Aerospace and Mechanical Engineering Seminar

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Laminar-Turbulent Boundary-Layer Transition on a Flared Cone at Mach 6

Hypersonic laminar-turbulent boundary-layer transition is still a major unresolved topic in fluid dynamics. The understanding of high-speed boundary-layer transition is required in order to develop reliable transition prediction methods that can be used for the design and safe operation of advanced high-speed vehicles. Transition to turbulence in supersonic/hypersonic boundary layers is associated with considerable increases in heat transfer. The increased heat loads on the structure of hypersonic vehicles represent one of the main difficulties in designing and operating such vehicles.

The flared cone geometry was designed to observe natural transition in so-called quiet hypersonic wind tunnels, such as the Boeing/AFOSR Mach 6 Quiet Tunnel, or BAM6QT, at Purdue University. This cone model is investigated using direct numerical simulations. The simulation results have exhibited streamwise streaks of high skin friction and of high heat transfer at the cone surface during the nonlinear transition stages. These streamwise streaks on the flared cone surface were also observed in the experiments carried out at the BAM6QT hypersonic wind tunnel using temperature sensitive paint. The goal of this research is to understand the underlying physical mechanisms that lead to the formation of these streamwise streaks and to asses if the streaks in the simulations are generated by the same mechanisms as in the experiments. Under certain circumstances the heat loads at the flared cone surface are increased substantially. A proper understanding of the formation mechanisms may help to "control" (prevent) the streak formation to reduce the increase in heat load.

Bio:
Hader received his undergraduate degree from the University of Stuttgart and then continued his graduate studies at the University of Arizona in 2009. He obtained his MS degree in 2011 under the supervision of professor Hermann Fasel.

AME Lecture Hall, Room S212
Thursday, Feb. 2, 2017
4 p.m.
Refreshments and socializing 3:45 p.m. at the east end of the AME Courtyard