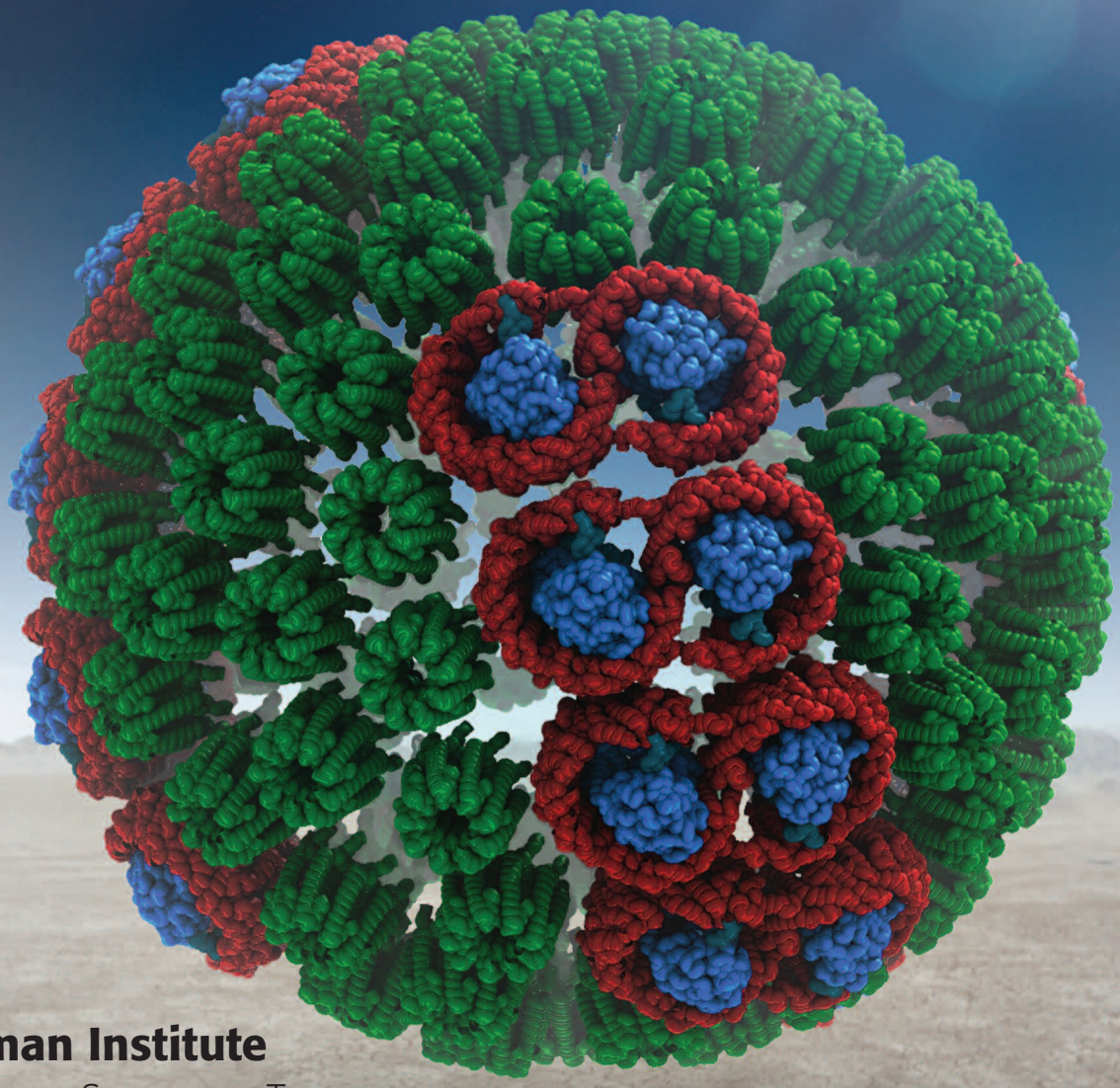
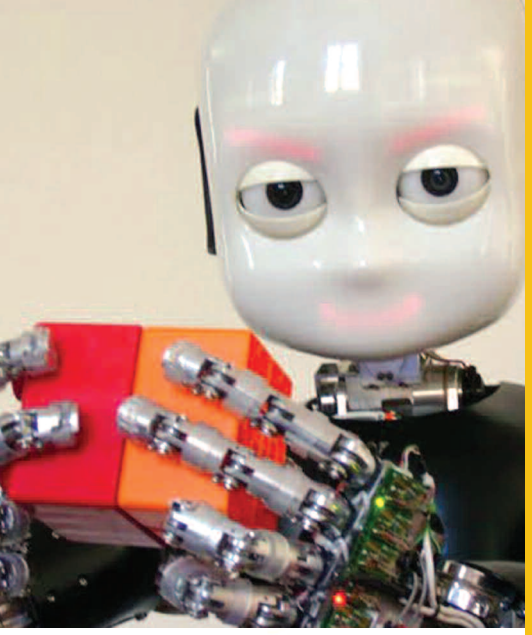
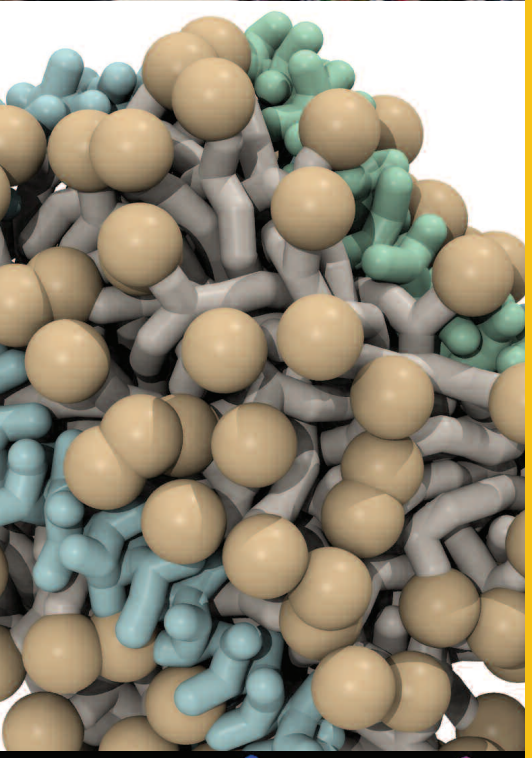
Advanced Computational Methods

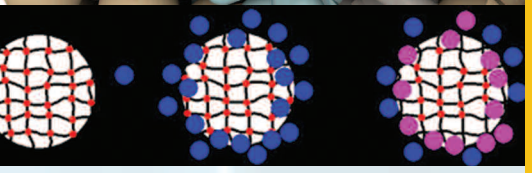


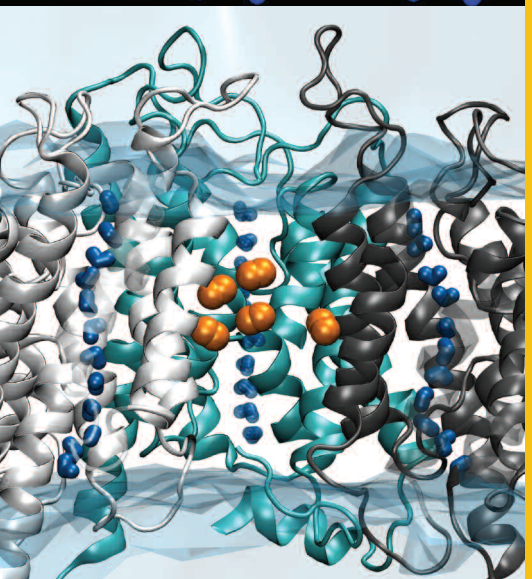
Beckman Institute

FOR ADVANCED SCIENCE AND TECHNOLOGY



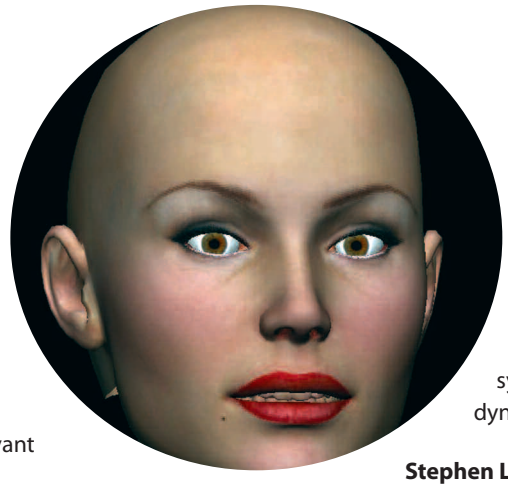






Advanced Computational Methods

Creating advancements in computer science and developing computational methods for a wide range of applications have been fundamental to the work taking place at the Beckman Institute since it opened more than 20 years ago. Research here is improving the human-computer interface through advances in areas such as search engines and face and voice recognition software, fueling discoveries by providing researchers with spectacularly simulated views of molecular scale biological processes, and taking medical and scientific imaging technologies into a future of higher resolution and faster results.



Thomas Huang is recognized worldwide as a pioneer in the fields of multimodal signal processing and computer vision thanks to his achievements in improving the human-computer interface. He and his group have led the way in development of emotion, face, and gender recognition software, and in developing relevant feedback for database searches.

Klaus Schulten and his group have been advancing dynamic computer simulations for understanding biological processes and structure for more than 20 years, creating simulations that have provided never before seen views of such functions as a gating mechanism that controls the electrical signals of nerve cells and the first-ever simulation of an entire life form, the complete satellite tobacco mosaic virus.

Narayana Aluru develops computational methods for the analysis and design of microelectromechanical systems (MEMS), microfluidics, and other applications in work that has led to discoveries about the physical mechanism underlying the rapid transport of water in carbon nanotubes, and about the behavior of molecules on a graphite surface.

Umberto Ravaioli develops simulations for insight into nanostructures such as nanoscale silicon devices and into ion transport in biological channels.

Narendra Ahuja focuses on the computational relationships between images and three-dimensional scenes toward improving the human-computer interface. His techniques have compactly represented multidimensional visual datasets for efficient image-based rendering and led to development of 3-D camera systems with capabilities similar to the human visual system.

Emad Tajkhorshid uses computational methods like dynamic simulations to study the biophysics of cellular membranes and understand how molecules and proteins function. Tajkhorshid achieved the first simulation of the binding of a molecule to a protein with a simulation of ADP binding to a protein lodged in the inner membrane of the mitochondrion.

Seth Hutchinson explores intelligent sensor-based robotics, focusing on solutions to problems involving sensory data processing, such as incorporating vision feedback directly into a robot's control system using the mathematics of dynamical systems with geometry.

Stephen Levinson's Language Acquisition and Robotics Laboratory uses an iCub, a highly-advanced humanoid robot with the physical dimensions of a human toddler, to study how language is acquired. The robot is not programmed to perform tasks but rather is programmed to *learn* to perform the same types of tasks and behaviors involved in human language acquisition.

Tim Brtel creates tools such as geometric search algorithms for motion analysis, planning, and control in biological and mechanical systems, including robots for planetary exploration, neuro-prosthetic devices, and autonomous sailplanes for atmospheric and environmental science.

Mark Hasegawa-Johnson applies higher-level knowledge from linguistics and psychology in research that uses computational methods to create models for automatic speech recognition (ASR) applications. He is working on projects that — through the development of ASR technology — seek to improve the ability of people with cerebral palsy to communicate, the accuracy in translating the multiple dialects of Arabic, and the fluency of second language learners' speech.

Scott Carney is a theoretical physicist whose work takes advantage of mathematical equations in order to advance imaging modalities such as optical coherence tomography (OCT) and spectroscopy. In one project, Carney's computational approach was able to take blurry optical microscopy images and turn them into high-resolution three-dimensional images.

Dan Roth develops algorithms for large-scale intelligent systems and learning systems toward advancing artificial intelligence applications and understanding learning and reasoning.