

# GDRE CONEDP CNRS-INDAM-UP in Control of PDE's

Ceremony on the occasion of the signature of  
the agreement, IHP, october 12 2010

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# Outline

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Our special thanks to

**the Institut Henri Poincaré,**

his director **Cédric Villani** and

his vice-director **Jorge Kurchan,**

together with the **teams of IHP and Center Emile Borel**

for hosting this ceremony and for all the provided logistics.

We are greatly obliged to

**Marco Marsilli**, Ministro Plenipotenziario, Ambasciata d'Italia a Parigi

**Guilio Alaimo**, Primo Consigliere, Ambasciata d'Italia a Parigi

for their participation to this ceremony

We would like to thank

INdAM, his president **Vincenzo Ancona** and her vice-president **Elisabetta Strickland**

INSMI-CNRS, his director **Guy Métivier** and his Deputy Director for International Relations **Pascal Chossat**

DERCI-CNRS, and her deputy director, European Research Area East **Francesca Grassia**

University of Provence, his president **Jean-Paul Caverni** and the vice-president of the scientific council **Denis Bertin**

for accepting to participate in this ceremony and for their support to the GDRE project CONEDP.

We also would like to thank the mathematical societies in France, Italy and Europe

the president of SMAI **Maria Esteban**,

the president of SMF **Bernard Helffer**,

the president of SIMAI **Nicolo Bellomo** together with his representative **Maria Esteban**

the president of EMS **Yuri Laptev** together with his representative, vice-president of EMS

**Mireille Martin-Deschamps**

for accepting our invitation and joining the ceremony

A **GDRE** is a *Groupement De Recherche Européen*.

It is a research structure between CNRS and partner institutions in Europe in an important scientific domain.

**Groupements de Recherche** are made to structure, organize, create synergies in important domains of research and to form and facilitate integration of young researchers: doctoral students, post-doc,...

It offers support from partner institutions to create a structured network, in particular for:

summer schools, thematic schools, conferences, scientific invitations and collaborations, theses in cotutelle ...

## Our motivations for a GDRE in control of PDE's:

- Control of PDE's exists since the seventies
- It is at the edge of many theoretical mathematical domains as well as of other domains of sciences.
- It is strongly and richly developing in many directions of mathematics theoretically, as well as numerically
- Moreover, there is an explosion of applicative domains which in turn generates new mathematical challenges
- It attracts a lot of talented young researchers in particular in France and Italy



## Control of PDE's in some words

**PDE's** describe the evolution of important characteristic variables of physical, mechanical, chemical, biological or economical models . . .

These characteristic variables may stand for the temperature of a device, the speed of a fluid, the vibrations of a mechanical structure, the blood pressure . . .

In engineering and industrial applications, as well as in biology and medicine, it is required to **control** these characteristic variables to guarantee that a bridge will not collapse, or that the temperature of a room is at the desired level or that its acoustics is of high quality . . .

**Controlling** these characteristic variables has several meanings for mathematics as well as for applications such as:

**steering them to a desired target** as for instance for a desired temperature

**reconstructing the initial state of the device, or identifying unknown values of the parameters** of a biological systems thanks to suitable measurements

**stabilizing the system for large time**, as it occurs for instance when reducing the vibrations of the antennas of satellites

These control objectives are often **constrained or linked to optimization criteria**, such as minimizing *cost*, *time* ...

## Motivations for a GDRE project between France and Italy in Control of PDE's :

Strong mathematical collaborations for several years

- in Control Theory
- and in related domains such as inverse problems, optimal control

There exists an important tradition of collaboration in mathematics between France and Italy and in particular under the GDRE structure. **Three other GDRE have been created between France and Italy in NonCommutative Geometry, Algebraic Geometry and Mathematical Physics**

We thank :

**Olivier Debarre** coordinator for France of the GDRE GRIFGA.  
Italian coordinator: **Lucia Caporaso**

**Jean-Luc Sauvageot and Stéphane Vassout** coordinators of the GDRE GREFI-GENCO. Italian coordinator: **Daniele Guido**

**Pierre Picco** coordinator of the GDRE GREFI-MEFI. Italian coordinator: **Carlangelo Liverani**

for accepting our invitation and joining the ceremony

The **GDRE CONEDP** is for its French part composed of a **GDR n° 3362** created by the CNRS on January 2010.

The agreement for the "**Groupe**ment de Recherche Européen" (**GDRE**) CONEDP involves three partners : the CNRS, INdAM for Italy and the University of Provence

The three partners give financial support to the GDRE

We also benefit from logistic support from the CNRS through Mathrice, as for diffusion lists, communications . . .

## The GDRE CONEDP is structured into 4 themes :

- 1. Control and Stabilization of PDE's : general tools, recent developments and applications
- 2. Control and Stabilization of PDE's : applicative domains
- 3. Numerical analysis and simulation of control problems
- 4. Interactions between Control Theory and other domains of mathematics

## Theme 1 is divided into

- Carleman inequalities and applications
- Energy methods and applications to control and stabilization of reversible PDE's
- Spectral, frequency, non-harmonic methods and number theory methods for control of PDE's
- Micro-local analysis and applications in control theory
- Interaction between finite and infinite dimensions in control theory
- Non-linear methods in control theory

## Theme 2 is divided into

- Control of nonlinear hyperbolic PDE's (conservation and balance laws, networks)
- Control of fluids and fluid-structure interactions
- Control of parabolic equations and reaction-diffusion PDE's
- Reduction of number of controls for complex coupled systems



## Theme 3 is divided into

- Domain decomposition methods for fluid-structure interactions
- Finite element methods and finite differences for control of PDE's
- Semi-discret methods and descente-type methods for control of PDE's
- Level set methods and applications in control and optimization of the shape of the control region

## Theme 4 is divided into

- Applications of control methods to inverse problems
- Optimal control and dynamic programming for evolution equations in infinite dimensions
- Control of stochastic PDE's

## The applications : some examples

- nonlinear control in particular in fluids
- quantic control
- fluid-structure interactions
- control of networks, conservation laws
- control of degenerate equations
- control of road traffic
- control of pollution

generate a strong dynamic of evolutions of the field, raising new mathematical questions on control of PDE's and on numerics

- about 220 members in the GDRE
- including doctoral students and post-doctorants
- 28 local nodes in France
- 26 in Italy

## Coordinators

**For France : Fatiha Alabau-Boussouira** (University Paul Verlaine-Metz and CNRS)

and as vice-coordinator **Olivier Glass** (University Paris-Dauphine)

**For Italy : Piermarco Cannarsa** (University of Roma Tor Vergata)

and as vice-coordinator **Fabio Ancona** (University of Padova)

A committee of scientific managing composed of the 4 coordinators and :

**5 members on the "french" side :**

Jean-Michel Coron (Paris 6)

Gilles Lebeau (Nice)

Jean-Pierre Puel (Versailles)

Emmanuel Trélat (Orléans)

Enrique Zuazua (BCAM, Bilbao)

## 5 members on the italian side :

Andrei Agrachev (SISSA, Trieste)

Maurizio Falcone (Roma La Sapienza)

Paola Loreti (Roma La Sapienza)

Luciano Pandolfi (Politecnico di Torino)

Benedetto Piccoli (IAC, CNR, Roma)

## The scientific managing committee :

**defines** the scientific program, evaluates the financial needs and budget.

**elaborates** the financial annual report and the scientific report



Our two countries have

privileged links to two strong research partner teams in Spain

BCAM, Bilbao, around Enrique Zuazua

Sevilla, around Enrique Fernández-Cara

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## Nodes in France and local coordinators :

- Paris 6 JLL, head : Sergio Guerrero
- Nancy-Metz (IECN-LMAM), head : Marius Tucsnak
- Orléans MAPMO, head : Jérôme Le Rousseau
- Grenoble Jean Kuntmann-Institut Fourier, head :  
Stéphane Labbé
- Toulouse, IMT, head : Jean-Pierre Raymond
- Orsay, LMO et LSS , head : Yacine Chitour
- Pau, LMA, head : Mehdi Badra
- ENS Cachan, Karine Beauchard
- Nanterre , MODAL'X, head : Luc Miller

- Cergy-Pontoise, LMAGM, head : Armen Shirikyan
- Mines-Patistech, CAOR et CAS, head : Pierre Rouchon
- INRIA Rocquencourt, MACS, REO, SISYPHE, head : Mazyar Mirrahi
- Versailles, LMO, head : Luc Robbiano
- Nice, Jean Dieudonné, head : Gilles Lebeau
- Marseille, LATP, head : Assia Benabdallah
- Strasbourg, IRMA, head : Bopeng Rao
- Besançon, LMB, head : Cédric Dupaix
- Toulouse, LAAS, head : Christophe Prieur

- Valenciennes, LAMAV, head : Serge Nicaise
- Clermont Ferrand, LM, head : Olivier Bodart
- Pôle Léonard de Vinci, head : John Cagnol
- Toulon, IMATH, head : Paola Goatin
- Polytechnique, CMAP, head : Ugo Boscain
- Compiègne, LMA, head : Stéphane Mottelet
- Bretagne Occidentale, LM, head : Pierre Cardaliaguet
- Lyon, Camille Jordan, INSA et ECL, head :  
Jean-Pierre Lohéac
- ENS Cachan Bretagne, head : Arnaud Debussche

- ESIEE, head : Bernadette Miara

## Partners in Spain and Chile /

- Sevilla (Spain), head Enrique Fernández-Cara
- Bilbao (BCAM), head : Enrique Zuazua
- Chile, (4 universities), head : Axel Osses

## Nodes in Italy :

- Bari
- Bologna
- Brescia
- Ferrara
- Firenze
- L'Aquila
- Lecce
- Politecnico di Milano
- Milano-Bicocca

- Milano
- Modena
- Padova
- Pavia
- Piemonte Orientale
- Scuola Normale di Pisa
- Pisa
- IAC CNR Roma
- Roma LUISS

- Roma La Sapienza
- Roma Tor Vergata
- Roma Tre
- Politecnico di Torino
- Trieste, SISSA
- Udine
- Venezia



## Scheduled meetings :

- Ceremony at IHP, October 12 2010
- IHP trimester in Control of PDE's October-December 2010
- Modelling and Control of Nonlinear Evolution Equations Workshop at SISSA, Trieste, May 24-27, 2011
- Workshop program of INdAM, GDRE CONEDP, "New trends in Analysis and Control of Nonlinear PDE's", June 13-15 2011, Roma.
- OPTPDE, BCAM summer school, Challenges in Applied Control and Optimal Design, July 4-8 2011, Bilbao, Spain
- Partial Differential Equations, Optimal Design and Numerics, August 28 - September 9 2011, Benasque International Center of Science, Benasque, Spain

## Past meetings :

- CIME session on Control of PDE's, Cetraro (Italy), July 19-23 2010. Organizers : P. Cannarsa and J.-M. Coron. Five courses given which will be published as Springer Lecture Notes.
- GDRE international conference at CIRM Luminy, January 25-29 2010. Organizers : F. Alabau-B., F. Ancona, F. Boyer, J. Le Rousseau. ...
- First conference of the GDRE project, IHP, Paris, October 14-16 2009, organizers : F. Alabau-B. and O. Glass.

IFAC Workshop on Control of Distributed Parameter Systems,  
Toulouse, July 20-24 2009, organizers : D. Matignon et C.  
Prieur

### **Other connected meetings :**

The "Groupe de travail Contrôle" at Paris 6. Organizers : J.-M.  
Coron, O. Glass and S. Guerrero

## **Planned meetings in 2012 :**

CNRS thematic school

Thirteen International Conference on Hyperbolic Problems:  
Theory, Numerics and Applications, Padova, June 25-29 2012

Peculiar attention is given to young researchers with sessions of courses organized to form doctoral students and post-doctoral fellows

With support from the GDRE to young researchers to attend courses and conferences

The GDRE gives great opportunities to organize structured research with support from CNRS (INSMI and DERCI), INDAM and UP

It also attracts financial and scientific support by ANR, PRIN, ERC grants, CIME, universities, . . .

This ceremony takes place within the **IHP trimester on Control of PDE's** organized by **Emmanuel Trélat, Jérôme Le Rousseau, Olivier Glass and Lionel Rosier**.

This trimester on a cutting-edge domain of mathematics is a very good scientific opportunity.

It also attests of the strong cooperation between our two countries since several invited professors and supported young researchers are italian.

Our special thanks to the organizers.

You are invited to the cocktail at the IHP lounge, second floor.

Merci de votre attention  
Grazie per la vostra attenzione