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Applied and Computational Mathematics Seminar

Professor Stefan Braun, Institute of Fluid Mechanics and Heat Transfer, Vienna University of Technology.

will speak on

Effect of non-uniqueness and bifurcation in marginal separation theory

Thu 5th October 2006 at 4:00PM

Location: Mathematical Sciences Seminar Room

Viscous-inviscid interaction solutions for steady two-dimensional laminar high Reynolds number boundary layer flows featuring localized flow separation are known to exist up to a critical value G c of a controlling parameter G (e.g. angle of attack of a slender airfoil) only. The investigation of three-dimensional unsteady perturbations of such boundary layers in the near critical regime — G - G c— shows that the governing equations simplify significantly allowing (i) a systematic study of blow-up phenomena which are believed to indicate the onset of the fast transition process to turbulence and (ii) the optimization of control devices (suction, surface mounted obstacles) to increase or reduce G c (to delay or force transition). Specifically, it is found that the evolution of disturbances is described by a forced type of Fisher's equation known from mathematical biology and that its solutions leading to the formation of finite time singularities can be continued beyond the blow-up time thereby generating moving singularities which are interpreted as coherent vortical structures similar to those observed in experimental studies and direct numerical simulations of transitional separation bubbles.