

# *Mechanical and Aeronautical Engineering*

## *Seminar*

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**Dr. Joe Skufca**  
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**Clarkson University**

**Will present a talk entitled**

### **The Edge of Chaos in a parallel shear flow**

#### **Abstract**

Plane Couette flow (shear flow between parallel plates), like pipe flow, can exhibit transient turbulence in some transitional region between the purely laminar flow and the fully turbulent condition. For flow conditions within this transitional region, the laminar flow state is stable, but if it is perturbed, a long turbulent transient may result. Understand this transition, as well as characterizing the stability limits of the laminar state remains an important research question.

In our research, we study the transition between laminar and turbulent states by exploring a Galerkin representation of a parallel shear flow. We find that the regions of initial conditions where the lifetimes show strong fluctuations and a sensitive dependence on initial conditions are separated from the ones with a smooth variation of lifetimes by an object in phase space which we call the “edge of chaos.” We describe techniques to identify and follow this structure, and our results indicate that the edge is a surface in phase space. For low Reynolds numbers we find that the surface coincides with the stable manifold of a periodic orbit, whereas at higher Reynolds numbers it is the stable set of a higher-dimensional chaotic object. In essence, the edge defines the stability region for the laminar flow condition. Although our low-dimensional model provides inadequate resolution to simulate an actual flow, we describe how our technique can be applied in full numerical simulations to identify and track this stability boundary.

This talk will highlight the applicability of dynamical systems and chaos to the study of turbulent flow.

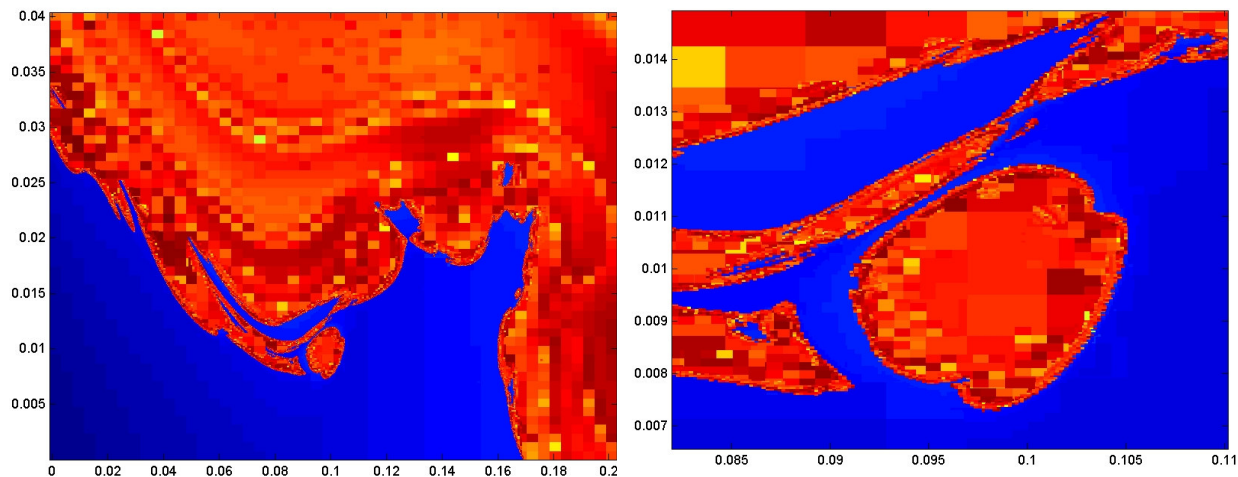


Fig. The edge, at  $Re=420$ .

Friday, February 10, 2006  
2:15 p.m., CAMP 176  
Refreshments will be at 2:00 p.m.