Labex INTERACTFS (https://labex-interactifs.pprime.fr/)

I. Informations générales :

Employeur de l'intervenant ***Employer***	☐ **UP** ☐ **ENSMA** ☒ **CNRS**
TITRE du cours en français ***French title***	**REDUCTION DE MODELES POUR LA MECANIQUE DES FLUIDES ET LES TRANSFERTS THERMIQUES**
TITRE du cours en anglais ***English title***	**MODEL REDUCTION FOR FLUID MECHANICS AND HEAT TRANSFERS**
Adéquation avec les thèmes du Labex ***Adequacy with Labex Research project topics***	☐ 1 - COUPLAGE ENTRE LES MATERIAUX ET DES CONDITIONS SPECIFIQUES D'ENVIRONNEMEN ☐ 2 - FONCTIONNALISATION DES SURFACES ☒ 3- FLUIDES ET PHENOMENES ELECTRIQUES AUX INTERFACES
Enseignant ***Teacher***	**Nom** : CORDIER **Prénom** : Laurent **Tel** : 05 49 49 69 22 **Email** : **Laurent.Cordier@univ-poitiers.fr**

Nb d'heures de cours :	10	ENSMA
Tuesday, November 19th	17:30 pm to 19:30 pm	A201
Wednesday, November 20th	17:30 pm to 19:30 pm	B138
Friday, November 22nd	17:30 pm to 19:30 pm	B138
Wednesday, November 27th	17:30 pm to 19:30 pm	B136
Thursday, November 28th	15:30 pm to 17:30 pm	B138

II. Description du cours proposé, objectifs et plan

Voir verso.

Model reduction for Fluid Mechanics and Heat Transfers

Course proposal – Labex INTERACTIFS

10 h

Lecturer: Laurent CORDIER (Laurent.Cordier@univ-poitiers.fr) - Directeur de Recherche CNRS – Directeur du GDR « Contrôle des Décollements » Pprime UPR 3346.

Language: This course may be given in English depending on the audience.

With the technical advances in the experimental and numerical domains, researchers are faced with increasingly large amounts of data. It has thus become more necessary than ever, to have methods allowing to extract, if possible in an automatic way, the essential information from a physical point of view in order to understand, predict and if possible control the phenomena of interest. This problem is at the heart of dimensionality reduction. In this course, we will address this problem from a kinematic point of view (extraction of modes according to different criteria) and from a dynamical point of view (construction of reduced-order models allowing to reproduce the dynamics of the system).

Table of contents

1/ Introduction.

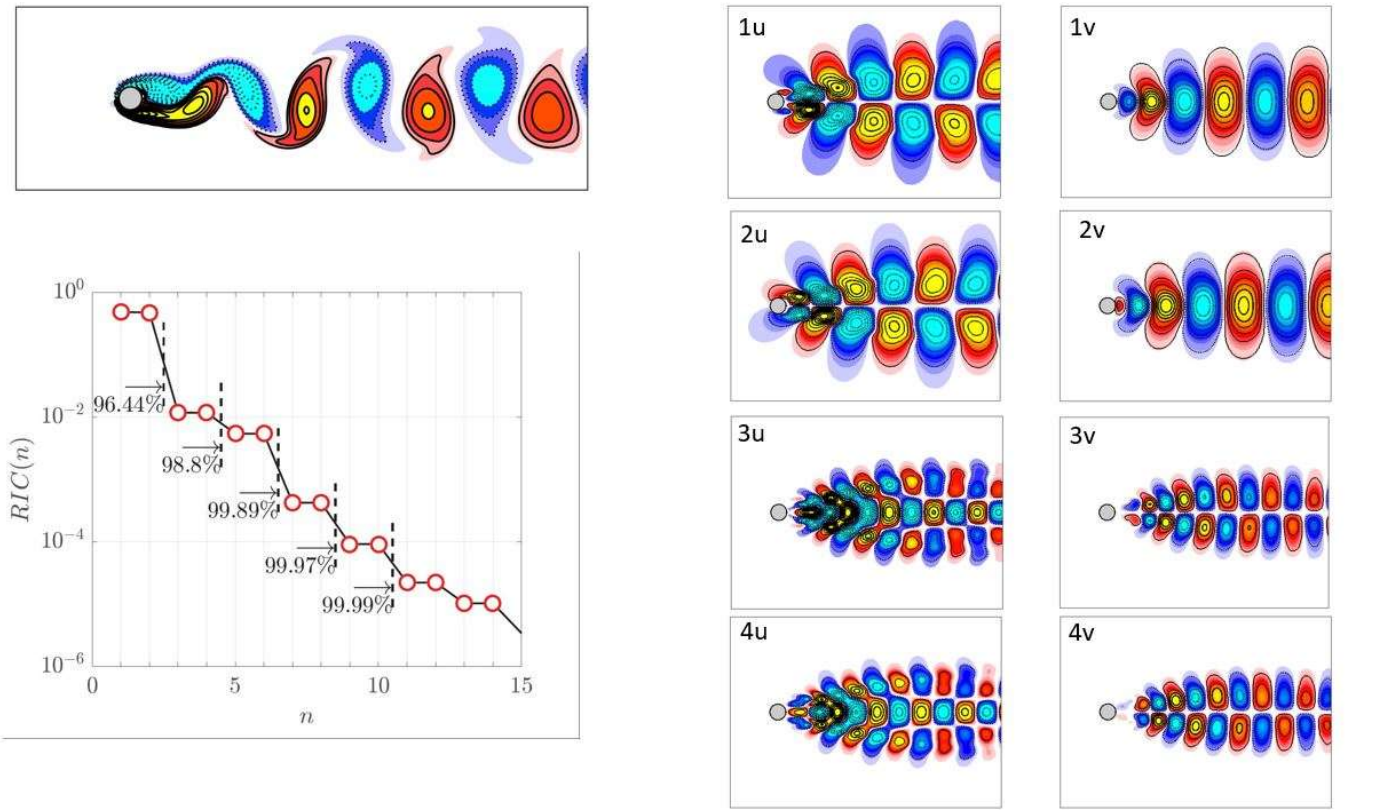
2/ Preliminaries
- 2.1/ Eigenvalue decomposition
- 2.2/ Singular Value Decomposition

3/ Data-driven reduction methods
- 3.1/ Proper Orthogonal Decomposition (POD).
- 3.2/ Dynamic Mode Decomposition (DMD).
- 3.3/ Balances modes (Balanced POD).
- 3.4/ Cluster-based Reduced Order Model (CROM).

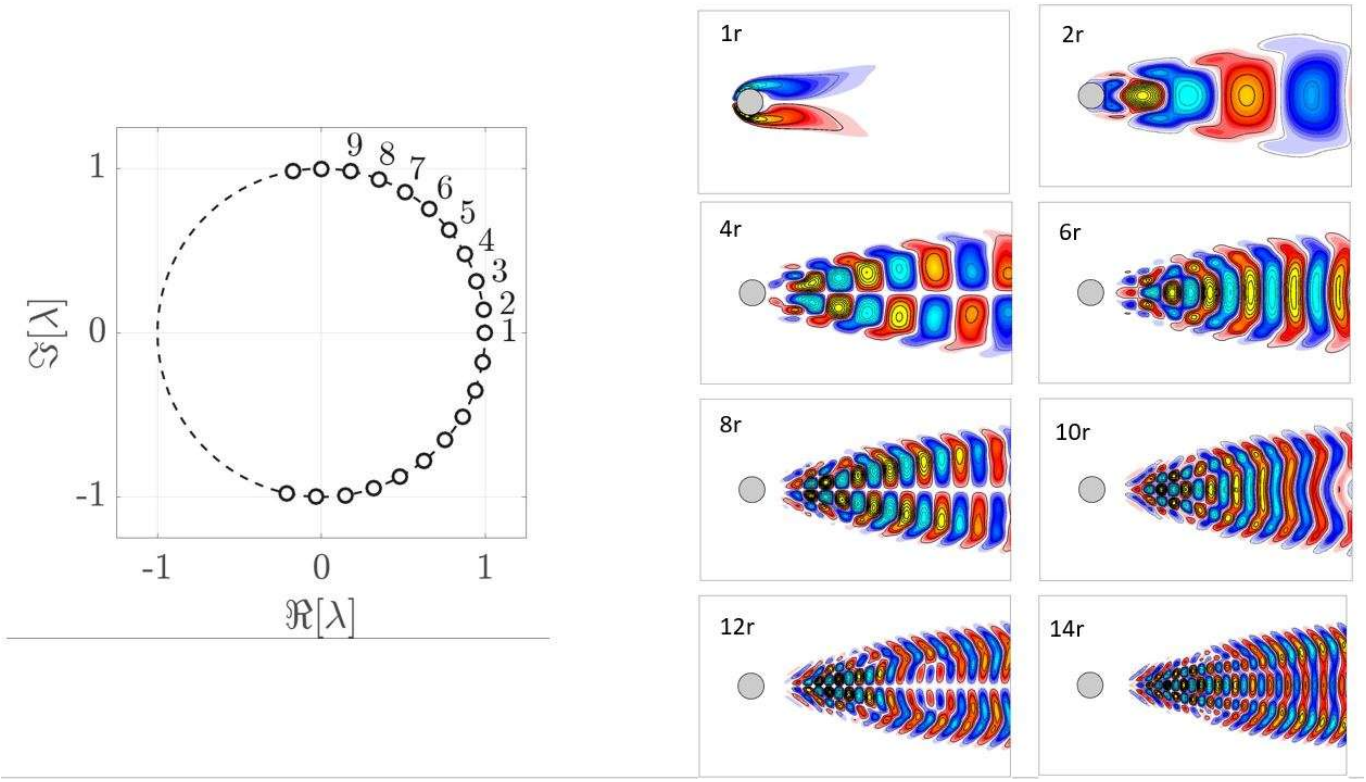
4/ Operator-based reduction methods
- 4.1/ Global stability analysis
- 4.2/ Resolvent modes
- 4.3/ Koopman analysis
- 4.4/ Galerkin Projection

5/ Model identification methods
- 5.1/ Linear regression model
- 5.2/ Sequential data assimilation
- 5.3/ Neural Network modeling with physical constraints

Notions of machine learning will be covered. These methods will be described in more detail in the course "Machine Learning for Physicists".



Model reduction by POD: illustration for a cylinder wake flow.



Model reduction by DMD: illustration for a cylinder wake flow.