Composite Materials – Design and Testing
by Prof. Stephen W. Tsai and Prof. J. D. Melo

March, 13th 2015, 9:00 am

Institute for Carbon Composites, Technische Universität München

The Institute for Carbon Composites (LCC) is very happy to invite you to a presentation and open discussion with Prof. S.W. Tsai and Prof. J. D. Melo. The participation is free of charge. For information how to get here please use: http://www.lcc.mw.tum.de/kontakt-und-anfahrt/anfahrt-forschungszentrum/. We are very much looking forward to your participation!

Agenda

09:00 – 10:30  Presentation of Prof. S.W. Tsai and Prof. J. D. Melo
10:30 – 11:00  Questions & Answers
11:00 – 11:30  Break
11:30 – 12:00  Open Discussion with Prof. S.W. Tsai and Prof. J. D. Melo

Composite materials are more complex than metals for having multiple failure modes and by adhering to archaic design practices. Used less optimally, weight savings are less than 30 percent of aluminum instead of more than 50 percent that is there to claim. We discovered trace of the stiffness matrix to be the heart and soul of composites from which all stiffness and strength of laminates can be defined not only in its pristine upper bound state but also be rated to account for manufacturing defects and micro cracks from loading past first ply failure. It works in both 2D and 3D. Instead of testing thousands of coupons of representative laminates with environments, we need only one value of trace for each environment like what is done with metals. We also propose one omni strain envelope to reflect a conservative failure criterion for laminates with all ply angles. All popular failure criteria would collapse to one ultimate failure envelope in principal strain space, anchored by the uniaxial tensile and compressive failure strains. With trace each material can be mapped onto a master stress-stain template. Direct comparison between laminates of a given material, and that between materials can be scaled linearly. To facilitate manufacturing optimal profile can be more easily determined for homogenized skins, asymmetric ply drop would be preferred leading to a stronger and lighter structure. New and improved materials and processes can now expect quicker consideration of their benefits without the current barrier posed by the required design allowable. We can finally realize the long-held anticipation of simultaneous weight and cost savings of composite materials. More information: stanford.edu/group/composites

Stephen W. Tsai is professor research emeritus in the Department of Aeronautics & Astronautics at Stanford University. He has trained thousands of engineers in composite materials and is a coauthor, with the late Edward M. Wu, of the Tsai-Wu failure criterion for anisotropic composites.