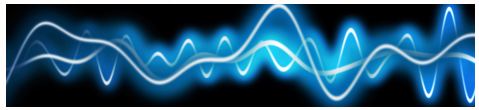


BCAM: views on reseach in Aplied Mathematics in the Basque Country

IKERBASQUE WORKSHOP

Enrike Zuazua

Ikerbasque researcher and Director of the Basque Center for Applied Mathematics

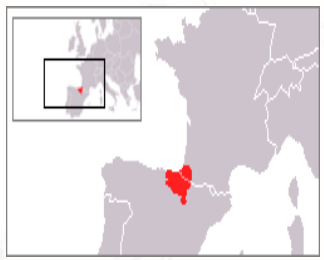
Txillidaleku, June 23, 2009

Outline:

1. BCAM
2. Our research team and interests
3. Where is the knowledge frontier in your research area?
4. What are the questions that scientist in your area are asking themselves?
5. What are the obstacles that block your way to reply to these questions?

1. BCAM

- The **Basque Center for Applied Matematics, BCAM,** is a research center on applied mathematics promoted by the **Basque Government** through **Ikerbasque**, with the support of **other basque R+D institutions** such as the University of the Basque Country.
- BCAM is one of the members of the **BERC network: Basque Excellence Research Centers.**
- BCAM aims to strengthen the Basque science and technology system, by performing interdisciplinary **research in the frontiers of mathematics, training and attracting talented scientists.**
- BCAM aims to become a **relevant node in the international mathematics research network,** recognized for the excellence of the research team and results, the quality of the infrastructures and equipment, where the people are the core and can entirely develop themselves, fostering the scientific progress in the Basque Country, Europe and the World.



Research Lines

- PDE – Partial Differential Equations, Numerics and Control Theory
- MIP –Multiphysics, Inversion and Petroleum
- NET – Network Analysis, Design and Optimization
- CVE – Calculus of Variations and Elasticity
- MB – Mathematical Biology
- HMC – Hybrid Monte Carlo Simulations

Scientific Council

- Juan José MANFREDI – U. Pittsburgh (USA) [President]
- Sir John BALL – U. Oxford (UK)
- Sem BORST – Bell Labs (USA) / Technische U. Eindhoven (Netherlands)
- Jean-Michel CORON – U. Pierre et Marie Curie & Institut Universitaire de France (France)
- Leszek F. DEMKOWICZ – U. Texas at Austin (USA)
- Pierre-Louis LIONS – Collège de France (France)

Come and visit us!

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2. Our reserach team and interests

- Enrique Zuazua (EZ) - Scientific Director of BCAM, Ikerbasque
- Peicheng Zhu (PZ) - Researcher, Ikerkasque
- Vincent Lescarret (VL) - Postdoctoral Fellow
- Francesco Rossi (FR) — Postdoctoral Fellow, starting on September 1^{st}
- Adrián Galdrán – Postdoctoral Fellow, starting on September 1^{st}.
- Aurora-Mihaela Marica (AM) - Ph.D Student
- Cristian-Mihai Cazacu (CC) - Ph.D Student
- Julen Alvarez (JA) - Ph.D Student, starting on September 1^{st}.
- Felipe Wallison Chaves Silva (FWCS) - Ph.D Student, starting on September 1^{st}

Goals:

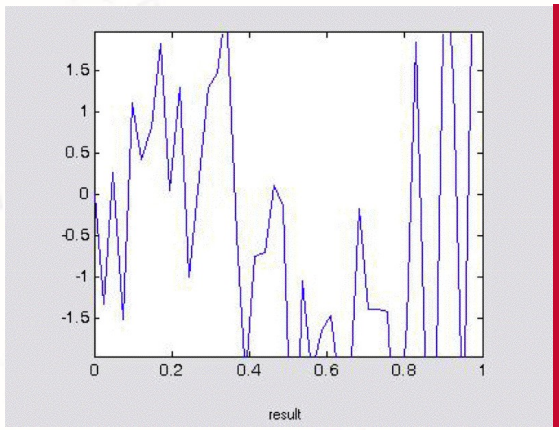
- To develop numerical methods allowing to mimic and reproduce fine qualitative properties of solutions to PDEs, oriented, in particular, towards design and control applications: aeronautics, networks (irrigation, gas, rivers,...), complex structures,...

Tools:

- Fine combination of several fields of Applied mathematics: Analysis, Partial Differential Equations, Numerical Analysis and Control Theory.

A challenge:

- Overcome the fact that humans, through mathematical analysis, and computers do not "see" the same reality. Spurious numerical solutions become an obstacle to develop efficient control strategies in real applications.



3. Topics:

Pb1 Control in fluid mechanics with applications in aeronautics in view

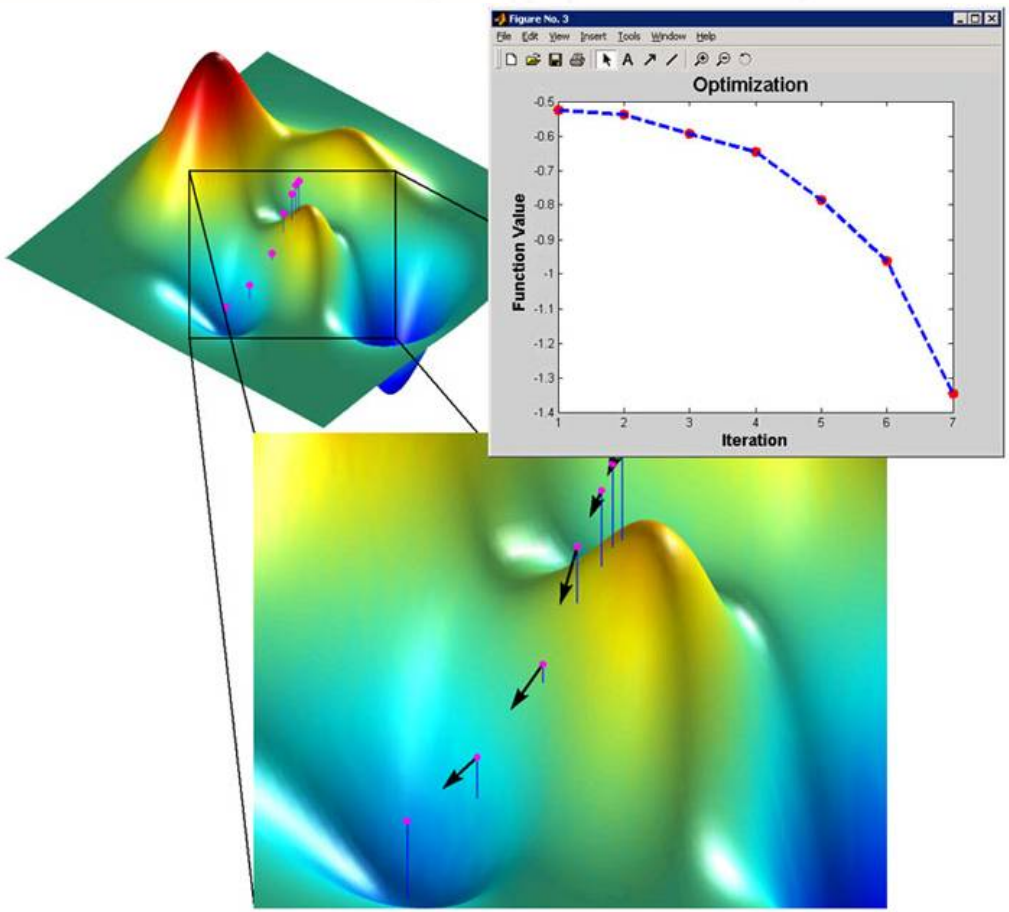
Pb2 Validity of some new models for phase transitions

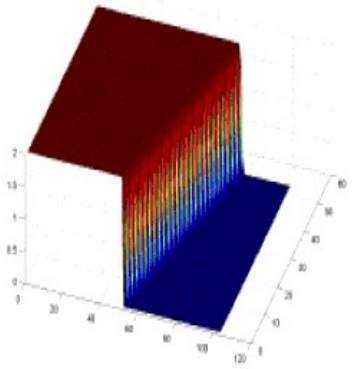
Pb3 Multi-structures

Pb4 Wave propagation in photonic crystals

Pb5 Discontinuous Galerkin methods for wave and Schrödinger equations

Pb6 Hardy inequalities and singular PDEs





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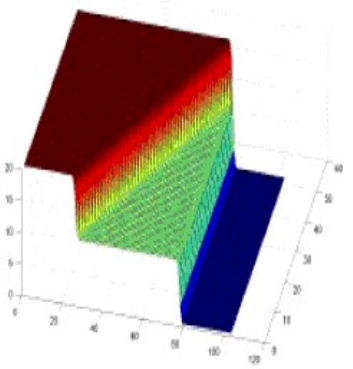

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3. Where is the knowledge frontier in your research area?

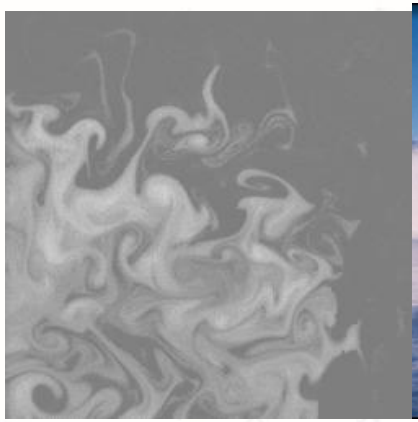
- Applied Mathematics has become much more than a branch or subfield of Mathematics.
- Nowadays Applied Mathematics is a lively melting pot of mathematicians, engineers, computer scientists and, in general, scientists of all areas of experimental and social sciences,...
- But these frontiers are diffuse, they are melting!

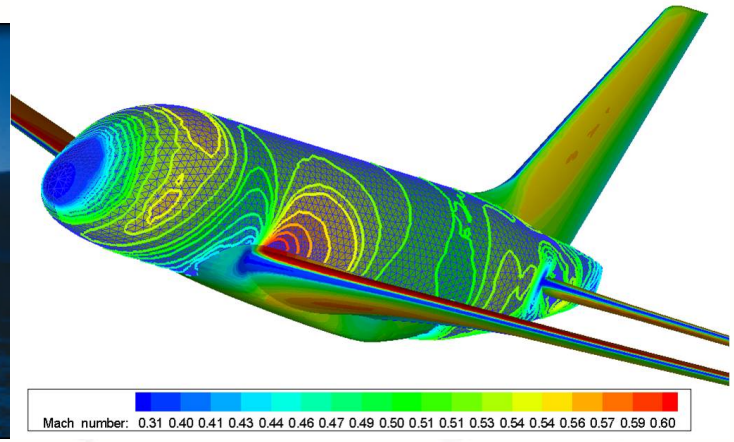
Applied Mathematics appears to be a small country with an increasing number of frontiers.

4. Some questions that scientists are asking themselves

- Applied Mathematicians address the **inner questions of Mathematics** such as the uniqueness and regularity of solutions of the Navier-Stokes equations in 3 space dimensions (air, water, blood,...) that was identified by the Clay Foundation as one of the Millenium Problems.

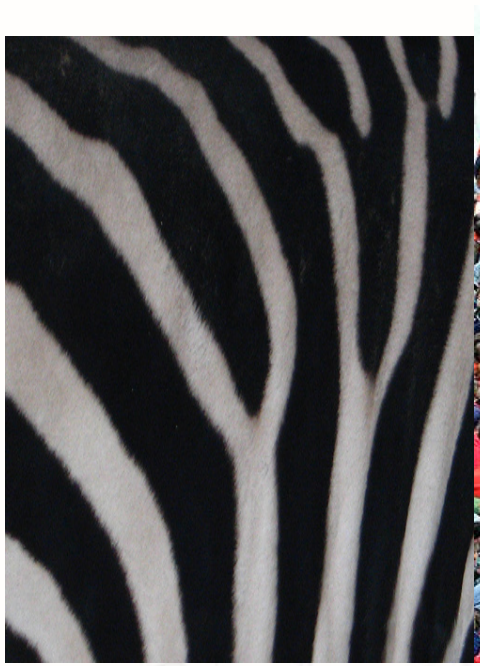
  http://www.claymath.org/millennium/Navier-Stokes_Equations/

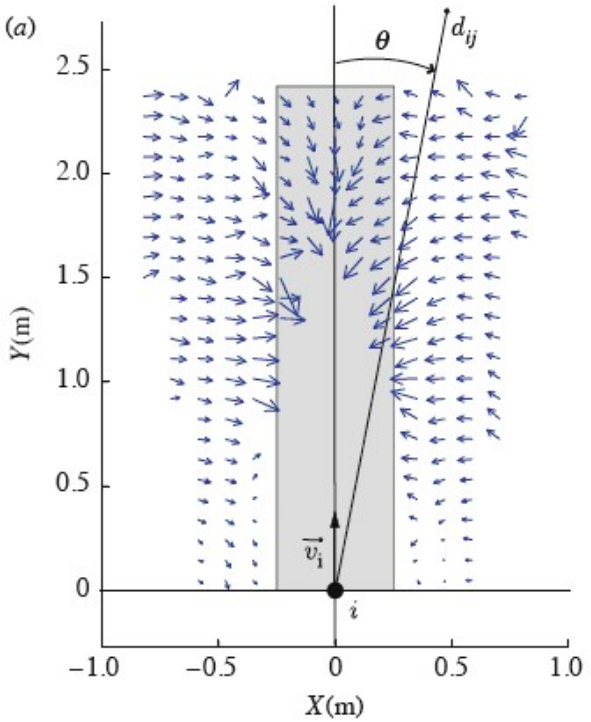




- But it also addresses other most practical but still challenging issues, such as the development of **efficient numerical methods for aronautics design.**

- The **interaction of mathematics with life and social sciences** is also becoming more and more relevant. How to simulate and understand social and human behavior? Any explanation on how humans organize theirselves in extreme situations?





5. Obstacles that block your way to reply to these questions?

A researcher needs:

- Time
- Research environment and atmosphere
- Team
- Stability
- Managers that understand us, and our needs
- Some funding to ensure acces to bibliography and meet colleagues
- Good taste for choosing topics and problems
- Intuition to indicate paths
- Talent and hard work to progress
- Some luck

A Challenge: Make the Basque Country and the Basque Science System attractive so that the best people might come. The best research needs the best people and it is harder and harder to compete with the top institutions.

Izarren hautsa egun batean bilakatu zen bizigai, hauts hartatikan uste gabean noizpait ginaden gu ernai. Eta horrela bizitzen gera sortuz ta sortuz gure aukera atsedenik hartu gabe: lana eginaz goaz aurrera kate horretan denok batera gogorki loturik gaude.

One day, the powder of the stars became the origin of life. From there, we were created at some point in time. And we still live that way, creating and creating, without rest: working we move forward, all strongly linked to that robust chain.

Izarren Hautsa, Xabier Lete.
http://www.youtube.com/watch?v=e-clfjktOVI