

Dr. Joshua Fu—Using Computer Simulations to Improve Olympic Air Quality

In 2008, all eyes will be on China for the summer Olympic Games in Beijing. Athletes will test their strength; countries will compete for gold medals; and people from across the globe will travel to China for the excitement. However, Dr. Joshua Fu, a research assistant professor in civil and environmental engineering, will be one of the few with his eyes not on the games, but on the skies.

For years, Fu has been working with a team of researchers from Argonne National Laboratory, the U.S. Environmental Protection Agency (EPA), Tsing-Hua University, Peking University and the Chinese Academy of Sciences to develop a strategic plan for China to improve its air quality for the 2008 Summer Olympic Games by using powerful computer clusters.

“Through simulation modeling, we’re able to identify the local contributors of air quality in Beijing,” said Fu, whose background on environmental system analysis and computing led him to this project. “With development of new governmental control strategies, we’re able to improve energy use in order to improve air quality in 2008.”

Beijing’s northern border is surrounded by hills that restrict venting pollution during hot, humid summer days, much like Los Angeles and the Tennessee Valley. Southern winds from the East and Yellow Seas collide with northern winds, creating ground-level ozone and particulate matter accumulation. Pollutants from surrounding regions get trapped and build up over several days until they are dispersed by wind or washed away by rain. Because of this, researchers are looking at how to control not only Beijing’s air quality, but surrounding provinces as well.



Using powerful computer clusters, Dr. Fu has worked with a team of researchers to develop a strategic plan for China to improve its air quality for the 2008 Summer Olympic Games.

“We’re trying to find out the regional effects to Beijing City,” said Fu. “All policy makers need to implement a control strategy for Beijing and surrounding provinces.” Findings from the research are in the development stages, and some policy makers in China have been implementing strategies such as a one-week vacation to control vehicles, shutting down industry in the region and encouraging residents to take a trip out of the city to reduce emissions.

The Pearl River Delta region in China is a manufacturing hub with severe air pollutants and another region of focus for Fu, who hopes to provide research results to Hong Kong and the Guangdong Province for policy makers to implement their own pollution control strategies.

After excitement from the Olympic Games blows over, policy makers in China will take the next step to air quality improvements and focus on energy policies. The Chinese EPA (SEPA), with help from Fu and others, created a five-year plan to reduce and improve energy emissions.

“The project identified options for energy use in China,” said Fu. “The use of different types of coal or alternative energies such as wind and solar are all part of the policy plans.”

Climate change is another big project Fu works on with researchers from Harvard, California Institute of Technology, GISS/NASA and Argonne National Lab. Backed by the competitive USEPA’s Science to Achieve Research grant (STAR), Fu and others study the consequences of climate change in air quality, explore computational demand and how the next generation of supercomputers can be built to solve complex problems.

“Global warming is a hot topic in research right now,” said Fu. “People need to look further than carbon dioxide for answers. Controlling air pollution is a way to reduce climate change.”

Fu also works on air quality modeling for the state of Tennessee. Knox and six other surrounding counties are what the EPA considers “non-attainment” zones, meaning the air quality is more polluted than current EPA standards allow.

Fu and his research team are looking into developing a control strategy for state agencies in order for Knox County to get into the attainment zone.

Fu has studied environmental issues throughout his academic career. A Taiwan native, Fu studied environmental engineering in Taiwan before moving to Los Angeles for his graduate work at the University of California, Los Angeles. After completing his Ph.D. work at North Carolina State University, Fu worked for the USEPA supercomputing center prior to coming in UT.

“The focus was specifically air quality,” said Fu. “I helped develop the AIRNow web site in 1999 to provide the public with easy access to national air quality information. It is a public awareness site that offers daily air quality index forecasts for over 300 United States cities.”

When he is not focused on the climate, Fu spends time at home with his wife, Rachel, who is a UT faculty member in the Department of Retail, Hospitality and Tourism Management, and their 9-year-old girl, Katherine, who keeps him focused on the future.

“Through my research, I want to figure out how to fix environmental problems and implement solutions for future generations,” Fu said.

—Story by Amanda Womac

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the university and replaced eight of the ten faculty members! Degree programs in civil, mechanical, mining and electrical engineering followed quickly, along with significant faculty expansion. He obtained UT’s first state appropriation in 1903. In 1892 Dabney hired a gifted mechanical engineering professor, Charles E. Ferris, and in 1913 the College of Engineering was established with Ferris as its first dean.



Dean Charles E. Ferris

Dean Ferris oversaw development of the college into its present form. In 1926, he initiated the engineering co-op program, the second in the southeast and only the 17th in the nation. Engineering research began with establishment of the Engineering Experiment Station in 1922. Mining engineering disappeared because of low enrollment, but chemical engineering (including metallurgy) was moved to the college from chemistry in 1936, and upon his retirement in 1940, Ferris became UT’s first professor of industrial engineering.

Major developments since Ferris’ time include research ties with the Atomic Energy Commission facilities in Oak Ridge after the close of World War II, initiation of doctoral programs (in chemical engineering and metallurgy) in 1949, founding of the Department of Nuclear Engineering in 1957 and the Department of Materials Science and Engineering in 1984 and recent commitments by the university administration for significant College of Engineering enhancements. Many faculty members and administrators have led these developments, but all have stood on the shoulders of the pioneers Estabrook, Dabney and Ferris.