Weekly CEAFM Seminar: Spring 2015

JOHNS HOPKINS
Center for Environmental
& Applied Fluid Mechanics

Date: **Friday, February 13, 2015**

Time: 11:00 AM

Location: Gilman Hall # 132

Speaker: **Prof. Louis N. Cattafesta, III** (Florida State University)

Title: ***"On the Control of a Canonical Separated Flow"***

Abstract

Flow separation is generally an undesirable phenomenon that produces adverse aerodynamic effects. Control of flow separation is a complex problem and thus a popular area of research. A common obstacle is the lack of understanding of the complex fluid mechanics in cases of flow separation, evident by the substantial amount of flow control achieved through trial-and-error methods. The purpose of this work is to better understand the nature of separation for improved active control methods, which includes closed-loop control via reduced order methods. Control of a canonical separation problem, with the key features of separated flow, is achieved at a chord Reynolds number of 105. Separation is created on a flat-plate model, devoid of curvature that would otherwise include effects particular to the type of aerodynamic body. The characteristics of the imposed separation are evaluated with the intent of having a nominally two-dimensional separated region, with the same essential flow characteristics of a more traditionally stalled airfoil. Results provide a reduced-order estimation technique that is used to identify global, dynamic modes through experimental measurements. Reattachment of the baseline separation is then achieved in open-loop control via zero-net mass-flux (ZNMF) actuation. Efficient reattachment is achieved by targeting the identified characteristic flow frequencies, enabling reattachment of the separated flow with less than a quarter of the control effort compared to open-loop high-frequency sinusoidal forcing. The baseline and control results are then used to identify a reduced-order model suitable for closed-loop control, with the resulting benefits of set-point tracking and full boundary layer reattachment with minimum control effort.