

Weekly CEA FM Seminar: Fall 2016



JOHNS HOPKINS

Center for Environmental
& Applied Fluid Mechanics

Date: **Friday, November 18, 2016**

Time: 11:00 AM

Location: Gilman Hall # 50

Speaker: **Prof. Sumanta Acharya** (Illinois Institute of Technology)

Title: ***“Slot and Discrete Jets in Crossflow - Application to Turbine Cooling”***

Abstract

Jets in crossflow are encountered in a variety of applications including turbine cooling, electronic cooling, VSTOL aircrafts, and plume discharges. As an example, in modern gas turbine engines components are subject to gas temperatures in excess of 30000 F that are well above the material limits for reliable operation. The engine components have to be therefore actively cooled to prevent engine failure. One of the more common cooling strategies is injecting a coolant jet from the surface into the crossflow. This approach is commonly used to cool the components of the high-pressure-turbine including the airfoil, shroud and end-wall. The mixing of the coolant jet with the surrounding airflow dictates the effectiveness of the cooling. In this talk, the physics of jets-in-crossflow is analyzed based on Large Eddy Simulation (LES) results. Both slot-jets and discrete-jets are studied. The role of external disturbances originating upstream of the crossflow (i.e., freestream turbulence) or in the plenum feeding the coolant jet are examined in detail. It is shown that the coolant jet behavior at low freestream turbulence is distinctly different, with organized flow structures that are very effective in entraining cross-stream fluid and reducing cooling effectiveness. At a higher freestream turbulence, the organized structures breakdown, and cooling effectiveness is increased.