

# LSIS : Laboratoire des Sciences de l'Information et des Systèmes

## LSIS : Information and System Sciences Laboratory

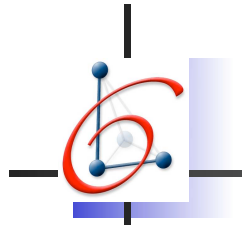




Laboratoire des Sciences  
de l'Information et des Systèmes



(Thanks to the Arcelor Group for the logos)

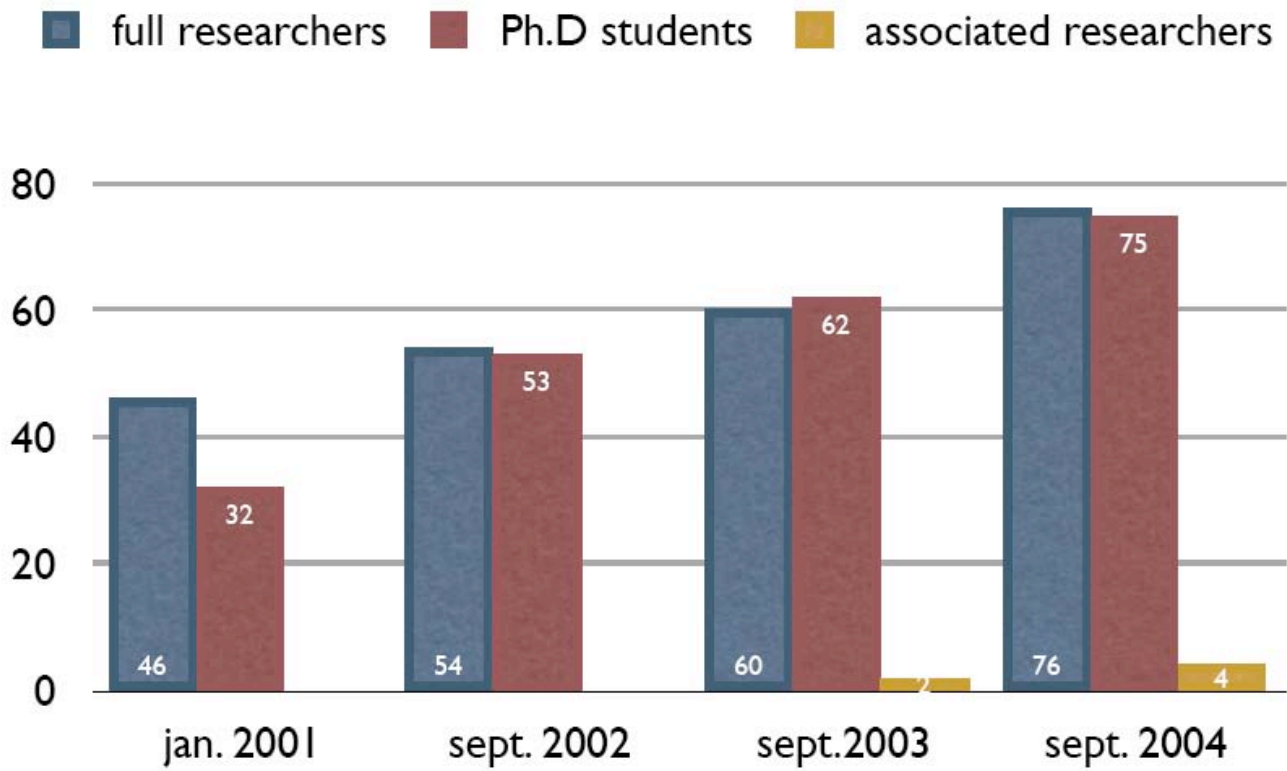


# LSIS : Laboratoire des Sciences de l'Information et des Systèmes

Set up in Jan. 2002 as a Mixed Research Unit (UMR CNRS 6168),  
LSIS employs 150 researchers and Ph.D students  
(75 full researchers, including more than 30 full Professors)

Thanks to the composition of its workforce, the research  
activities at the Laboratory cover several areas of  
Computer Sciences and Control Theory.

# Evolution of LSIS Manpower



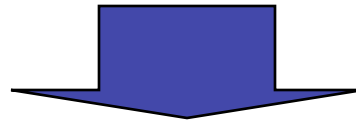


# LSIS Research Domains

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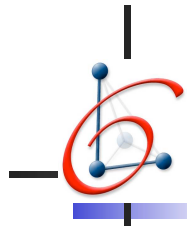
Fundamental and theoretical researches in:

**Computer Sciences and Control Theory**  
**Centered on**  
**the design and the analysis of artificial systems**



Emergence of new fundamental concepts for :

- real system modelling
- definition of solving problem methods concerned with artificial systems



# Research Teams

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- ✓ **COSI:** Control and Simulation (design of knowledge-based systems - modelling and simulation - system diagnosis, industrial automation).
- ✓ **IMS:** Engineering, Mechanics, Systems (integrated and cooperative design and engineering - machines and intelligent systems).
- ✓ **InCA:** Inference, Constraints and Applications (logical representation of knowledge and simulation of reasoning - automatic demonstration and constraint satisfaction).
- ✓ **INCOD:** Distributed Information and Knowledge (design of IS, multi-agent systems - security and cognition).
- ✓ **LXAO:** Computer-aided Modelling, Design and Reconstruction (modelling and control of forms - segmentation and recognition of forms - coherence of geometrical models).



# COSI Team

## Control and Simulation

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Research activities centered on the on the development of formal models and methods for simulation-based problem solving in :

- design, control, piloting and diagnosis of dynamic systems.

The major originality of our work is the integration, within only one methodology, of the concepts resulting from the three basic modeling approaches of dynamic systems:

- continuous modeling,
- discrete events modeling,
- knowledge-based modeling.

Applications of this approach :  
control of blast furnaces, vehicle, manufacturing processes, CGF,...



# COSI Team

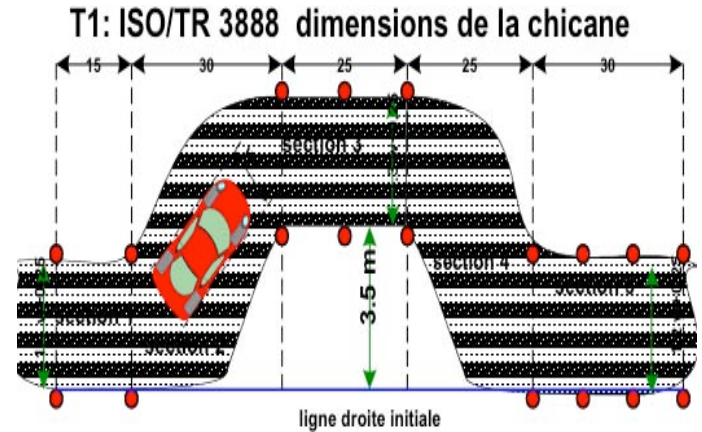
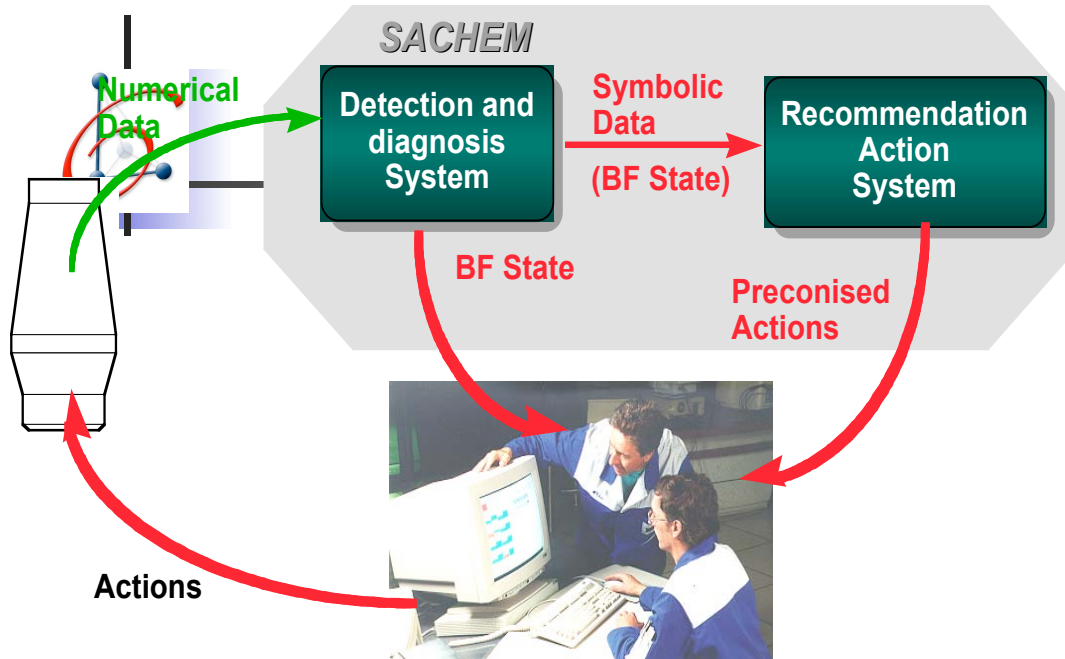
## COntrol and SIMulation

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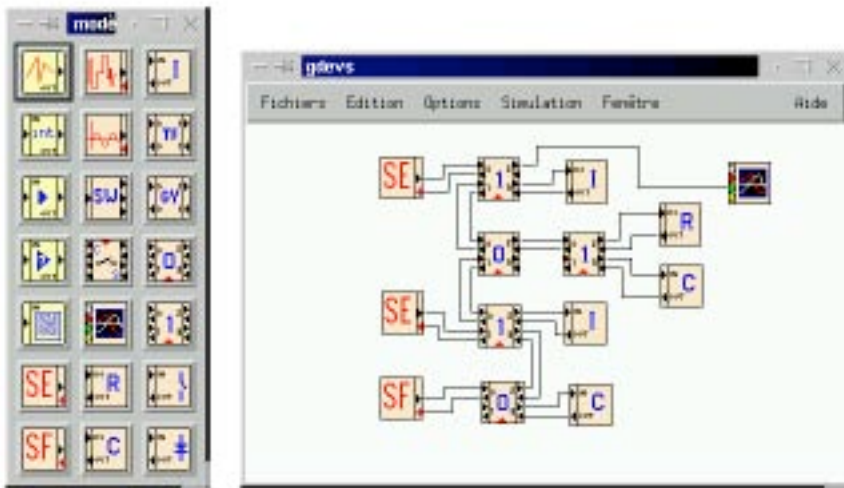
Some significant results:

- Generalization of the concept of discrete events model: G-DEVS
- Formal transformations of Event graphs, TA, Workflow into DEVS
- Specification and Operationalization of Expert Conceptual Models: SACHEM system (Arcelor)
- CAM: Definition of self-organized control systems, workflow modelling and validation
- Control and Diagnosis of Dynamic Systems: non-linear systems, decentralized and adaptive control, neural networks, model-based diagnosis, fault-tolerant control

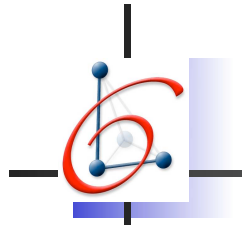
# COSI Team



*Vehicle dynamics control*



*Discrete event simulation  
of continuous models  
In G-DEVS*



# IMS Team

Ingénierie, Mécanique, Systèmes

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## **Industrial systems – Collaborative Engineering**

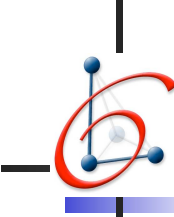
models, methods and tools for applying information and communication technologies to:

- the organisation and infrastructure for distributed collaborative working (CSCW)
- the handling and adaptation of shared geometrical models (digital mock-ups)

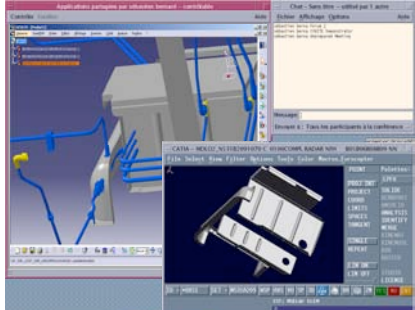
## **Mechanical systems – Intelligent Machines and Systems**

modelling, identification and control of dynamic systems to provide new possibilities such as:

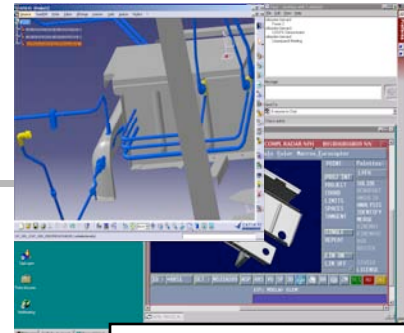
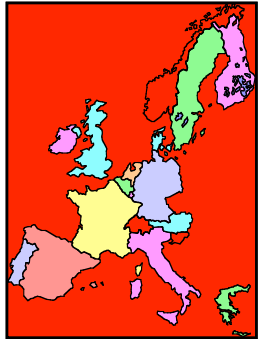
- machines that are capable of self-learning and adapting themselves
- robust identification and control aimed at active noise and vibration control
- prediction and selective use of self-vibration in manufacturing (vibration drilling)



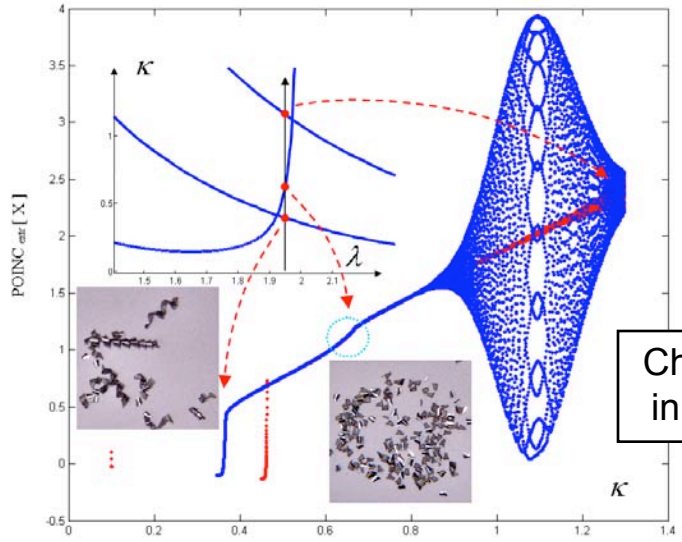
CSCW pilot application with EUROCOPTER  
 European project ENHANCE  
 (ENHance AeroNautical Concurrent Engineering)



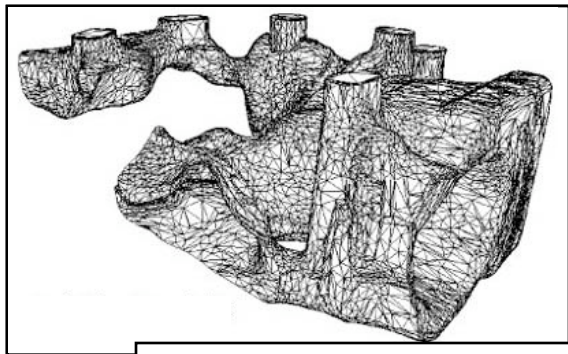
Filton, UK (Struct. Analysis)  
 Operating system: Windows  
 CAD system: Catia V5  
 Collaboration tool: NetMeeting



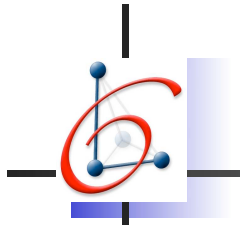
Marignane, F (Integration)  
 Operating system: Unix  
 CAD system: Catia V4  
 Collaboration tool: SunForum



Chip fragmentation  
 in vibration drilling



Polyhedral model for the  
 thermal calculation of the  
 internal cooling circuit of  
 a cylinder head (Courtesy  
 of IFP)



# INCA Team

## INferences, Constraints and Applications

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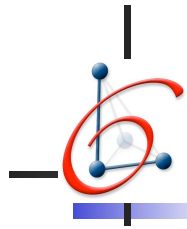
Research addresses two significant and complementary topics of

### **Artificial Intelligence :**

- logic based knowledge representation and reasoning,
- automated deduction and constraint satisfaction.

Main application fields are geographic information systems, constraint programming, constraint-based configuration and design of strategies for argumentation.

One objective of our research is to define new formalisms for knowledge representation.

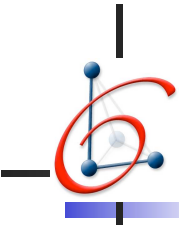


# INCA Team

## INferences, Constraints and Applications

### **Significant results:**

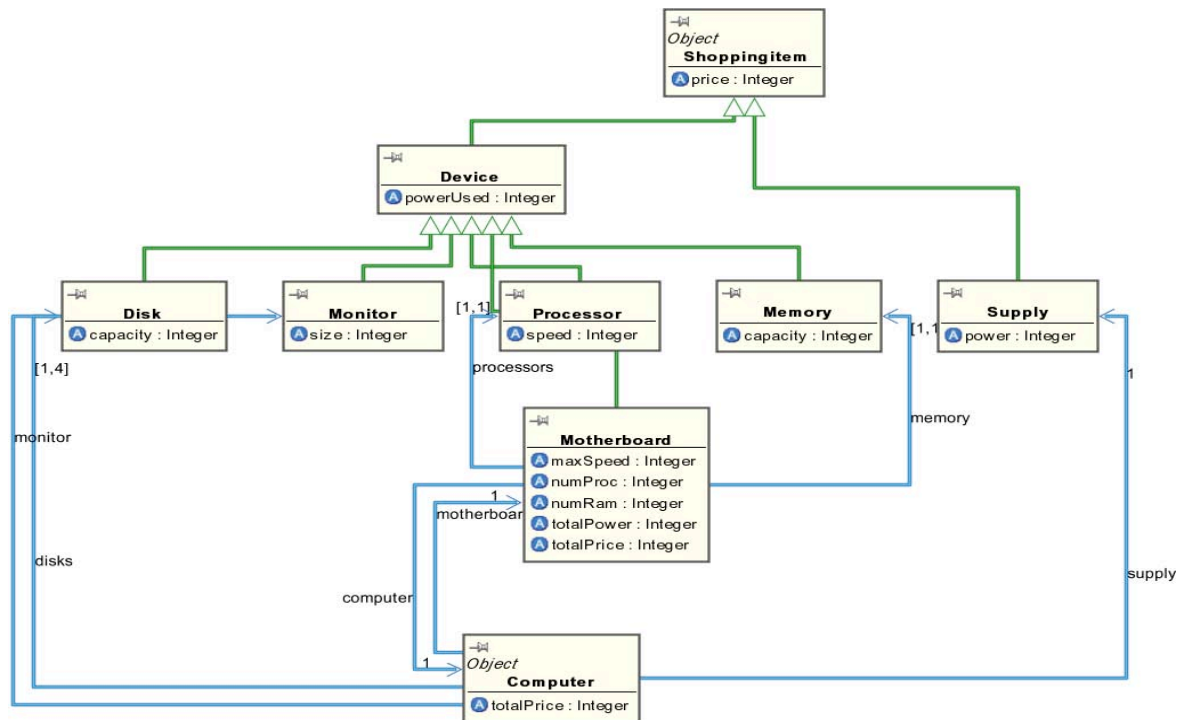
- Uncertainty in geographic informations, spatial and temporal reasoning: application to geographic informative systems.
- Constraint satisfaction problems: hybrid and cooperative approaches, constraint network decomposition, combinatorics and complexity.
- Constraint based configuration: definition and study of a formal framework and algorithms.
- Non-standard reasoning, non-monotonic logic : modeling reasoning ; (X-Logics)
- Logics for argumentative reasoning.



# INCA Team

## Inferences, Constraints and Applications

Development of theoretical and practical tools for computer-aided configuration of complex objects described by sets of constraints.



relations and constraints induced by this kind of configuration activity.



# LXAO Team

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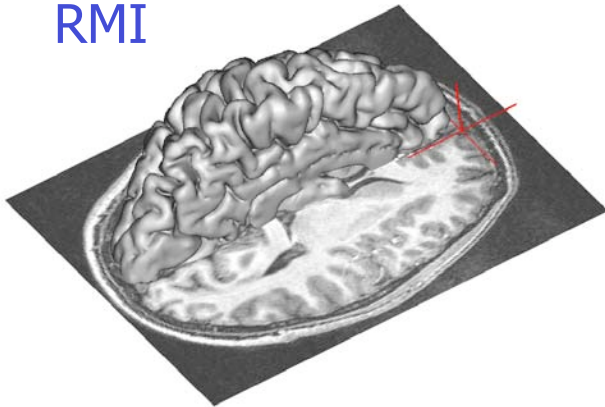
- **Research fields:**
  - Image Analysis
  - Geometrical Modeling
  - Scientific Visualization
- **Research areas :**
  - 3D Medical Imaging
  - Geometrical Modeling and CAD
  - Simulation, Scene Analysis and Augmented Reality
  - Virtual Sculpture and Image Synthesis



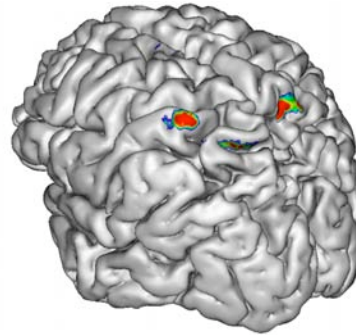
# LXAO Team

Providing supports for diagnosis and surgical planning

RMI



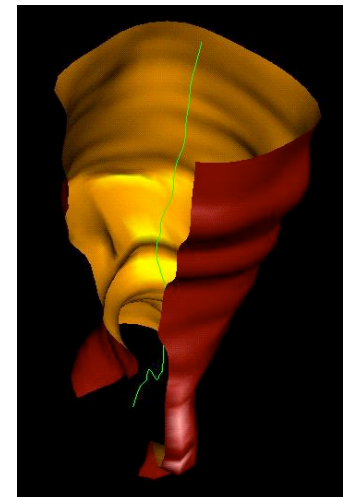
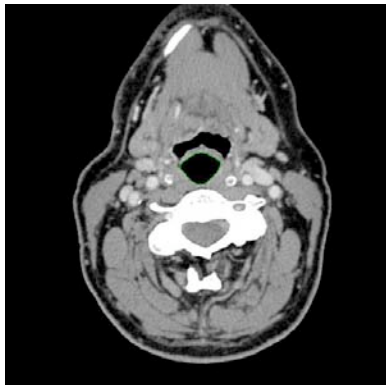
Anatomical MRI Segmentation



Functional activations



Parameterization of the cortical surface

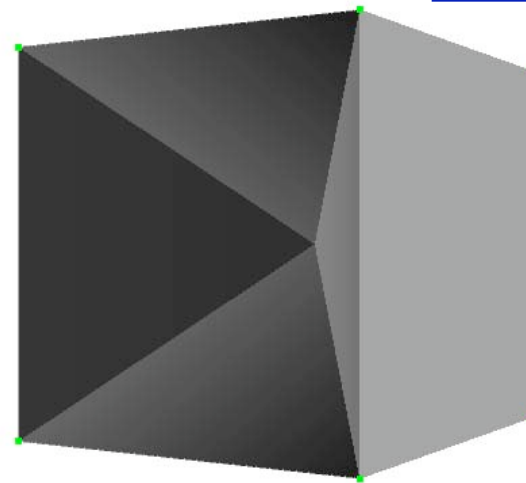
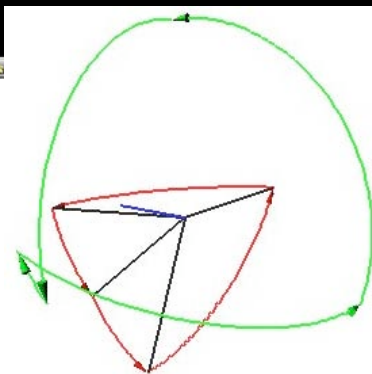
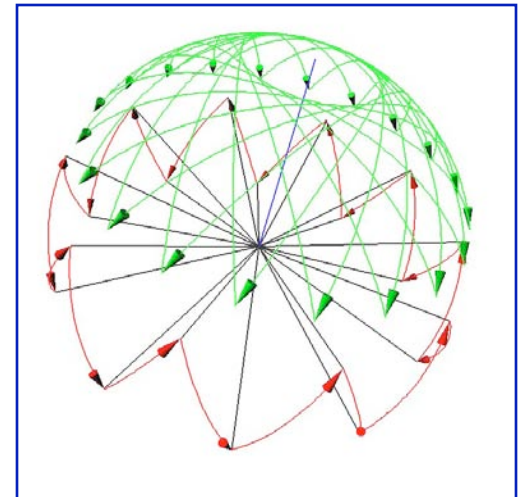
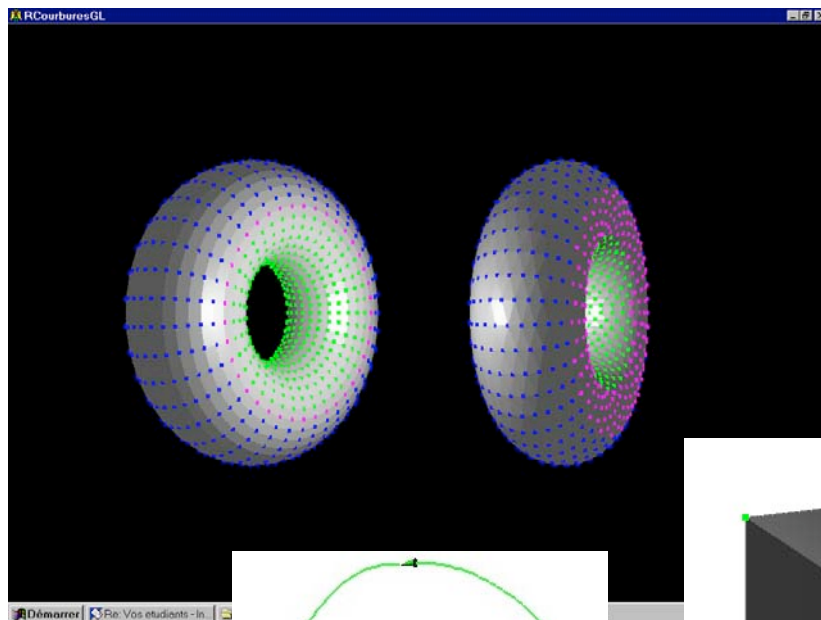


Virtual Endoscopy



# Geometric Modeling and CAD

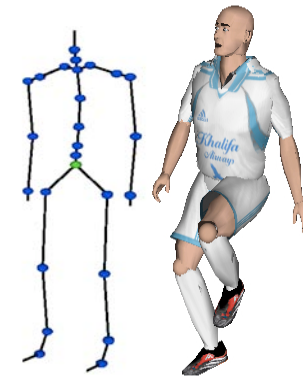
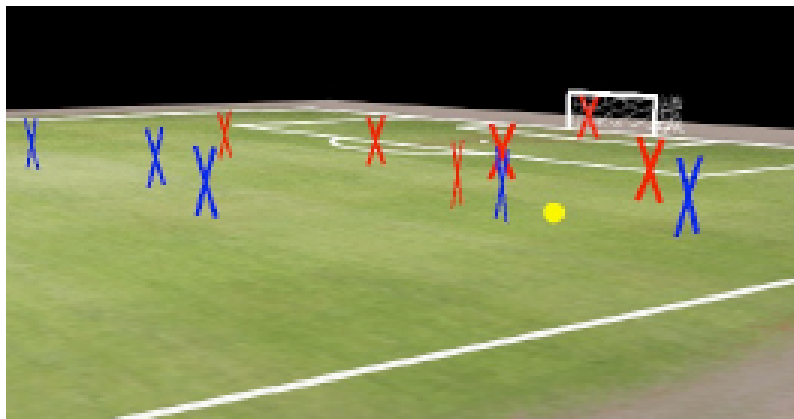
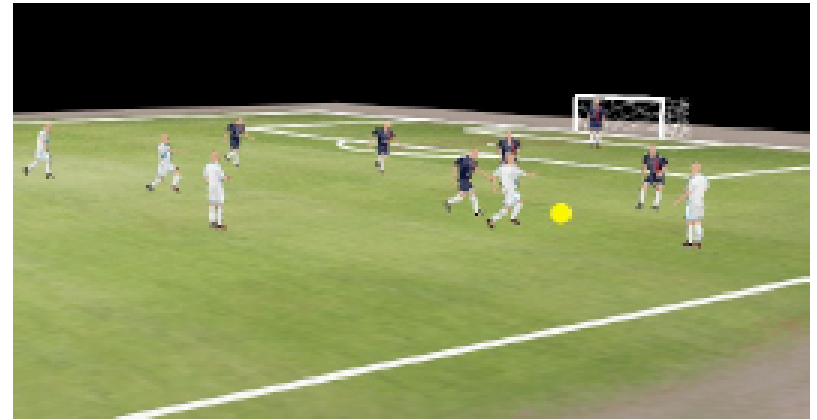
## Study of Discrete Curvatures for Surfaces



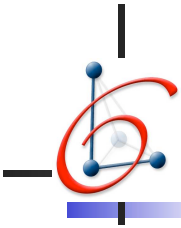


# LXAO Team

Simulation, Scene Analysis and Augmented Reality



Simulfoot and 3D Scene Analysis



# INCOD Team

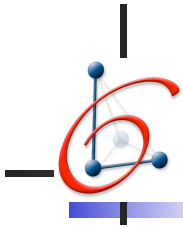
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[Bernard.espinasse@lisis.org](mailto:Bernard.espinasse@lisis.org)

## Research fields:



Information and Knowledge Systems Engineering, with focus on distributed, cooperative and safety aspects:

- Design, cooperation, integration of Information Systems (IS) based on components and agents,
- Agent-based modelling and simulation of complex systems,
- Safety and cognition



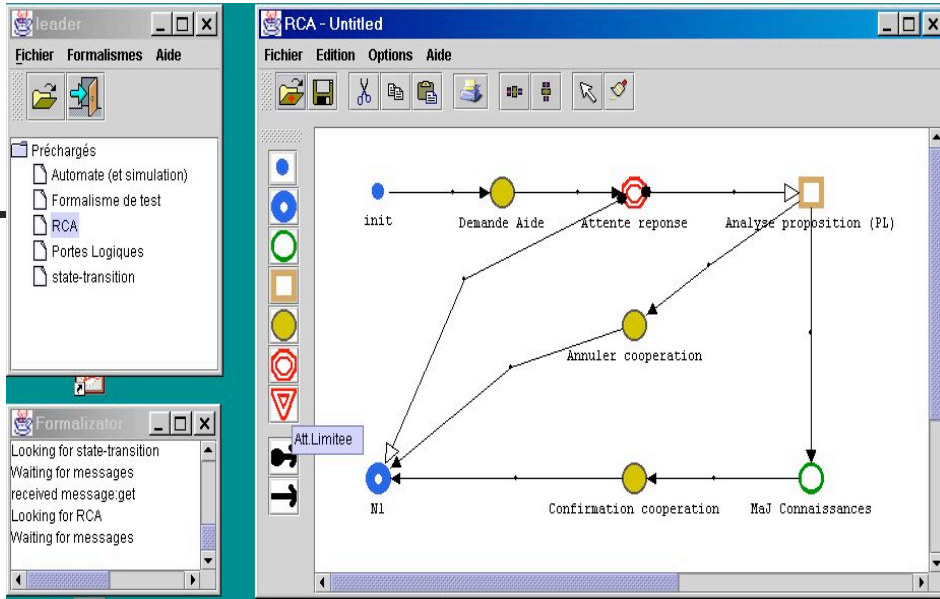
# INCOD Team

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## **Some significant results :**

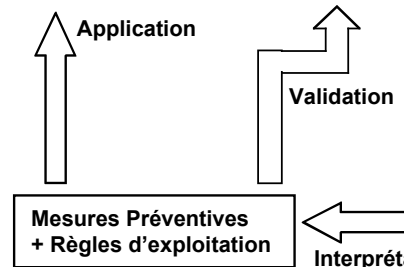
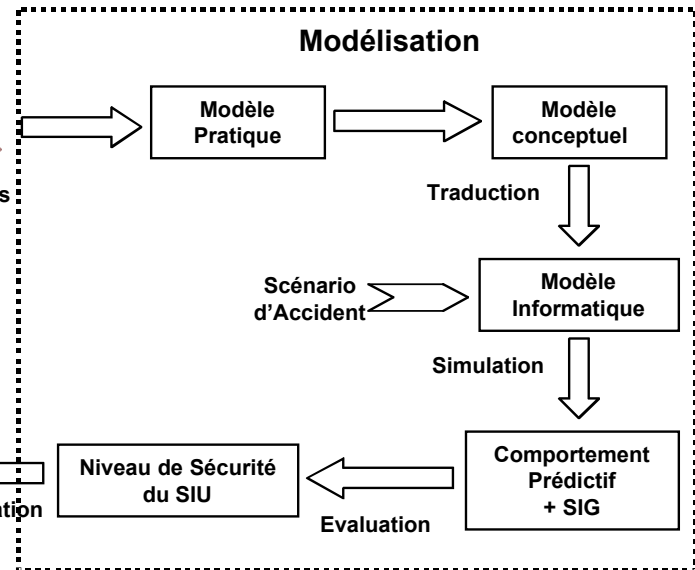
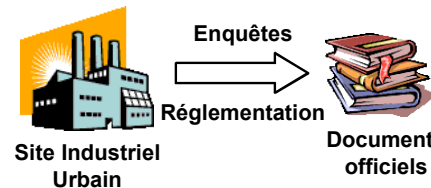
- IS design by reuse: models for the acquisition and the representation of domain knowledge,
- Agent-based Cooperative IS : Autonomous component interaction in a distributed architecture; data and software integration,
- Agent-based Modelling and simulation of complex systems: application to supply chains and anthropic ecosystems management, ...
- A priori approach of the safety : knowledge based modelling for human behavior in critical situation,
  - A posteriori approach of the safety : modelling and diagnosis of Accidents.

# INCOD Team

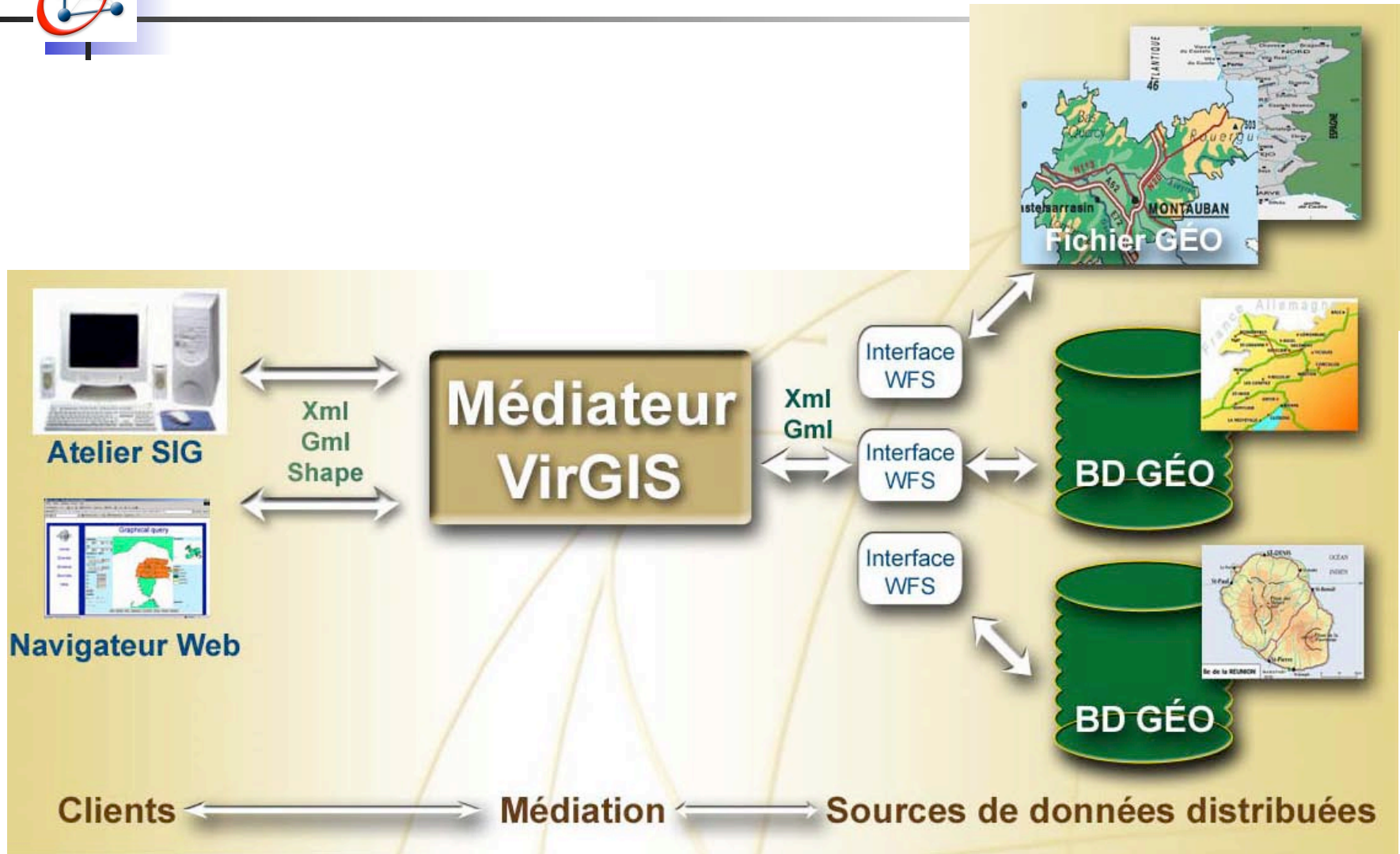
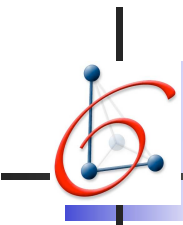


**Specification and implementation of agent behaviors**

**The safety previsionnal analysis process within a safety management process of an urban industrial site**



# INCOD Team





# Transversal Poles

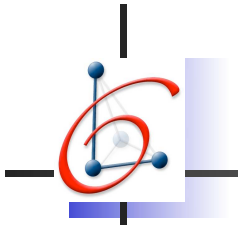
Contact :  
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3 transversal Poles have been identified and set up at the LSIS. The poles are federative and flexible.

Their aim is to allow researchers from different teams and cultures that are involved in associated areas of application or problems to meet on a regular basis and develop joint activities.

In addition, these areas highlight the skills of the LSIS in terms of application areas or problem classes, from both a scientific and industrial standpoint.



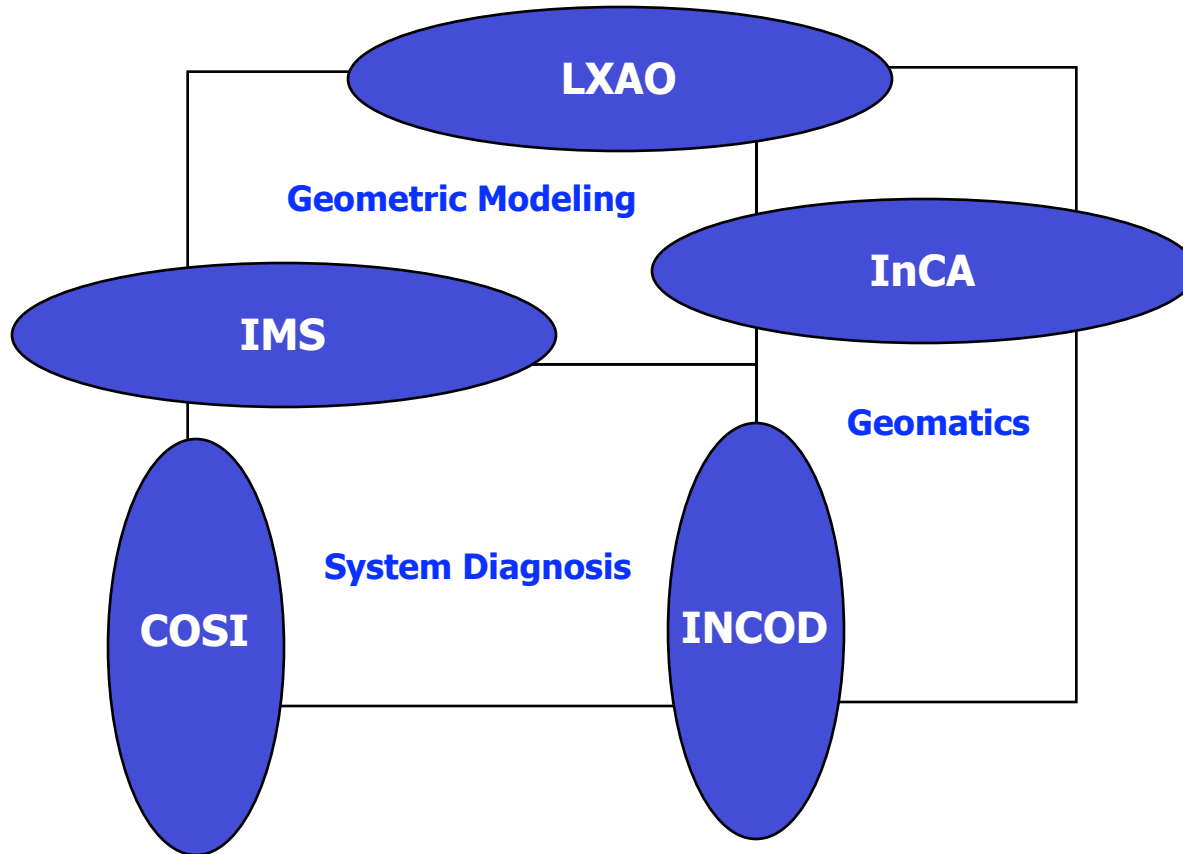
# Transversal Poles

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- ✓ **System Diagnosis** offers a full range of approaches for the development of computer-aided diagnosis. It is made up of researchers from Computer Sciences, AI and Control Theory,
- ✓ **Geomatics** contains researchers from the LXAO, InCA and INCOD teams who are interested in geographical information systems and activities linked to spatial modelling, graphical languages, ...
- ✓ **Geometric Modelling** covers geometric modelling from all theoretical and practical aspects as well as its different applications and implications. In this framework, Mechanics is a privileged but not exclusive domain. This involves mainly the IMS and LXAO teams, with the InCA team offering important additional theoretical support.



# Research Teams and Transversal Poles





# LSIS and Education

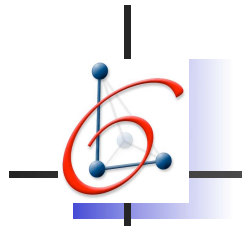
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The LSIS is also a driving force behind training through research, due to its intense involvement in numerous university courses, in particular, at three engineering colleges:

- École Nationale Supérieure des Arts et Métiers (ENSAM),
- École Supérieure d'Ingénieurs de Luminy (ESIL),
- Polytech'Marseille.

And a Master in Computer Sciences and Control Theory :

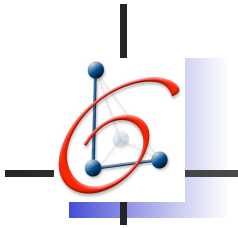
- Research (70 students/year)
- Engineering (100 students/year)



# LSIS and Industrial Cooperations

The development of the research performed by the LSIS is translated by a clear-cut increase in :

- industrial contracts (more than 1 500 000 euro of contracts in 2004)
- the set-up of two mixed teams (LSIS-Entreprise),
- the conclusion of several outline agreements with local, national and international companies
- a marked rise in the number of grants from industry and **Cifre** (the French industrial agreement on training for Ph.D students) -which have grown from just a few to over 25 since the start of the 2003 academic year.



# LSIS and Industrial Cooperations

Arcelor, Eurocopter,  
Cybernetix, Thales,  
Ilog, Bull, Sema-group,  
Dassault Aviation,  
GEM+, STMicroelectronics...

Praxitec, 3IG, Vibria,  
Itesoftware, P2I, Brgm, Biomet,  
Coretech, Praxim, SESCOI,  
Deshons, Dynamic Software,  
Sautelma-Rotolok,  
TCHP, Transim....

## And Governmental

DGA, INRA, INRIA,  
INRETS, .....



# LSIS and International Cooperations

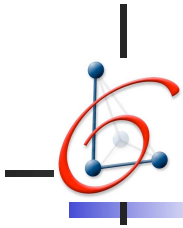
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## **Projects :**

CAPES/COFECUB, ESPRIT, ECOS (franco-chilien),  
GALILEE (action franco-italienne),  
PROCOPE (action franco-allemande),  
IEPAL (Joint EC/US Consortia),  
ERASMUS-SOCRATES, ...

## **Academic** (Conventions with Universities) :

Buenos-Aires, Rosario, ITES Monterey, Téhéran, Sofia, Gênes, Montréal,  
Québec, Techno. Univ. Vienne, Stevens Technology Institute, Boston  
College, Western Ontario, Moscou, Bucarest, Ottawa, Shangaï, Yerevan  
Danang, Seville, ...



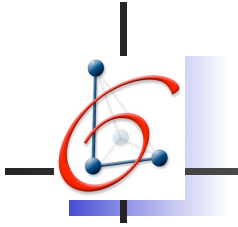
# LSIS and International Cooperations

Recent Intl. Conf. Created or Organized by the LSIS:

- 13<sup>th</sup> European Simulation Symposium (SCSI),
- 4<sup>th</sup> International Workshop on HMS
- AI, Simulation and Planning,
- AISC'2002 6<sup>th</sup> International Conference on Artificial Intelligence and Symbolic Computation
- CALCULEMUS'2002 10<sup>th</sup> Symposium on the Integration of Symbolic Computation and Mechanized Reasoning
- MAJECSTIC'03 et 04
- I3M 'International Mediterranean Modeling Multiconference'
- AVCS

# LSIS

## Synergy between Researchers



The initial desire to create **a synergy:**

- On one hand, between researchers focused on formal academic approaches and those oriented towards the socio-economic world,
- On the other hand, between Computer Sciences researchers  
And Control Theory researchers,

**has become reality today...**

Academic projects, industrials contracts and publications at the LSIS are further proof of the reality of such synergy."