DEPARTMENT OF MECHANICAL ENGINEERING
Purdue School of Engineering and Technology

FALL 2006 SEMINAR SERIES

Date: Thursday, October 12, 2006
Time: 11:00 am - 12:00 pm
Room: SL 165

Reception at 10:45 am (cookies and refreshments served)
Everyone is invited

High-Temperature, High-Frequency Fretting Fatigue of a Single Crystal Nickel Alloy

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Abstract. Fretting fatigue is a structural damage mechanism observed when two contacting bodies are subjected to an oscillatory loading. A critical location for fretting fatigue induced damage has been identified at the blade/disk and blade/damper interfaces of gas turbine engine turbomachinery and space propulsion components. The high-temperature, high-frequency loading environment associated with such turbomachinery components can accelerate the fretting fatigue damage at these contact interfaces. The severe stress peaks and stress gradients that develop at the edge-of-contact can drive crack nucleation and propagation. These contact stresses are sensitive to the geometry of the contacting bodies, the contact loads, materials, temperature, and contact surface tribology. To diagnose the threat that small and relatively undetectable fretting cracks pose to damage tolerance and structural integrity of in-service components, the objective of this work is to develop a well-characterized experimental fretting rig capable of investigating fretting behavior of advanced aerospace alloys subjected to load and temperature conditions representative of such turbomachinery components. Experimentally measured contact loads, as obtained in-situ, are then used with finite element contact sub-modeling to correlate the fretting crack nucleation behavior with the local contact stresses.

About the Speaker. Dr. John F. Matlik joined Rolls-Royce Corporation in January 2005 after obtaining his doctoral degree from Purdue University's School of Aeronautics and Astronautics as a National Science Foundation Fellow. In his first position at Rolls-Royce, Dr. Matlik developed contact fatigue tools based on his PhD work for application to gas turbine engine blade/disk attachments. This work continued in March 2005 as Dr. Matlik began a six-month secondment in Derby, England where he served as technical lead for contact fatigue analysis and inspection tool development efforts with Rolls-Royce, plc and Oxford University's Solid Mechanics Laboratories. Dr. Matlik continues to support contact lifing efforts while leading development efforts for application of nonlinear (creep and plastic) life prediction methodologies to hot section engine components. His work in tribology, contact mechanics, and fretting fatigue of aerospace structures has led to several published papers in refereed journals and a book chapter on fretting fatigue.