

MAE 210C – FLUID MECHANICS III
FINAL PRESENTATIONS SPRING 2017

- Topic 1: ABSOLUTE AND CONVECTIVE INSTABILITIES¹

Students: Garner, Klose, Lawrence, Sun

Literature:

- Juniper, MP, Hanifi, A & Theofilis, V, Modal stability theory, Applied Mechanics Reviews, Vol. 66, 024804, 2014
- Huerre P & Monkewitz PA, Local and global instabilities in spatially developing flows, Annual Review of Fluid Mechanics, Vol. 22, 473-537, 1990

Key issues:

- Local vs global stability
- Quasi-parallel approximation in spatially evolving flows
- Temporal, spatial and spatiotemporal stability
- Stable, convectively unstable and absolutely unstable flows
- Causality/Briggs-Bers criterion
- Saddle points in the complex k-plane
- An example of application to a real flow: wakes or jets

¹Contact Wilfried Coenen (wicoenen@eng.ucsd.edu) for guidance.

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- Topic 2: GLOBAL LINEAR STABILITY AND SENSITIVITY²

Students: Felez, Huang

Literature:

- Schmid, PJ & Brandt L, Analysis of fluid systems: stability, receptivity, sensitivity, Applied Mechanics Reviews, Vol. 66, 024803, 2014
- Marquet, O, Sipp, D & Jacquin, L, Sensitivity analysis and passive control of cylinder flow, Journal of Fluid Mechanics, Vol. 615, 221-252, 2008

Key issues:

- Local vs global stability
- Eigenvalue sensitivity
- Adjoint modes
- Structural sensitivity
- Sensitivity to modifications in the base flow
- An example of application to a real flow: flow around a cylinder

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• Topic 3: RECEPTIVITY³

Students: Liao, Zhang, Zhou, Zhu

Literature:

- Trefethen, LN, Trefethen, AE, Reddy, SC & Driscoll, TA, Hydrodynamic stability without eigenvalues, Science, Vol. 261, 578-584, 1993
- Schmid, PJ & Brandt, L, Analysis of fluid systems: stability, receptivity, sensitivity, Applied Mechanics Reviews, Vol. 66, 024803, 2014

Key issues:

- Modal vs nonmodal stability
- Energy norm
- Harmonic forcing
- Resolvent norm
- Spectrum vs pseudospectrum
- Transient growth
- Nonnormality
- Optimal harmonic forcing and response
- An example of application to a real flow: Poiseuille flow through a pipe

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• Topic 4: DOUBLE-DIFFUSIVE CONVECTION

Students: Remigio, Schwartz

Literature:

- Turner, J.S., Double-diffusive phenomena, Annual Review of Fluid Mechanics, Vol. 6, 37-54, 1974
- Knobloch, E. et al, Journal of Fluid Mechanics, 78:821–854, 109: 25–43, 166: 409–448.

Key issues:

- Examples + underlying physics
- Linear theory
- Nonlinear formulation: 5 ODE model
- Transition to chaos

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- Topic 5: INTRINSIC FLAME INSTABILITIES

Students: Christopher, Mahajan, Puthan

Literature:

- Sivashinski, G.I., Instabilities, pattern formation, and turbulence in flames, Annual Review of Fluid Mechanics, Vol. 15, 179-99, 1983
- Clavin, P., Premixed combustion and gas dynamics, Annual Review of Fluid Mechanics, Vol. 26, 321-352, 1994.

Key issues:

- Darrieus-Landau instability. Linear theory. Nonlinear theory.
- Thermodiffusive flame instability. One-reactant linear theory. Nonlinear theory.

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- Topic 5: INTRINSIC FLAME INSTABILITIES

Literature:

- Sivashinski, G.I., Instabilities, pattern formation, and turbulence in flames, Annual Review of Fluid Mechanics, Vol. 15, 179-99, 1983
- Clavin, P., Premixed combustion and gas dynamics, Annual Review of Fluid Mechanics, Vol. 26, 321-352, 1994.

Key issues:

- Darrieus-Landau instability. Linear theory. Nonlinear theory.
- Thermodiffusive flame instability. One-reactant linear theory. Nonlinear theory.