Composite Materials Applications for the Next Generation of Aircraft Engines

ABSTRACT

Aircraft engines provide the greatest challenges and opportunities for the development and application of advanced materials. Today’s ultra high bypass gas turbine engines demand further efficiencies through the use and application of light-weight and advanced composite materials, especially in the front section of the engine. Components such as fan blades, in the front section of the engine, have to be designed and certified to withstand high-velocity impact from birds and other debris. Composite materials made using textile processes such as 3D weaving and braiding offer superior impact resistance. However, to design with such complex materials it is necessary to develop a modeling capability that provides guidance in the selection and optimization of the virtually unlimited fiber architectures possible with today’s electronically controlled textile machines. This talk will describe one such design analysis tool that is developed to provide effective 3D stiffness and strength properties in a computationally efficient application that allows rapid parametric studies to assess the effects of varying the different fiber architecture parameters of a textile composite. Some of the excruciating and elaborate tests that are required for the FAA certification of aircraft engine components such as fan blades and fan containment cases will also be described. Finally, the challenges in the design, structural analysis, damage modeling, processing and process modeling of gas turbine engine composite components will be discussed.

BIO

Dr. Rajiv Naik is Technical Fellow at Pratt & Whitney in their Materials and Processes Engineering group which develops advanced materials and provides materials solutions for the design and manufacture of aircraft engine components. Dr. Naik is involved in the development of innovative computational materials modeling tools for both metallic and composite materials. He has worked in all areas of composite materials characterization and analysis including micromechanics, fatigue life and durability prediction, and fracture mechanics of polymeric matrix, metal matrix, and ceramic matrix composite materials. Prior to his current position, Dr. Naik worked on contract research at the NASA Langley Research Center. At NASA, he developed the TEXCAD code for the general purpose analysis of the stiffness, damage progression, and strength of textile composites. Dr. Naik has over 65 publications in the field of composite materials and fatigue life prediction of metallic and single crystal materials. He received his B. S. degree from the Indian Institute of Technology, Bombay in 1979, his M. S. from the University of Maine in 1982, and his Ph. D. from Old Dominion University in 1986.

Refreshments will be served at 3:30 p.m.