Award-Winning Research Advances Composite Analysis Methods

Silvestre Pinho, a senior lecturer in Aero-Structures at Imperial College London, Department of Aeronautics, was the recent winner of the 2010 Albert Cardon Award for "Best Under 35-Years-Old European Researcher in Composite Materials," given once every two years by the European Community in Composite Materials. To those who have met him, it's evident that Pinho brings enthusiasm and innovative methods to his research.

"My research is focused on multiscale structural models for advanced composite materials," Pinho commented. "The importance of this area in aeronautics is easy to understand: While modern commercial aircraft look very similar to those from a few decades ago, the structural materials inside are completely different. And again, in a few decades, aircraft will be made of different materials, and the evolution is only possible because significant research is being devoted to it."

Pinho's workplace and alma mater, Imperial College London, is consistently ranked in the world's top 10 in the (*Times Higher Education)* World University Ranking. Its Department of Aeronautics was rated with the top classification (5*) in the last Research Assessment Exercise, undertaken on behalf of U.K. higher education funding councils to evaluate the quality of research conducted by British higher education institutions. Pinho's group currently has 10 Ph.D. students and two Post Doctoral Research Assistants. To date, his group's main contributions have been the development of micromechanical models for different failure mechanisms for carbon fibre reinforced composites and the development of mode I translaminar fracture toughness tests, a numerical smeared crack formulation, cohesive elements and multiscale modeling.

In 2009, Pinho collaborated with SIMULIA in the 3rd World-Wide Failure Exercise (WWFE), where accurate modeling of crack propagation in composite materials is essential. Pinho later prepared a framework for user-defined failure criteria suitable for composites to be used in conjunction with the XFEM feature in Abaqus. Through collaboration with SIMULIA R&D this technique—which allows users to define the onset of crack propagation, the orientation of the fracture plane and the fracture toughness as a function of the damage mode predicted by user stress- and strain-based criteria—has been included in Abaqus starting with the pre-release version of Abaqus 6.10-EF.

Silvestre Pinho with Aeronautics engineering students at Imperial College London.

"Abaqus is an excellent platform for structural research, as it allows researchers to develop and test their own research models, while benefiting from a state-of-the-art finite element code, including complementary models and user-friendly pre- and post-processing," says Pinho. "SIMULIA staff members are very open to collaboration with model developers. They are supportive and responsive to ideas and suggestions. They also have a positive, strategic view of the importance of academic model developers for Abaqus."

Beginning in 2011, SIMULIA will be involved with Pinho on a new research project that his group has outlined as: "Bridging the Scales; from the toughness of small specimens to the damage tolerance of large aerospace panels." Airbus will also be involved in this three-year project, sponsored by the Engineering and Physical Sciences Research Council. The goal of this research project is to develop methods to accurately predict the strength and damage tolerance of large composite components by gaining a deep understanding of 1) the failure process at the micromechanical level, 2) the corresponding energy absorbing mechanisms, and 3) the different scales involved in the fracture process.

"The demands of new aircraft developments require a significant improvement in the modeling capabilities for characterizing and simulating the behavior of laminated composite materials," says Alan Prior, SIMULIA's aerospace lead in Europe. "This research, to work in parallel on both testing and modeling, is very important and distinct. It is critical for our industrial customers that new and innovative numerical methods are supported with real physical data rather than being theoretically isolated. Silvestre's team research proposal is very timely and will help SIMULIA address major requirements for the realistic simulation of composite structures."

Silvestre Traveira Pinho studied Mechanical Engineering at the University of Porto and graduated with an M.Sc. in Mechanical Engineering in 2002. During his Masters degree, numerical modeling stood out as a very active and interesting research area. His research is focused on multiscale structural models for advanced composite materials. He obtained his Ph.D. in Aeronautics from Imperial College London in 2005.

For More Information
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