

# Past Winners: HPC Innovation Excellence Awards (slide 1 of 2)

- Alenia Aermacchi (Italy)
- ALYA RED (Spain)
- Amazon Web Services (U.S.)
- Aon Benfield Securities, Inc. (Canada)
- Argonne National Laboratory, NRG (Netherlands), SCK-CEN (Belgium), TerraPower, and the University of Illinois at Urbana-Champaign
- Argonne National Laboratory, Caterpillar, Convergent Science (U.S.)
- BGI Shenzhen (China)
- Bottero S.p.A. (Italy)
- BP (U.S.-UK)
- Bright Computing (U.S.)
- California Institute of Technology (U.S.)
- Center for Development of Advanced Computing (India)
- Center for Green Research on Energy & Environmental Materials (U.S.)
- Center for Pediatric Genomic Medicine at Children's Mercy Hospitals Kansas City (U.S.)
- Central Michigan University (U.S.)
- Cerebras (U.S.)
- CINECA (Italy)
- Columbia University (U.S.)
- Cornell University Center for Advanced Computing (U.S.)
- Continuous Casting Consortium & NCSA (U.S.)
- EPCC at the University of Edinburgh, York Plasma Institute at the University of York, and Lund University (UK)
- Ergolines (Italy)
- Cycle Computing (U.S.)
- Department of Defense High Performance Computing Modernization Program (U.S.)
- Disney Animation Studios (U.S.)
- Dreamworks Animation (U.S.)
- ESTECO and Airworks Engineering (Italy)
- Facebook (U.S.)
- Ford Werke GmbH (Germany)
- Fortissimo Project (EU)
- GE Global Research (U.S.)
- GIS Federal (U.S.)
- High Performance GeoComputing Laboratory at the University of California at San Diego (U.S.)
- HydrOcean/Ecole Centrale Nantes (France)
- Imperial College London and NAG (UK)
- Intelligent Light (U.S.)
- Kinetica (U.S.)
- Korea Institute of Science and Technology Information (KISTI)
- Lawrence Berkeley National Laboratory (U.S.)

# Past Winners: HPC Innovation Excellence Awards (slide 2 of 2)

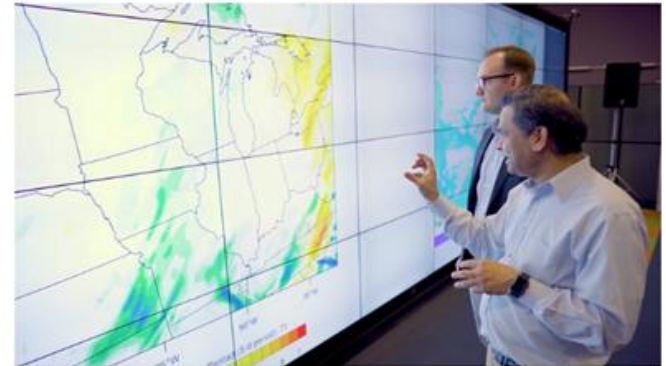
- Lawrence Livermore National Laboratory (U.S.)
- Mary Bird Perkins Cancer Center and Louisiana State University (U.S.)
- NASA (U.S.)
- National Institute of Supercomputing and Networking, Korea Institute of Science and Technology Information (Korea)
- NexIO Simulation (France)
- North Carolina State University (U.S.)
- Novartis (Switzerland)
- NERSC (U.S.)
- NVIDIA (U.S.)
- Oak Ridge Leadership Computing Facility, Oak Ridge National Laboratory (U.S.)
- Ohio State University Cancer Comprehensive Care Center (U.S.)
- PayPal (U.S.)
- Pipistrel d.o.o. (Slovenia)
- Pittsburgh Supercomputing Center (U.S.)
- Polestar Racing (Sweden)
- Princeton University/Princeton Plasma Physics Laboratory (U.S.)
- Procter & Gamble Company (U.S.)
- Queen Mary University of London and NAG (UK)
- Ramgen Power Systems LLC (U.S.)
- RENCi (U.S.)
- Rolls-Royce, Procter and Gamble, National Center for Supercomputing Applications, Cray Inc., Livermore Software Technology Corporation (U.S.)
- Sardinia Systems (Estonia)
- St. Vincent's Institute of Medical Research (AUSTRALIA)
- SickKids Hospital-Toronto (Canada)
- Southern California Earthquake Center (U.S.)
- Spectraseis Inc (U.S.) and CADMOS, University of Lausanne (Switzerland)
- Stevens Institute of Technology (U.S.)
- Studio 100-M.A.R.K. 13 (Germany)
- Sugon (China)
- Swift Engineering (U.S.)
- Tata Consultancy Services (INDIA)
- Technical University of Denmark (Denmark)
- Tech-X Corporation (U.S.)
- UberCloud (U.S.)
- United States Postal Service (U.S.)
- United Technologies Research Center/NERSC IPM (U.S.)
- University College London and NAG HECTOR dCSE (UK)
- University of California (U.S.)
- University of Illinois (U.S.)
- University of Minnesota (U.S.)
- University of Rochester (U.S.)
- University of Texas MD Anderson Cancer Center, Texas Advance Computing Center (TACC) and Elekta AB (U.S.)
- University of Warwick and NAG HECTOR dCSE (UK)
- University of Wisconsin-Madison (U.S.)
- Westinghouse Electric Company LLC, ORNL (U.S.)
- Zuse Institute Berlin (Germany)

# Sample Submissions: Past Award Winners

# Risk and Resiliency of Infrastructure Southeastern USA for AT&T

**Rao Kotamarthi, Jiali Wang, Eugene Yan,  
Julie Bessac, Alissa Jared and Tom Wall. Argonne  
National Laboratory**

**First time using a series of high spatial resolution physical based models for regional climate, surface hydrology and coastal flooding to build a dataset that provides estimates of changes in the risk of flooding, which was used by AT&T to develop a risk and resiliency tool**



# Automated Segmentation of Knee Bone and Cartilage Combining Statistical Shape Knowledge and Convolutional Neural Networks

The Max Delbrück Center for Molecular Medicine provided an infrastructure for Zuse Institute Berlin to combine Convolutional Neural Networks and 3D Statistical Shape Knowledge to automate the identification of Osteoarthritis on a DDN A3I system

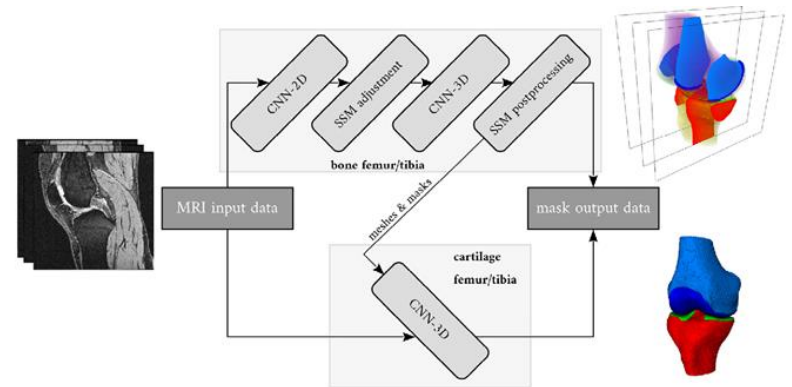
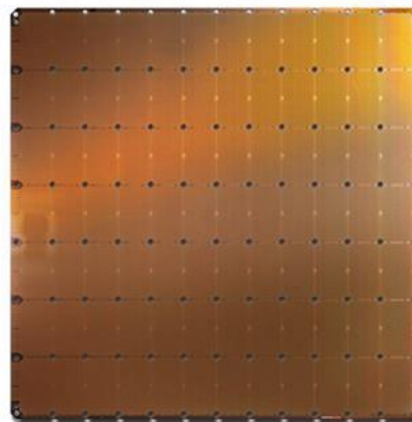


Figure 1: Pipeline for knee bone and cartilage segmentation. A cascade of CNN1 and SSM steps yields 2D segmentation masks of the femoral and tibial b

# Cerebras Wafer Scale Engine

Andrew Feldman, Cerebras

**Cerebras has built the largest chip ever, which contains more than 1.2 trillion transistors and 400,000 compute cores to solve AI problems, that used to be solved in months, in minutes**



**Cerebras WSE**  
1.2 Trillion transistors  
46,225 mm<sup>2</sup> silicon



**NVIDIA Tesla V100**  
21.1 Billion transistors  
815 mm<sup>2</sup> silicon

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# HPC Simulations of the Impact of Drug-induced Arrhythmias in Living Hearts

This research project was performed by researchers from the Living Matter Laboratory at Stanford University, and supported by Living Heart Project members from SIMULIA, Hewlett Packard Enterprise, Advania, and UberCloud



- Before a new drug reaches the market, pharmaceutical companies need to check for the risk of inducing arrhythmias. Currently, this process takes years and involves costly animal and human studies
- In this project, the Living Matter Laboratory of Stanford University developed a new software tool enabling drug developers to quickly assess the viability of a new compound

# Model for the Effects of Sea Level Rise in the Hurricane Storm Surge

Conducted by the Stevens Institute of Technology/New York City Economic Development Corporation (U.S.) led by Phil Orton and Alan Blumberg



- Orton and his colleagues separated the different factors that can cause ocean water to rise, such as changes in atmospheric pressure, wind direction, tides, swelling rivers pouring into the sea. They then modeled the factors individually and wove them back together to experiment with changes to each parameter
- New insights could lead to models that can predict flooding more specifically, “neighborhood by neighborhood.”



# Massive Genetic Study Shows How Humans are Evolving

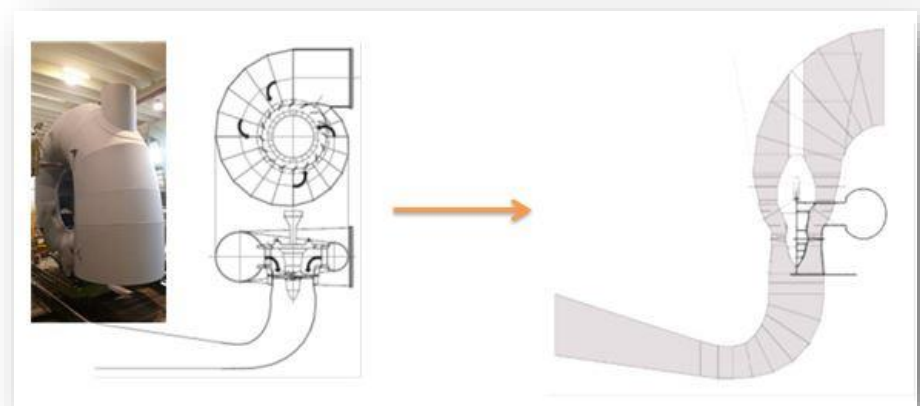
Hakhamanesh Mostafavi, an evolutionary biologist at Columbia University, led the study



- A huge genetic study that sought to pinpoint how the human genome is evolving suggests that natural selection is getting rid of harmful genetic mutations that shorten people's lives
- The work analyzed DNA from 215,000 people and is one of the first attempts to probe directly how humans are evolving over one or two generations

# SuRE\_HPC: Sustainable & Renewable Energy HPC

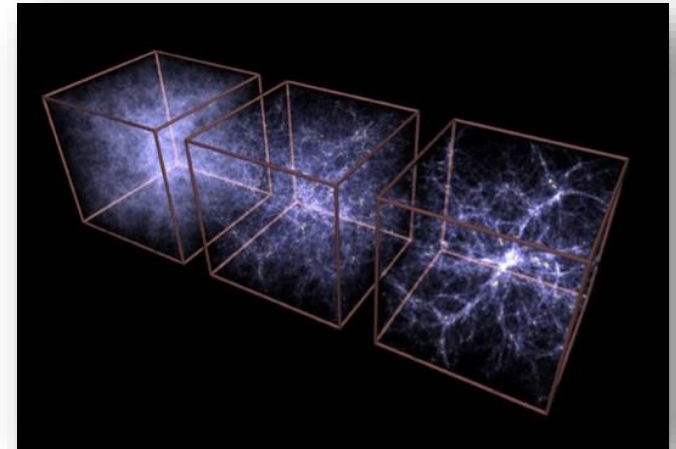
- This project was funded by the EU commission within FP (framework programme) 7th, along with Enginsoft and CINECA, the largest Italian supercomputing centre
- The SuRE\_HPC project is working to enable Zeco – an EU maker of turbines for hydraulic power plants - to be more competitive in the hydro market thanks to HPC cloud simulations for a new Kaplan design
- The Kaplan turbine is a propeller-type water turbine which has adjustable blades
- This effort is part of Fortissimo (Factories of the Future Resources, Technology, Infrastructure and Services for Simulation and Modeling), a collaborative project that has the aim of enabling European SMEs to get access to the use of simulations services running on a HPC Cloud-based infrastructures



# Galactos Project Solves One of Cosmology's Hardest Challenges

Project team included Brian Friesen, Mostofa Patwary, Brian Austin, Nadathur Satish, Zachary Slepian, Narayanan Sundaram, Debbie Bard, Daniel Eisenstein, Jack Deslippe, Pradeep Dubey, and Prabhat

- There is an open problem in astronomy and cosmology in computing the anisotropic (direction-dependent) and isotropic (direction-averaged) 3-point correlation (3CPF) function which provides information on the structure of the universe
- Galactos has made a major breakthrough in successfully running the 3-point correlation calculation on Outer Rim, the largest known simulated galaxy dataset that contains information for two billion galaxies
- Essentially the innovation transforms an  $O(n^3)$  problem into an  $O(n^2)$  one
- The Galactos code ran on the NERSC Cori system at Lawrence Berkeley National Laboratory



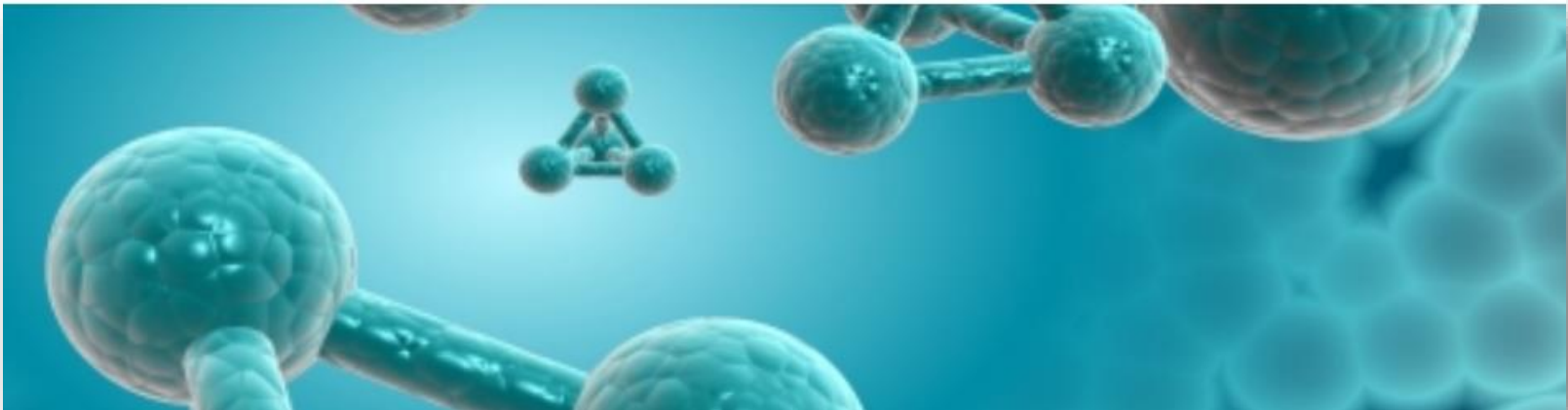
# PSC Models Show Value of Vaccine Choice in Fighting Flu



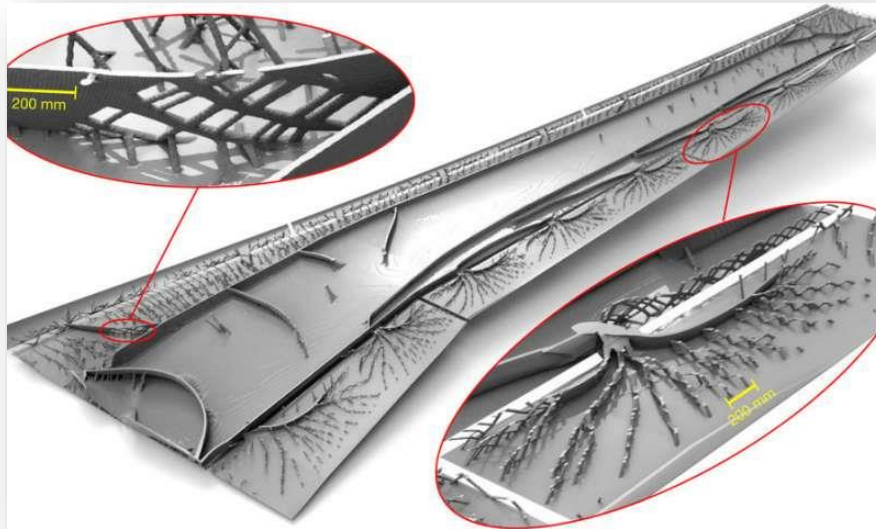
- **PSC’s Public Health Applications Group and collaborators at PSC, the University of Pittsburgh and Soongsil University in the Republic of Korea, used PSC supercomputers to find out whether offering different types of vaccination -- the familiar injected vaccine or two types of “needle sparing” vaccines -- would reduce flu cases and make vaccination more cost effective**
- **The work allowed the scientists to test a wider range of assumptions about increased coverage and virus spread, showing that even moderate increases in coverage due to offering more choices can reduce costs and decrease influenza cases**

# Research Centre Identifies Precision Treatments

- **The Center for Computational Medicine (CCM) is a Core Facility within the SickKids Research Institute**
- **Their mission is to provide the scientists and clinicians at SickKids with computational expertise, including High Performance Computing resources, Bioinformatics Analysis consulting and software development**
- **In this project, 107 trillion calculations per second help predict the minute differences between individual children to identify precise treatments to manage and cure disease**

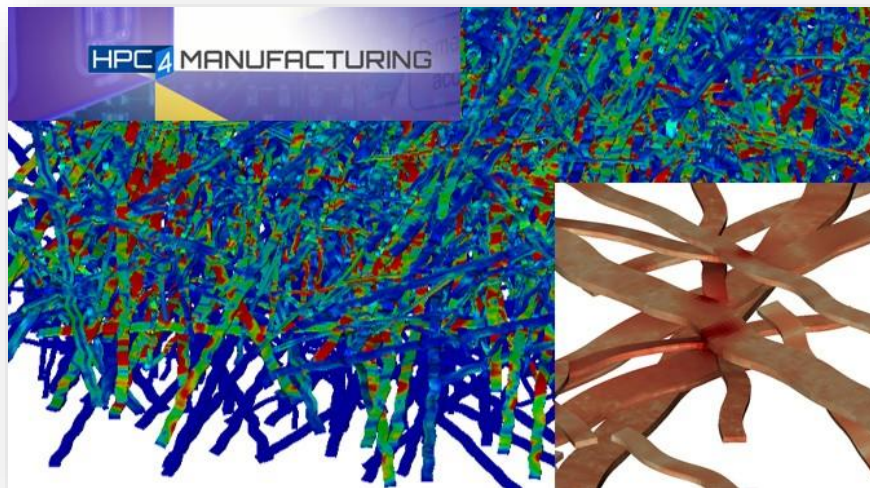


# Supercomputer Redesign of Aeroplane Wing Mirrors Bird Anatomy



- A team of researchers - Niels Aage et al - with the Technical University of Denmark applied an engineering technique in a new way to the design of the interior of an airplane wing. The resulting design is 2 to 5 percent lighter than conventional designs
- Translated to the real world, the team calculated that such a savings in weight would result in a Boeing 777 airplane having wings 200 to 500 kilograms lighter than those in use today which they further calculated would result in a savings of 40 to 200 tonnes of fuel per year

# Researchers Eye Papermaking Improvements Through HPC



- Procter and Gamble regularly uses high-performance computing to develop its products, but simulating the way in which paper fibers contact each other is complicated and expensive
- To help the company speed up the development process LLNL researcher Will Elmer and his team of programmers developed a parallel program that prepares the fiber geometry and meshing input needed for simulating thousands of fibers
- The ensuing research, performed for an HPC4Manufacturing (HPC4Mfg) project with the papermaking giant, resulted in the largest multi-scale model of paper products to date, simulating thousands of fibers in ParaDyn with resolution down to the micron scale