

A Decade of Discovery

The Texas Advanced Computing Center celebrates 10 years of enabling discoveries through the use of advanced computing technologies



The Texas Advanced Computing Center (TACC) at The University of Texas at Austin is one of the leading centers of computational excellence in the United States. Located on the J.J. Pickle Research Campus, the center's mission is to enable discoveries that advance science and society through the application of advanced computing technologies.

On June 1, 2001, the newly reorganized Texas Advanced Computing Center (TACC) officially began supporting computational researchers at The University of Texas at Austin (UT Austin) and throughout the national academic community.

Now home to some of the most powerful and recognized supercomputers in the open science community, TACC began 10 years ago by building from a predecessor organization, and by inheriting a dozen employees, a space on the J.J. Pickle Research Campus, and a small 88-processor, liquid-cooled Cray T3E, the original Lonestar system.

From these humble beginnings, TACC began a rapid ascent to become one of the leading supercomputing centers in the world. Born from the shared vision of leadership at UT Austin and TACC's director, Jay Boisseau, TACC has become an epicenter for research that advances science and society through the application of advanced computing technologies.

"The University of Texas, situated in Austin, presented a tremendous opportunity to build a world-class advanced computing center that supported outstanding science not just at UT, but across the nation," Boisseau said. "The quality of the university, the depth of the talent pool, the high profile of the university and the city, and the small, but dedicated staff that were already on hand, presented the elements for a new plan, a new center, and laid the foundation for what we've accomplished thus far."

Over the past decade, TACC's expert staff and systems have supported important scientific work, from emergency simulations of the Gulf oil spill, which helped the Coast Guard protect property

and wildlife, to the first models of the H1N1 virus, which enabled scientists to understand the virus's potential resistance to antiviral medication, to the clearest picture yet of how the early universe formed. In addition, TACC helped predict the storm surge from Hurricane Ike, delivered geospatial support during the Haiti disaster, and is currently providing emergency computing resources to Japanese researchers who are unable to access their own systems in the wake of the earthquake and tsunami.

The center has deployed increasingly powerful computing systems, which have enabled important scientific accomplishments. These include three systems that debuted in the top 30 "most powerful in the world" on the Top 500 list for open science: Lonestar 2 (#26 in 2003); Lonestar 3 (#12 in 2006); and Ranger (#4 in 2008). At \$59 million, the Ranger award also represented the largest single grant to The University of Texas from the National Science Foundation (NSF).

Additionally, TACC currently operates the world's highest-resolution tiled display (2008: Stallion), and the largest remote and collaborative interactive visualization cluster (2010: Longhorn).

TACC did not emerge in a vacuum. UT Austin had operated supercomputers through a variety of institutes and centers since 1986, including the UT System Center for High Performance Computing, the UT Austin High Performance Computing Facility, and the UT Austin Advanced Computing Center for Engineering and Science (ACCES).

Prior to the formation of TACC, the staffing and systems for advanced computing was at an all-time low on campus. An external



Deployed in February 2011, Lonestar 4 is TACC's newest supercomputer and the third largest system on the NSF TeraGrid. It ranks among the most powerful academic supercomputers in the world with 302 teraflops peak performance, 44.3 terabytes total memory, and 1.2 petabytes raw disk.

review board had reported to UT Austin leadership in 1999 that if it wanted to sustain and extend leadership in research in the 21st century, the University needed to develop its computational capacity. As a first step, the Vice President for Research, Juan Sanchez, hired Jay Boisseau, who got his PhD from UT Austin and who had previously worked at the San Diego Supercomputing Center and the Arctic Region Supercomputing Center, to lead the effort. Boisseau rapidly set about expanding the core team inherited from ACCES, and recruiting additional talented staff to broaden TACC's technology scope and to help realize his vision.

Said Sanchez: "TACC grew from a vision to the reality it is today thanks to the strong commitment of The University of Texas at Austin to become a leading player in advanced computing, and the dedication, focus and expertise of its director, Dr. Boisseau, and his outstanding staff."

Leveraging top-tier research faculty at the University, local technology partners like Dell Inc., and funding from the NSF, TACC developed rapidly from a small center to a leading provider of computational resources nationwide. TACC currently has nearly 100 employees and continues to expand.

As TACC resources grew in capability and the center hired additional staff, bringing great expertise, the center's position in the high performance computing community grew as well. In 2002, the High Performance Computing Across Texas (HiPCAT) consortium was formally established by researchers at Rice University, Texas A&M, Texas Tech, University of Houston, and UT Austin, with Boisseau as the first director. In 2004, TACC was selected to join the NSF TeraGrid, the world's largest distributed infrastructure for open scientific research.

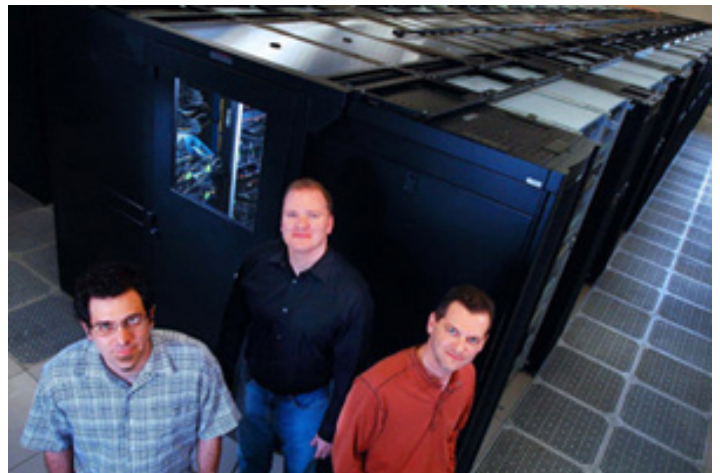
In 2007, TACC began providing resources on Lonestar 3 to other UT System institutions, a role that has now grown in scale with Lonestar 4 and with the UT Research Cyberinfrastructure project. In 2009, the NSF awarded a \$7 million grant to TACC to provide a new compute resource (Longhorn), and the largest, most comprehensive suite of visualization and data analysis services to

the open science community. And in 2010, TACC was selected as one of four U.S. advanced computing centers awarded \$8.9 million for eXtreme Digital (XD) Technology Insertion Service (TIS) award to evaluate and recommend new technologies as part of the NSF TeraGrid and its follow-on initiative.

In February 2011, TACC deployed a powerful new supercomputer, Lonestar 4, for the national scientific community. The center also received word in May that the National Science Board had approved \$121 million for the follow-on to the NSF TeraGrid, known as Extreme Science and Engineering Discovery Environment (XSEDE), in which TACC will play a leading role.

The emergence of TACC as a world-class supercomputing center has arisen in the context of computational science becoming the third method of investigation, which, in conjunction with theory and experimentation, is driving advances in all fields of research. The resources that TACC deploys enable scientists to explore phenomenon too large (i.e. black holes), small (quarks), dangerous (explosions), or expensive (drug discovery) to investigate in the laboratory.

High performance computing is also used to predict the outcome of complex natural phenomena. This is the case for Clint Dawson, one of the leaders in forecasting storm surges associated with tropical storms.



"Ranger" Principal Investigator (PI), Jay Boisseau, and Co-PIs, Karl Schulz, Tommy Minyard and Omar Ghattas (not pictured) brought the 579.4 teraflop supercomputer to The University of Texas at Austin where it helps the nation's top scientists address some of the world's most challenging problems.

"We rely on our partnership with TACC because, without them, we wouldn't be able to do real-time forecasting of extreme weather events," said Dawson, head of the Computational Hydraulics Group housed in the Institute for Computational Engineering and Sciences (ICES) at UT Austin, and a longtime user of the center's systems.

This sentiment is shared by nearly all of the scientists and engineers who use TACC's systems. The majority of computational cycles are allocated by the NSF to the most promising computational science research; some cycles are reserved for researchers at Texas institutions of higher learning, including community colleges and minority-serving institutions. As much as a new telescope or

electron microscope drives discoveries in astronomy or biology, advanced computing systems allow for new kinds of investigations that push knowledge forward across all scientific disciplines.



The particles in the visualization represent portions of the oil spill and their position is either hypothetical or reflect the observed position of the oil on the surface. The data is visualized using Longhorn and MINERVA, which is an open source geospatial software. [Credits: Univ. North Carolina at Chapel Hill, Institute of Marine Sciences; Univ. Notre Dame, Computational Hydraulics Laboratory; Univ. Texas, Computational Hydraulics Group, ICES; Univ. Texas, Center for Space Research; Univ. Texas, Texas Advanced Computing Center; Seahorse Coastal Consulting]

“We wouldn’t be able to do anything without TACC,” said Mikhail Matz, a professor of integrative biology at UT Austin who combines the power of supercomputers with next-generation gene sequencers. “We can generate massive amounts of genetic sequences, but then what? The main challenge here is to figure out the most appropriate and effective way of dealing with this huge amount of data, and extracting the information you want. To do that, we need very powerful computers.”

But TACC is more than the host of powerful computing systems. It is also home to an inimitable group of technologists who are instrumental in accelerating science, often by working directly with researchers to make sure their codes run quickly and effectively.

“In order to do these large-scale science runs, it’s a big team effort,” said Philip Maechling, information architect for the Southern California Earthquake Center, who uses Ranger to simulate earthquakes and predict their impact on structures in the Los Angeles basin. “You need the help of a lot of people on our end, but also the help of the staff at TACC in order to get all the pieces to come together.”

Working with Maechling’s team, TACC has helped advance earthquake science and contributed to the development of updated seismic hazard estimates and improved building codes for California.

For users like Dawson, Matz, and Maechling, access to TACC’s Ranger supercomputer and other systems means faster time-to-solution, higher-resolution models, more accurate predictions, and the ability to do transformative science with the potential for social impact.

“We’ve made our systems reliable, high performance and scalable, and we’ve provided great user support,” said Boisseau. “Our systems are constantly in demand — often far in excess of what

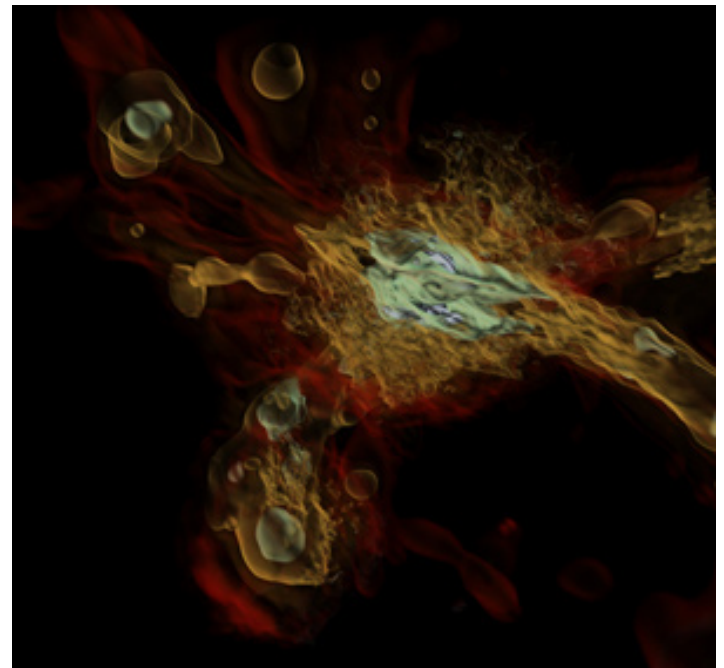
what we can even provide — because we’ve established a reputation for making TACC a great environment for scientific research.”

TACC supports more than 1,000 projects, and several thousand researchers, each year, on its diverse systems.

On Friday, June 24, TACC will commemorate its 10th Anniversary with a half-day celebration and colloquium event on the J.J. Pickle Research Campus. The event will bring together experts in the high performance computing community, top scientific researchers who use TACC’s resources, and leadership from the center to discuss the past, present and future of advanced computing, and the ways in which high performance computing is advancing science and society.

[A full description and calendar of events is available online at: <http://www.tacc.utexas.edu/10-year-celebration/>]

June 1, 2011



Galaxy Formation in the Early Universe: This is a visualization of a galaxy formation dataset, about 5 million particles simulated for 631 timesteps on Ranger. This simulation and corresponding visualizations help answer questions about the formation of the early Universe, about 100 million years after the Big Bang. This research also helps guide the observations of the James Webb Space Telescope, the replacement for the Hubble Space Telescope, scheduled for launch in 2013. [Image credit: Christopher Burns, Thomas Greif, Volker Bromm, and Ralf Klessen]