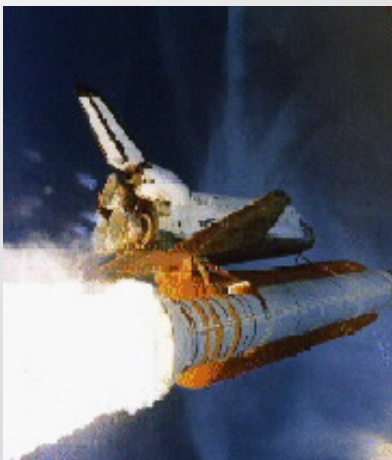


The Fundamentals of High-Speed Flight

Researchers use Ranger supercomputer to manage shock waves for next-generation aircraft



As the Air Force designs hypersonic aircraft, they are supporting research aimed at understanding the shock waves which play a dangerous role in ultra-high-speed flight.

“If your shock induces a serious separation, then the engine can stop working,” said Chaoqun Liu, mathematics professor and director of the Center for Numerical Simulation and Modeling at The University of Texas at Arlington. “If there’s no air inside the engine, you lose power and you’re going to crash.”

Through a grant from the Air Force Office of Scientific Research, Liu is using the Ranger supercomputer at the Texas Advanced Computing Center, as well as high-performance computers at the Army High Performance Computing Center, to explore these interactions in next-generation aircraft.

Physical experiments are necessary to understand the dynamics of shock/boundary-layer interactions, but it is the virtual trials on supercomputers like Ranger that have the greatest benefit for next-generation aircraft design and testing.

Using approximately 370,000 computing hours on Ranger, Liu developed a new mathematical framework that represents shock/boundary-layer interactions at super- and hypersonic speeds. His framework manages high-speed turbulence with accuracy, something many researchers thought was impossible because of shock’s discontinuous nature.

“This is very important, not just for the Air Force, but for nuclear weapons, because they involve shock and sound waves; for finding cancer; and for modeling porous media flow, where you have fluids, sands and stone,” Liu explained. “All of these functions are discontinuous, and this numerical scheme will be good for any such phenomenon. I think it’s a breakthrough.”

Liu is also testing solutions that can reduce the drag, noise and danger associated with shock/boundary-layer interactions.

“We don’t just design these aircraft, we try to understand the physical processes,” Liu said. “With numerical simulation, we get very detailed data, graphics and movies that tell you the ‘why’ and ‘how’ of the mechanics.”



Chaoqun Liu, mathematics professor and director of the Center for Numerical Simulation and Modeling at The University of Texas at Arlington

For more information, please contact: Faith Singer-Villalobos, Public Relations, faith@tacc.utexas.edu, 512.232.5771