# School of Aeronautics and Astronautics

SYMPOSIUM

# The 2014 Research Symposium Series

## * Free Pizza *

## Monday, February 24, 2014

## 4:30 pm in ARMS 1021

### ALTAIR: A Balloon-Borne Light Source for Precision Photometric Calibration

*Max Fagin*

The ability of type Ia supernova surveys to distinguish among the various proposed theories of dark energy is presently limited by the need to reduce systematic photometry errors to the <1% level. In pursuit of this goal, Stubbs and Tonry (2006) have proposed an approach to astronomical photometric calibration that deemphasizes celestial standards in favor of using a NIST-calibrated photodiode as the radiometric standard. We have successfully implemented this technique in calibrating instruments and in accounting for molecular extinction in the atmosphere. We report on the design of ALTAIR, a stratospheric balloon-borne vehicle intended to directly measure the aerosol component of atmospheric extinction. ALTAIR lofts a calibrated, polychromatic light source to 100 kft, which, when observed from the ground with a spectrometer, directly reveals the transmission function of the atmosphere at selected wavelengths. The light source employs a bank of laser diodes to excite an integrating sphere which precisely maintains the luminosity ratios among colors across all viewing angles. An onboard photodiode with NIST-traceable sensitivity function monitors the source luminosity.

### Predictions of Microstructurally Driven Fatigue Crack Initiation and Scatter in Polycrystalline Materials

*Saikumar Reddy Yeratapally*

At least 50% of all mechanical failures are due to fatigue. The two stage process which leads to fatigue failure is i) fatigue crack nucleation and ii) crack propagation to final failure. The lifetime for fatigue crack nucleation is closely related to the microstructure of the material, as it governs strain localization, which is a precursor for crack nucleation. Scatter observed in the fatigue life of many polycrystalline materials can be attributed to the variabilities observed in the material's microstructure. Hence, there is great interest in linking the microstructure to fatigue properties using a multiscale approach. With this as a motivation, a multiscale fatigue model is developed, which obtains hot-spots within the microstructure, using rate-dependent crystal plasticity finite element simulations of a one-cycle loading, and uses the hot-spot locations to define the corresponding local slip system activity within the microstructure. The quantitative information of the microstructure is fed into a physics based life prediction model which models the energy of persistent slip band structures and uses its stability with respect to the dislocation motion as the failure criterion for crack initiation. Statistically equivalent synthetic microstructures are generated to predict the scatter and probability of fatigue failure in a deterministic manner.

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