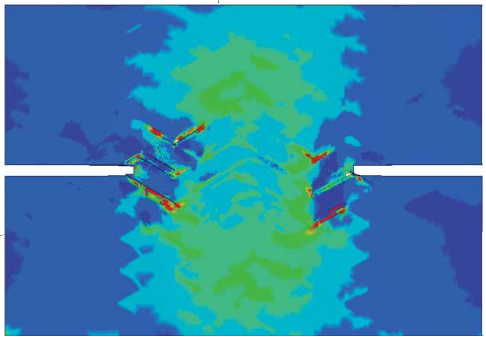

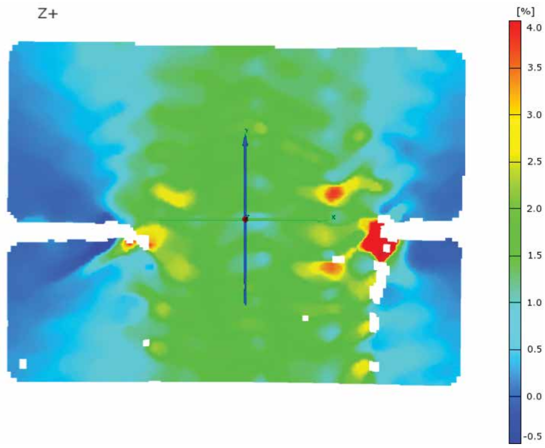

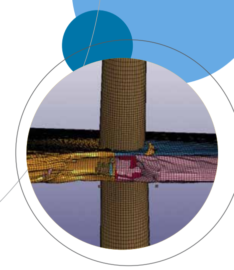

Aircraft Crashworthiness

Binienda performs simulations to reveal critical details

It's a bit frightening to ponder, but in the past, to understand how safe an airplane was, engineers had to wait for a crash. There wasn't much physical testing that could be done, as with cars.

However, in today's age of high performance computing, understanding aircraft crashworthiness can be analyzed through reverse engineering simulations. Wieslaw Binienda, Ph.D., professor and chair of The University of Akron's Civil Engineering Department, is using the Ohio Supercomputer Center's Owens and Oakley clusters to perform these types of simulations to make airplanes lighter, stronger and safer.

Most current airplanes are made of aluminum, steel and titanium. But the future is in composite material designs, such as carbon fibers locked into place with plastic resin, to make planes lighter, cheaper and more comfortable.

But there's a problem.

"How do you know if a new design is safe?" Binienda said. "Fortunately, there hasn't been a crash of a large composite plane yet. And nobody is going to crash an airplane on purpose and compare it to see how passengers would survive. We don't want accidents, but they happen. The only way to see what happens is to simulate crashes and computer power now is significant enough to simulate crash physics."

Binienda is conducting numerical projects using LsDyna3D and Fluent software to perform simulations that reveal complicated details of airplane crashes. To do that, he and his four graduate students have three phases within the overall scope.

In one, his group is conducting multi-scale modeling for impact analysis and material characterization of advanced composite materials. The goal is to develop an efficient modeling method at the micro, meso and macro scale to predict weaknesses in composite structures.

Another project uses reverse engineering via 3D scans of airplanes to build finite element models of large structures and creating digital terrain topography needed for digital crash scenes to understand how trees, soils and other materials affect crashing planes.

The third phase is conducting aerodynamic wind tunnel simulations of airplane structures and subcomponents using Fluent for forensic engineering of airplane crashes.

"The modeling work has a lot of challenges," Binienda said. "But even large simulations are less expensive and more informative than any experimental crash test.

"We usually submit several jobs using the Owens and Oakley clusters. The memory requirement for these calculations is significant and OSC's resources highly accelerate our research." •

PROJECT LEAD // Wieslaw K. Binienda, Ph.D., The University of Akron RESEARCH TITLE // LsDyna simulation of impact problems FUNDING SOURCE // University of Akron WEBSITE // uakron.edu/engineering/CE/profile.dot?identity=1064521

VISUALIZATIONS // Experimental and numerical results of a deformed shape after impact.