ETH zürich

Institute of Fluid Dynamics
Institute of Energy and Process Engineering

# Colloquium Thermo- and Fluid Dynamics

## Weak nonlinearity for strong nonnormality

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We propose a theoretical approach to derive amplitude equations governing the weakly nonlinear evolution of nonnormal dynamical systems when they experience transient growth or respond to harmonic forcing. This approach reconciles the nonmodal nature of these growth mechanisms and the need for a center manifold to project the leading-order dynamics. Under the hypothesis of strong nonnormality, we leverage the fact that small operator perturbations suffice to make the inverse resolvent and the inverse propagator singular to conduct a multiple-scale asymptotic expansion and apply it to several application cases highlighting common nonnormal mechanisms in hydrodynamics: the flow past a backward-facing step and plane Poiseuille flow.

*François Gallaire obtained, in 1998, an engineering degree from the Ecole Polytechnique in Paris and, in 1999, a master's degree at the Pierre et Marie Curie University, also in Paris. He then joined the Laboratory of Hydrodynamics (LadHyX) at the Ecole Polytechnique in 2003, under the direction of Jean-Marrc Chomaz. In 2003, he was appointed CNRS research fellow at the J.A. Dieudonné Laboratory of the University of Nice Sophia-Antipolis, and in 2009, he joined the EPFL to found the Laboratory of Fluid Mechanics and Instabilities (LFMI). His research focuses on the study of fundamental stability properties of fluid flows and is guided by real-world applications, in particular flow control. Recently, he has made important contributions in the fields of micro-fluidics, the stability of free-interface flows, damping mechanisms in sloshing flows and the stability of flow around porous obstacles. Francois Gallaire is fellow of the American physical society.*

Date: Wednesday, 10 May 2023
Time: 16:15 – 17:30
Place: ETH Zurich, ML H 44
Host: Prof. Filippo Coletti, IFD

Further information: https://ifd.ethz.ch/events/ktf.html

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