UNIVERSITY OF MARYLAND

THE BURGERS PROGRAM FOR FLUID DYNAMICS
THE FLUID DYNAMICS REVIEWS SEMINAR SERIES

AN OVERVIEW OF ONGOING RESEARCH EFFORTS ON HYPERSONIC BOUNDARY LAYER TRANSITION AT ONERA AND CEA

Monday, October 30, 2023 | 4 pm

Aerospace Conference Room
3164 Glenn L. Martin Hall

Abstract

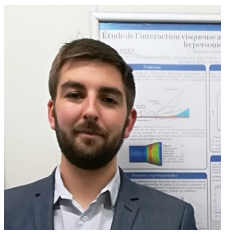
This presentation is divided into two parts, each offering insights into the ongoing research efforts in France related to hypersonic aerodynamics and the intriguing question of transition to turbulence in hypersonic flows.

In the first part, introduced by Mathieu Lugrin, we introduce the ONERA team specializing in the analysis of hypersonic transition phenomena. We provide an overview of the research activities at ONERA, encompassing both experimental and numerical approaches to transition analysis. Additionally, we present a specific case study involving the Direct Numerical Simulation (DNS) of an idealized hypersonic engine's internal flow. While not directly linked to transition analysis, this case study allows us to discuss numerical methods and the setup of large-scale computations, with a nod to their potential applications in transition analysis. We also compare the results with traditional RANS (Reynolds-Averaged Navier-Stokes) and innovative mesh-adapted simulations.

In the second section, led by Clément Caillaud, we delve into our ongoing research efforts focused on the transition to turbulence in hypersonic flows. This collaborative project between ONERA and CEA revolves around experimental and numerical investigations of transition phenomena on the CCF geometry. We place special emphasis on comparing our global stability results with recent measurements obtained at the R2Ch facility at Mach 6 and 7.

This comparison yields valuable insights into the receptivity effects and the dynamics of convective instabilities. Collectively, these two sections provide a nuanced perspective on our latest efforts in field of transition to turbulence.

Speakers



MATHIEU LUGRIN

Mathieu Lugrin serves as a research scientist in the Aerodynamics Department at ONERA. He earned his Ph.D. from Ecole Polytechnique, ONERA, and CEA, where his research concentrated on the comprehensive exploration of hypersonic boundary layer transition on a compression ramp, integrating experimental and numerical approaches. In his current role, he leads research efforts with a primary focus on the physical mechanisms underlying laminar-to-turbulent transition in hypersonic flows. This involves a multidisciplinary approach, combining experimental investigations, stability analysis, and high-fidelity simulations. One key aspect of his research aims at improving the numerical replication of wind tunnel experiments.

CLÉMENT CAILLAUD

Clément is a Post-Doctoral researcher at the French Atomic Energy Commission (CEA) specializing in hypersonic flow dynamics and transition to turbulence. He earned his PhD in fluid mechanics through collaborative research between CEA and the Pprime Institute, where he explored the pathways to turbulence in hypersonic flows containing streaks or roughnesses. Clément's current work is done within an ONERA-CEA project and involves both experimental and numerical analyses of transition dynamics on cone-cylinder-flare geometries, employing global stability tools, DNS, and advanced experimental techniques.

A. JAMES CLARK SCHOOL OF ENGINEERING