Seminaires @ ICARE

New Approaches to the Analysis of Instabilities in Complex Flows

par

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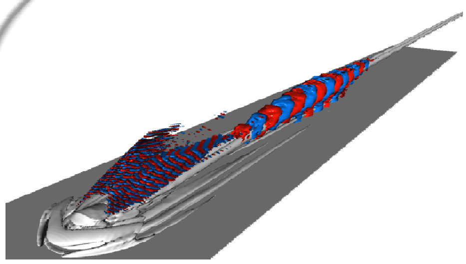

Global mode superposed on the isovalue of the Q-criterion for a jet in supersonic cross-flow

The tendencies of flows to change patterns when perturbed has been the subject of fluid mechanics research for decades. Stability studies aim to understand transitions from laminar, organized flows to turbulent, dynamic states. However, difficulties appear when an attempt is made to quantify disturbance behaviour in complex flows, such as are encountered in combustion chambers or in the wakes of jets in crossflow. How do such flows evolve and how are transitions triggered? Such questions are yet to be fully answered, and the description of complex flow stability today remains a key goal, critical to diverse industrial applications.

Over the last 20 years, new tools for tackling this complex problem have emerged from the mathematical community. Dynamic Mode Decomposition (DMD) is the latest of such tools. This technique captures the flow dynamics from a sequence of snapshots (experimental or numerical) and reveals the underlying physical mechanisms, even in the absence of explicit knowledge concerning such mechanisms. In contrast to POD (Proper Orthogonal Decomposition), DMD gives more relevant details on instabilities present in the studied flow, concerning frequency, growth rate, modes and non modal behaviour. We discuss the application of this interesting technique to jets in supersonic cross-flow.