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***	**CONTRÔLE DES ÉCOULEMENTS ET DES TRANSFERTS THERMIQUES**
TITRE du cours en anglais ***English title***	**CONTROL OF FLOWS AND HEAT TRANSFERS**
Adéquation avec les thèmes du Labex ***Adequacy with Labex Research project topics***	1 - COUPLAGE ENTRE LES MATÉRIAUX ET DES CONDITIONS SPÉCIFIQUES D'ENVIRONNEMENT 2 - FONCTIONNALISATION DES SURFACES 3- FLUIDES ET PHÉNOMÈNES ÉLECTRIQUES 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
Wednesday, October 15th	17:30 pm to 19:30 pm	B139
Wednesday, October 29th	17:30 pm to 19:30 pm	B139
Friday, October 31st	17:30 pm to 19:30 pm	B139
Wednesday, November 5th	17:30 pm to 19:30 pm	B139
Friday, November 7th	17:30 pm to 19:30 pm	B139

II. Description du cours proposé, objectifs et plan

Voir verso.

Control of flows and heat transfers

Course proposal – Labex INTERACTIFS
10 h

Lecturer: Laurent CORDIER (Laurent.Cordier@univ-poitiers.fr) - Directeur de Recherche CNRS - Pprime UPR 3346.
Language: This course will be given in English.

Constrained optimization, linear control theory and data assimilation

Optimization is at the center of many scientific and/or societal issues (understanding and modeling of complex physical phenomena, improvement of system performance, reduction of noise or pollution, machine learning, ...). The objective of this course is to present the concepts and tools (mainly numerical) necessary to approach in a modern way the control of flows and heat transfers. First, we will introduce the optimal control methods by showing the diversity of problems that can be solved in this framework. We will then present the essential elements of analysis and control of linear systems (LQR and LQG methods). We will illustrate these different methods on examples from fluid mechanics and thermal transfers.

Table of contents

3.1/ State space representation of dynamical systems.

3.2/ Linear state representation.

3.2.1/ Illustration: Orr-Sommerfeld/Squire system.

3.3/ Commandability and observability.

3.4/ Balanced representation.

4/ Closed-loop linear control with full information.

4.1/ Linear Quadratic Control (LQR). Riccati equations.
4.1.1/ Illustration: Control of a stable non-normal linear system modeling a transient energy growth.
4.1.2/ Illustration: Control of the heat equation.

5/ Linear closed-loop control with state estimation.

5.1/ Reminder on stochastic processes.

5.2/ Estimation and Kalman filter.

5.3/ Linear Gaussian control (LQG). Principle of separation.

From flow control to biomimetism. After Franck Fish.