Translational AI Center Seminars Fall 2021

Adarsh Krishnamurthy

October 14 at 12:00 noon

https://iastate.zoom.us/s/9378976918

Data-Driven Computational Modeling for Cardiovascular Mechanics

Cardiovascular diseases, such as heart failure, are one of the leading causes of death in the U.S. and pose a severe burden to the healthcare system. Most current treatments for cardiovascular diseases are based on rough estimates of outcomes from the results of clinical trials, which might not apply to individual patients due to patient-specific variations. Data-driven computational models of the cardiovascular system, developed from patient-specific clinical data, can help refine the diagnosis and personalize the treatment. In this talk, I will present recent advances in computational modeling that enable the simulation of a full four-chamber cardiac model. We have developed tools to generate a patient-specific high-order four-chamber cardiac mesh and use isogeometric analysis to simulate an entire cardiac cycle. The second part of the talk will focus on novel machine-learning algorithms to optimize the design of bioprosthetic heart valves. Machine-learning tools can significantly accelerate biomechanics simulations, leading to the development of a high-fidelity surrogate model. This surrogate model can then be used for optimizing the geometry of bioprosthetic valves, leading to patient-specific valves with better fit and performance, reducing the need for premature valve replacements. Finally, I will present some recent results in scientific machine learning in solving parametric partial differential equations (PDEs). The tools and methods developed in this research will help improve patient care and treatment outcomes, ultimately benefiting society with improved healthcare.

Short Bio

Adarsh Krishnamurthy is an associate professor in the mechanical engineering department at Iowa State University, where he currently leads the Integrated Design and Engineering Analysis (IDEA) lab. He was a post-doctoral researcher at UC San Diego and received his Ph.D. from UC Berkeley before this. He was the recipient of the NSF CAREER award in 2018 for developing GPU-accelerated tools for patient-specific cardiac modeling. His research interests include computer-aided design (CAD), GPU and parallel algorithms, machine learning, biomechanics, patient-specific heart modeling, solid mechanics, and computational geometry. His lab is currently funded by the NSF, ARPA-E, NASA, NIH, and the ONR.