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NEWS RELEASE

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2017 ACM Gordon Bell Prize Awarded to Chinese Team that Employs the World's Fastest Supercomputer to Simulate 20th Century's Most Devastating Earthquake

Denver, Colorado, November 16, 2017 – ACM, the Association for Computing Machinery (www.acm.org), has named a 12-member Chinese team the recipients of the 2017 ACM Gordon Bell Prize for their research project, "18.9-Pflops Nonlinear Earthquake Simulation on Sunway TaihuLight: Enabling Depiction of 18-Hz and 8-Meter Scenarios." Using the Sunway TaihuLight, which is ranked as the world's fastest supercomputer, the team developed software that was able to efficiently process 18.9 Pflops (or 18.9 quadrillion calculations per second) of data and create 3D visualizations relating to a devastating earthquake that occurred in Tangshan, China in 1976. The team's software included innovations that achieved greater efficiency than had been previously attained running similar programs on the Titan and TaihuLight supercomputers.

The ACM Gordon Bell Prize (awards.acm.org/bell) tracks the progress of parallel computing and rewards innovation in applying high performance computing to challenges in science, engineering, and large-scale data analytics. The award was presented today by ACM President Vicki Hanson and Subhash Saini, Chair of the 2017 Gordon Bell Prize Award Committee, during the International Conference for High Performance Computing, Networking, Storage and Analysis (SC17) (sc17.supercomputing.org/) in Denver, Colorado.

Although earthquake prediction and simulation is an inexact and emerging area of research, scientists hope that the use of supercomputers, which can process vast sets of data to address the myriad of variables at play in geologic events, may lead to better prediction and preparedness. For example, the Chinese team's 3D simulations may inform engineering standards for buildings being developed in zones known to have seismic activity. In this vein, many have advocated for a significant increase in the

amount of sensors to regularly monitor seismic activity. The Tangshan earthquake, which occurred on July 28, 1976 in Tangshan, Hebei, China, is regarded as the most devastating earthquake of the 20th century, and resulted in approximately 242,000-700,000 deaths. In developing their simulations for the Tangshan earthquake, the winning team included input data from the entire spatial area of the quake, a surface diameter of 320 km by 312 km, as well as 40 km deep below the earth's surface. The input data also included a frequency range of the earthquake of up to 18 Hz (Hertz). In the study of earthquakes, a Hertz is a unit of measurement that measures the number of times an event happens in the period of a second. For example, it might correspond to the number of times the ground shakes back and forth during an earthquake. Previous simulations of violent earthquakes have employed a lower frequency than 18 Hz, since enormous memory and time consumption are needed for high frequency simulations.

This year's winning team is not the first to develop algorithms for supercomputers in an effort to simulate earthquake activity. In the abstract of their presentation, the 2017 Gordon Bell recipients write: "Our innovations include: (1) a customized parallelization scheme that employs the 10 million cores efficiently at both the process and thread levels; (2) an elaborate memory scheme that integrates on-chip halo exchange through register communication, optimized blocking configuration guided by an analytic model, and coalesced DMA access with array fusion; (3) on-the-fly compression that doubles the maximum problem size and further improves the performance by 24%."

Of its new innovations, the Chinese team adds that its on-the-fly compression scheme may be effectively applied to other challenges in exascale computing. In their paper, the authors state: "The even more exciting innovation is the on-the-fly compression scheme, which, at the cost of an acceptable level of accuracy lost, scales our simulation performance and capabilities even beyond the machine's physical constraints. While the current compression scheme is largely customized for our specific application and the Sunway architecture, we believe the idea has great potential to be applied to other applications and other architectures."

Winning team members include Haohuan Fu, Tsinghua University and National Supercomputing Center, Wuxi, China; Conghui He, Tsinghua University and National Supercomputing Center, Wuxi, China; Bingwei Chen, Tsinghua University and National Supercomputing Center, Wuxi, China; Zekun Yin, Shandong University; Zhenguo Zhang, Southern University of Science and Technology, China; Wenqiang Zhang, University of Science and Technology of China; Tingjian Zhang, Shandong University, Wei Xue,

Tsinghua University and National Supercomputing Center, Wuxi, China; Weiguo Liu, Shandong University; Wanwang Yin, National Research Center of Parallel Computer Engineering and Technology, China; Guangwen Yang, Tsinghua University and National Supercomputing Center, Wuxi, China; and Xioafei Chen, Southern University of Science and Technology, China.

Innovations from advanced scientific computing have a far-reaching impact in many areas of science and society—from understanding the evolution of the universe and other challenges in astronomy, to complex geological phenomena, to nuclear energy research, to economic forecasting, to developing new pharmaceuticals. The annual SC conference brings together scientists, engineers and researchers from around the world for an outstanding week of technical papers, timely research posters, and tutorials.

The Sunway TaihuLight is a Chinese supercomputer with over 10.5 M heterogeneous cores and is ranked as the fastest supercomputer in the world. Located at the National Supercomputer Center in Wuxi, Jingsu, China, it is nearly three times as fast as the Tianhe-2, the supercomputer that previously held the world record for speed.

About ACM

ACM, the Association for Computing Machinery (www.acm.org) is the world's largest educational and scientific computing society, uniting computing educators, researchers and professionals to inspire dialogue, share resources and address the field's challenges. ACM strengthens the computing profession's collective voice through strong leadership, promotion of the highest standards, and recognition of technical excellence. ACM supports the professional growth of its members by providing opportunities for life-long learning, career development, and professional networking.

About the ACM Gordon Bell Prize

The ACM Gordon Bell Prize (awards.acm.org/bell) is awarded each year to recognize outstanding achievement in high-performance computing. The purpose of this recognition is to track the progress over time of parallel computing, with particular emphasis on rewarding innovation in applying high-performance computing to applications in science. The prize is awarded for peak performance as well as special achievements in scalability and time-to-solution on important science and engineering problems and low price/performance. Financial support for the $10,000 awards is provided by Gordon Bell, a pioneer in high-performance and parallel computing.

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