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# Stability and sensitivity analysis for flow control

**Lorenzo Siconolfi[1], Simone Camarri[2], Vincenzo Citro[3], Flavio Giannetti[3] and Paolo Luchini[3]**

[1] LFMI - EPFL, Lausanne, Switzerland
[2] DICI, University of Pisa, Italy
[3] DIIN, University of Salerno, Italy

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The characterization of instabilities in spatially-developing open flows is a key result in fluid dynamics. A better understanding of the flow patterns and transition scenarios is, in fact, the basis to model their behaviour and to design novel and efficient flow controls. Moreover, the dramatic increase of the computational power that we are seeing in the last decades allows to investigate the stability properties of complex and tree-dimensional flow configurations.

In the first part of the talk, some examples of local and global stability analysis will be presented, highlighting (i) passive methods for transition delay in boundary layers, aimed at the reduction of the friction drag and (ii) the effect of temperature gradients for the enhancement of the degree of mixing between inlet fluids in micromixers.

In the second part, weakly non-parallel flows are considered, where the WKBJ asymptotic analysis provides a rigorous strategy to link the local and global stability approach [1]. We will see that, the use of the WKBJ approximation up to the physical optics [2] allows to provide accurate estimations of the global frequencies, reducing the error by about one order of magnitude than the geometrical optics approximation. The proposed approach is finally applied to analyze three-dimensional flow configurations, providing accurate estimations at highly reduced computational costs in comparison to the fully three-dimensional global stability analysis.

E-mail: lorenzo.siconolfi@epfl.ch

## REFERENCES

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