

Master 2 of Science in Computational Biology and Biomedicine

*Track of the Master of Computer Science
Option Biology, Informatics, Mathematics*

Nice Sophia Antipolis University, France

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Teaching language: English
Public: International attendance, applied mathematicians



The evolution towards personalized and computerized medicine

March 12, 2030: Bill suffers from knee arthritis...
Severe pain and reduced flexion



Dr House first looks for a medication

- Sequences Bill's genome and tracks deficient genes
- Seeks drugs fixing the protein which malfunctions

Dr House and Bill agree on surgery

- Design of a patient specific prosthesis: pre-op simulations
- Computer monitored physiotherapy

Computational biology and biomedicine

An emerging **interdisciplinary** field that applies the techniques of **computer science, applied mathematics and statistics** to address **biological and medical** problems.

- **Mathematical** modeling
- **Computational** simulation techniques.

Focus on the **human** being

From different **perspectives**:

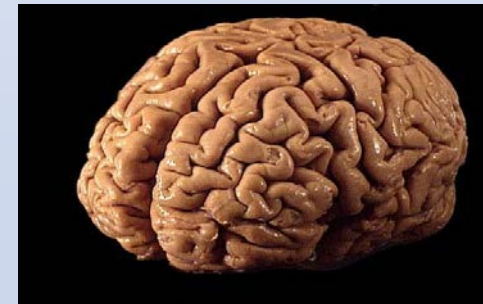
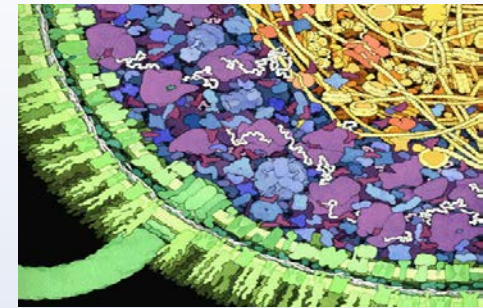
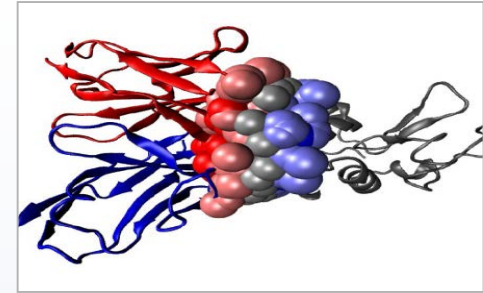
- Understanding and modeling functional aspects.
- Interpreting biomedical signals for various devices.

At different **scales**:

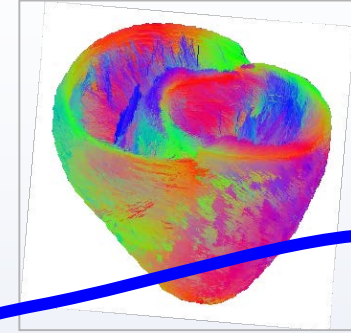
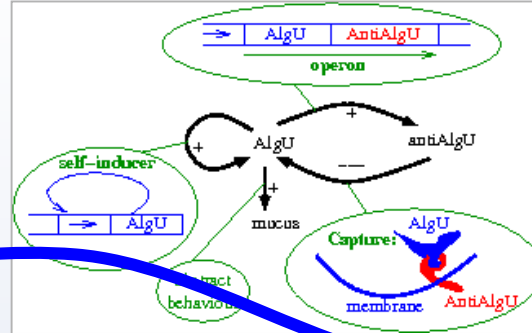
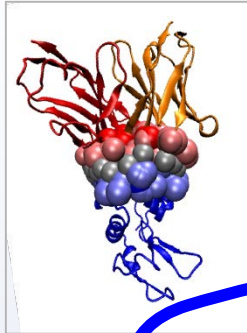
- From molecules to organs and the whole organism.

Three **main topics**:

- Bioinformatics
- Biomedical signal and image analysis
- Modeling in neuroscience



Bioinformatics: problems and methodologies



F. Cazals

J.L Gouzé

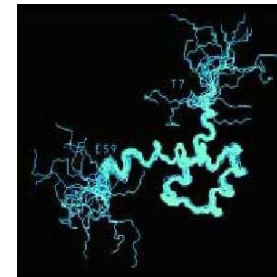
Computational Structural Biology

- Stability and specificity of macro-molecular complexes.
- Prediction ? (with little/no structural information).

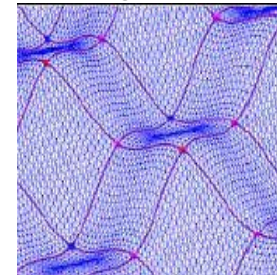
Gene Regulatory Networks, systems biology

- Structure of interaction networks (topology).
- Associated dynamics (feedbacks and control loops).

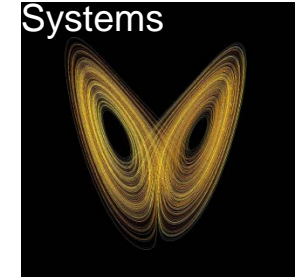
Geometry



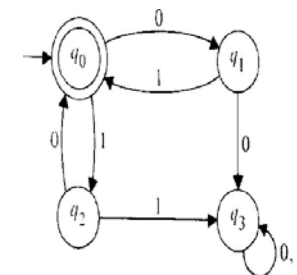
Topology



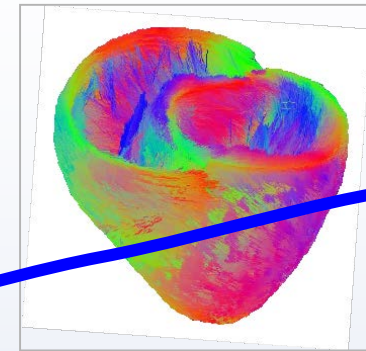
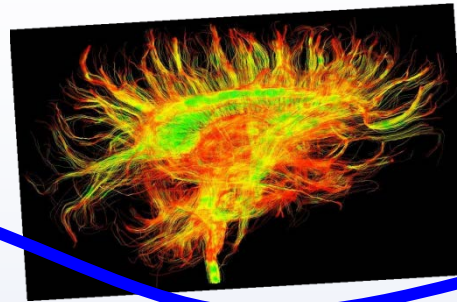
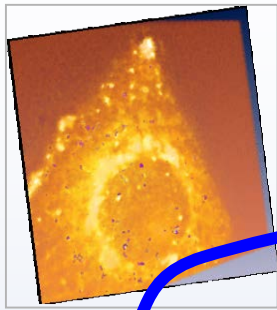
Dynamical Systems



CS



Biomedical signal and image analysis



Signal processing and inverse problems

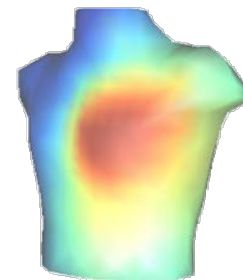
- Image/Signal denoising and enhancement.
- Inverse problems for confocal microscopy
- Coupling to physical properties of sensors and tissues.

Virtual human and patient specific modeling

- Parameter identification.
- Statistical analysis (in shape spaces).
- Electro/biomechanical Simulations.

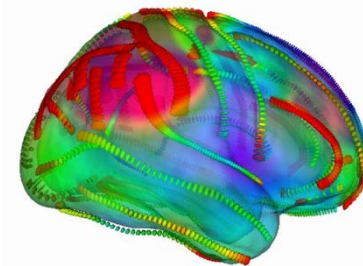
J. Zerubia O. Meste

Inverse problems

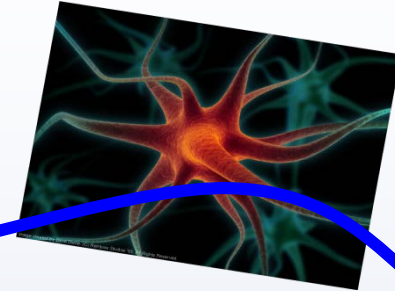
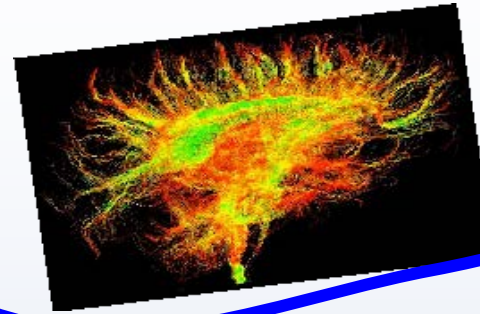


X. Pennec

Shape Statistics
Biomechanics



Modeling in neuroscience



B. Cessac

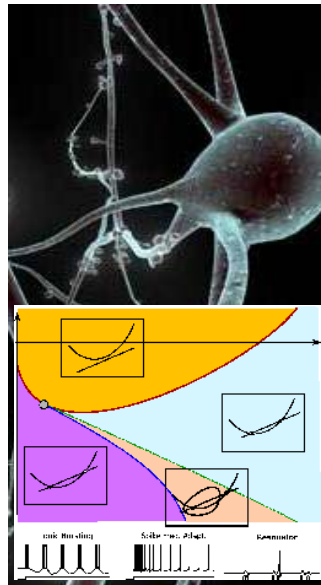
M. Clerc

R. Deriche

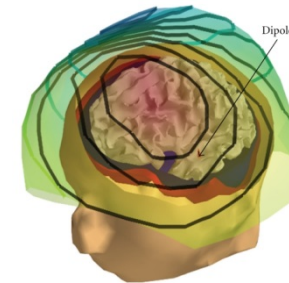
A multiscale multidisciplinary problem

- Neurons and synapses: analysis of neuron dynamics
- Neuronal networks: Dynamical evolution.
- Macroscopic connections (connectome)
- Measuring the brain in action

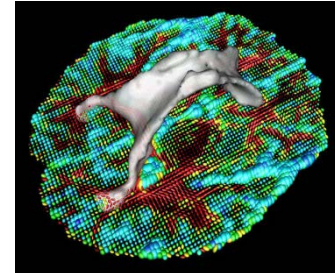
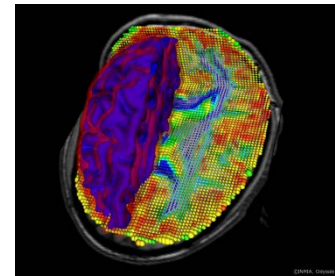
Dynamical systems



Inverse problems



Geometric PDEs



CBB Scientific program

➤ M2 Semester 1, Mid-September-February - 30 ECTS

- ❑ Courses – teaching language: English
- First 2 weeks (4 ECTS):
 - Basics in Biology
 - Basics in Computer Science
 - Project (6 ECTS)
- Period 1 (10 ECTS):
 - Computational Structural Biology
 - Confocal Microscopy
 - Computational Anatomy & Physiology
 - PDEs for Brain Imaging
 - Neuron Dynamics
- Period 2 (10 ECTS):
 - Gene Regulatory Networks
 - Inverse Problems in Brain Imaging
 - DSP for electrophysiological records
 - Large Scale Distributed Systems
 - Data Mining
 -

➤ M2 Semester 2, March-August - 30 ECTS

- ❑ 6-month full time internship in one research team.

So... why joining us?

- **You** will have a **truly inter-disciplinary learning experience** in the **challenging field** of computational biology and biomedicine given by experts, outstanding Professors and Researchers.
- **You** will have access to a wide network of contacts helping you to **find the best opportunities** for your internship, PhD or industrial position.



Till end of May
Accepting applications.

Mid/End of June
Notification of acceptance.

<http://cbb.unice.fr>

Alumni

In 2009/2010, out of 26 applications, 8 students accepted from: Argentina, France, India, Indonesia, Italy (2), Lebanon, Pakistan.

In 2010/2011, out of 30 applications, 8 students accepted from: Chile, India (2), Poland, Romania, Rwanda, Sri Lanka, Uruguay.

In 2011/2012, out of 30 applications, 5 students accepted from: India (2), Nepal, Romania, Russia.

In 2012/2013, out of 19 applications, 6 students accepted from: Algeria, Bangladesh, France, Greece (2), Kazakhstan.

In 2013/2014, out of 21 applications, 7 students accepted from: Algeria, Iran, Greece, Morocco, Russian, Turkey.

In 2014/2015, out of 21 applications, 4 students accepted from: Greece, France, Serbia.

Out of these 38 students, **19 started a PhD**, 5 are working in companies (Amadeus, Philips, ...), 2 are lecturer, 1 did another master 2.