo Park, CA 2018 - Present
Leading the computer vision, artificial intelligence, and biomedical signal processing research team at Gauss Surgical Inc. to develop an AI-enabled platform for real-time monitoring of surgical blood loss, asset tracking, and patient monitoring in the operating room.

- Ideated, designed, prototyped, and developed a first-of-its-kind multi-sensor (camera and ultrasound) based in-line patient fluid characterization system capable of quantifying the mass flow of hemoglobin in real-time for efficient blood management.
- Lead the development of iPhone-based sponge and instrument counting technology that uses a combination of deep learning algorithms to reconcile sponges and surgical instruments counted in and counted out during a surgery.
- Hands-on experience applying machine learning and deep learning algorithms to analyze historical product usage data to drive data-driven product updates within the FDA's regulatory framework.

Work Experience

Graduate Research Assoociate, ECE Dept. Rice University 2015-2018
Worked on end-to-end computer vision system design, machine learning and deep learning algorithm development, clinical study design, experiment design, iterative prototyping, and clinical translation of camera-based biomedical imaging system — PulseCam and CameraVitals.

Innovator-in-Residence, Gauss Surgical Inc., Los Altos, CA Summer 2015
Developed a minimum-viable prototype for non-contact vital sign monitoring technology and explored its commercialization potentials; developed algorithm for duplicate sponge recognition.

Corporate R&D Intern, Qualcomm, San Diego, CA Summer 2013
Developed new algorithm for non-linear interference cancellation (NLIC) in 4G communication systems.

Co-founder, Yantrr Electronic Systems (YES) Pvt. Ltd., New Delhi, India 2011-2013
Developed Yantrr's IoT device cloud architecture and shaped Yantrr's strategy to become a leader in Industrial IoT serving customers in more than 60 countries.

Algorithm Developer, Stanford India Biodesign, AIIMS New Delhi Fall 2011
Devised novel algorithm for detecting weak (100 nV) Auditory Brainstem Response (ABR) signal in presence of 30 dB high electromagnetic noise to identify hearing loss in newborn babies.

PhD Research

PulseCam: Design, development and clinical evaluation of a new multi-sensor camera-based blood flow imaging modality

- Developed a first-of-its-kind camera-based, non-contact, clinically accurate and highly sensitive blood flow imaging modality to reliably measure the flow of blood underneath the skin surface using only the video recording of the skin surface.
- PulseCam blood flow imaging has widespread clinical application; clinical studies are underway (i) to monitor peripheral perfusion in the diabetic population, (ii) to evaluate circulatory status in premature babies in critical care, and (iii) to assess the efficacy of vascular surgery.
- PulseCam technology is being evaluated for clinical translation at Baylor College of Medicine in Houston, at Barretos medical center in Brazil and at Agadha Medtech in Chennai, India.

MS Research

CameraVitals: Robust camera-based non-contact vital sign monitoring

- Developed a new algorithm (DistancePPG) to reliably measure vital signs such as heart rate, heart rate variability, and breathing rate using only a person's video.
- CameraVitals achieves clinical-grade accuracy for people of varying skin tones, under diverse lighting conditions and in the presence of different types of motion — scenarios where past approaches failed.
- CameraVitals technology was used by IBM research aging-in-place labs and integrated into their care robot platform for elderly care; resulted in a highly cited research publication; widespread application in mobile health.

Patents

Systems and methods for in-line fluid characterization (PCT 2019, US Provisional, 2018)
Systems and methods for tracking surgical items (US Provisional, 2019)
High resolution blood perfusion imaging using camera and pulse oximeter (US/PCT, 2017)
Camera-based photoplethysmogram estimation (US Utility Patent, Nov 2015)
A system for Auditory impairment screening (PCT, 2013) (Stanford India Biodesign)

Relevant publications

[J1] Mayank Kumar, James W. Suliburk, Ashok Veeraraghavan, and Ashutosh Sabharwal. "pulsecam: a camera-based, motion-robust and highly sensitive blood perfusion imaging modality." Scientific Reports 10, no. 1 (2020): 1-17.

[J2] Mayank Kumar, Ashok Veeraraghavan, and Ashutosh Sabharwal, "DistancePPG: Robust non-contact vital signs monitoring using a camera," Biomed. Opt. Express 6, 1565-1588 (2015) (**Cited more than** 200 **times; Among the top-ten most cited article in the journal.**)

[C1] Mayank Kumar, James Suliburk, Ashok Veeraraghavan and Ashutosh Sabharwal, "PulseCam: High-resolution blood perfusion imaging using a camera and a pulse oximeter," 2016 38th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), Orlando, FL, 2016, pp. 3904-3909.

[C2] Peter Washington, Mayank Kumar, Anant Tibrewal, and Ashutosh Sabharwal, 'ScaleMed: A Methodology for Iterative mHealth Clinical Trials' IEEE Healthcom 2015 - SSH 2015.

[C3] M. Chowdhary, CSR Technology, USA; M. Sharma, A. Kumar, IIT, India; S. Dayal, CSR Technology, India; M. Kumar, IIT, India. Robust Attitude Estimation for Indoor Pedestrian Navigation using MEMS Sensors. ION GNSS 2012

Awards and Honors

Best Ph.D. presenter award, Rice ECE (2018)
NSF award for young professionals contributing to smart and connected health (2016)
Hershel M. Rich Invention Award for developing CameraVitals (2017)
Texas Instruments Graduate Student Fellowship (2015-Present)
Audience Choice Award, Rice 90 Second Thesis Competition 2014
Best Graduate Student Poster, Rice ECE Affiliates Day 2014, 2017
NASA Space Health Challenge 2014 (2nd Prize)
Best B.Tech Project Award in IIT Delhi, 2010
Yahoo HackU Award, 2009 by Yahoo R&D
Indian National Physics Olympiad, 2006

Technical Skills

Programming Language: Python, MATLAB, C/C++,
Development Libraries: NumPy and SciPy, OpenCV, Scikit-learn, TensorFlow and Keras, PyTorch,
System design: Computer Vision and machine learning end-to-end system design, clinical study design, experiment design, iterative prototyping, and clinical translation, Software as a Medical Device

References

Ashutosh Sabharwal: Prof. of Electrical and Computer engineering, Rice University; Founder Scalable Health Lab; IEEE Fellow
James W. Suliburk, MD, FACS: Prof. of Surgery, Baylor College of Medicine
Rebecca Richards-Kortum: Prof. Bioengineering, Rice University; Director Rice 360° Institute of Global Health
Ashok Veeraraghavan: Prof. of Electrical and Computer Engineering, Rice University
Siddharth Satish: CEO, Gauss Surgical Inc. (USA) ; Forbes 30 under 30 Healthcare
Andrew Hosford: VP (Engineering), Gauss Surgical Inc. (USA)
Paul Addison: Technical Fellow, Medtronic and CEO, CardioDigital Ltd (UK)