



SAPIENZA  
UNIVERSITÀ DI ROMA

**mclab**

## **Model Checking Lab**

Computer Science Department  
Sapienza University of Rome, Italy

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Marco Esposito, Leonardo Picchiami

<http://mclab.di.uniroma1.it>

# Sapienza University of Rome

- Founded in **1303**
- The **largest** university in Europe
  - **115K** students
  - **7K** foreign students
  - **1K** incoming Erasmus students / year
- Steadily within **top 3%** world universities [Shangai Ranking]
- **250** Bachelor & Master Programmes
- **11** Faculties
- **63** Departments



# Computer Science Dept. @ Sapienza

- **45** Faculty Members
- **23** Post-Doc Researchers
- **20** PhD Students
- Internationally active in most of main stream CS **research areas**.
- Organized in informal **research groups**.
- Research group involved in this project:

**Model Checking Lab (MCLab)** (<http://mclab.di.uniroma1.it>)

# Model Checking Lab @ Sapienza

- Research group within the Computer Science Department
- **5** faculty members, **1** post-docs, **1** PhD students, **1** research fellow, **10** graduate students
- **Research focus:** design and development of **AI and Machine Learning-based** software tools for **simulation-driven** verification, validation and synthesis of **mission/safety-critical distributed intelligent systems.**

## Typical domains for MCLab activity:

- aerospace
- critical infrastructures
- transportation
- medicine
- smart grids

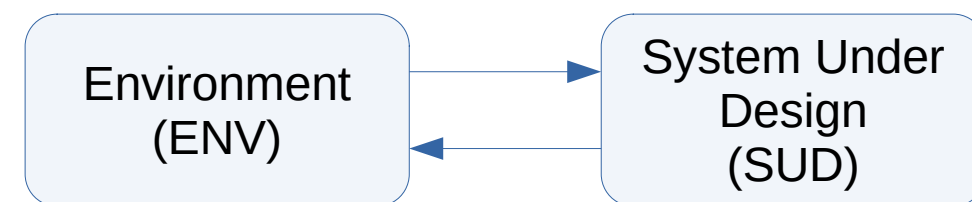


**MCLab**



# Safety/Mission Critical Intelligent Systems V&V

- Define properties to be verified.
  - ▶ Model properties through KPI (Key Performance Indicators) computed during simulation.
- Provide evidence that *all possible plausible scenarios* (e.g., fault sequences, attacks, etc) have been adequately considered.
  - ▶ Model environment using Markov Chains and show completeness and soundness.
- *Testing may change our SUD*, since intelligence often implies that system behavior changes in order to adapt to environment behavior.
  - ▶ Use adversarial learning to challenge SUD.
- *High statistical confidence* values about correctness are typically required. This entails a huge number of simulation runs (easily many millions).
  - ▶ Use Statistical Model Checking and scenario optimization to save on number of simulation runs.
- Amount of *time needed for each simulation run*.
  - ▶ Use Surrogate Models and HPC to save on simulation time.



# MCLab in Aerospace

## EC FP7 Ulisse (4.8 M€)

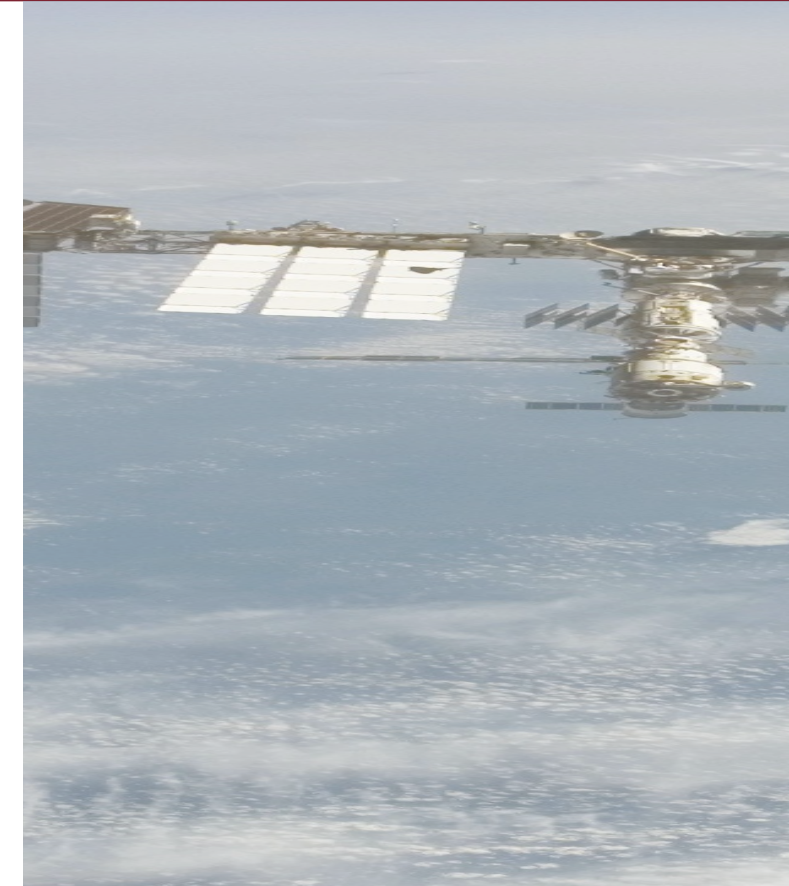
Verification & Validation of mission planning and on-board procedures



## ESA ITI Verifying Satellite

### Operational Procedures (150 k€)

Verification & Validation of ground segment satellite operational procedures



## ESA ITT System & Software Functional Requirements Technique (200 k€)

Verification & Validation of system level design for satellite and avionics vehicles

**POR FESR Aerospace and security - A system for hostile UAV detection in critical areas (340 k€).** Optimal positioning of antenna relays for radiogoniometry



# MCLab in Transportation

## MIUR Tramp, Setram, Interception (3.5 M€)

Optimal management of intermodal transportation of dangerous goods, guaranteeing security standards

Safety verification of communication protocols and control policies for the control center



## FILAS Sintesi (100 k€)

Sense and response system for critical resource management



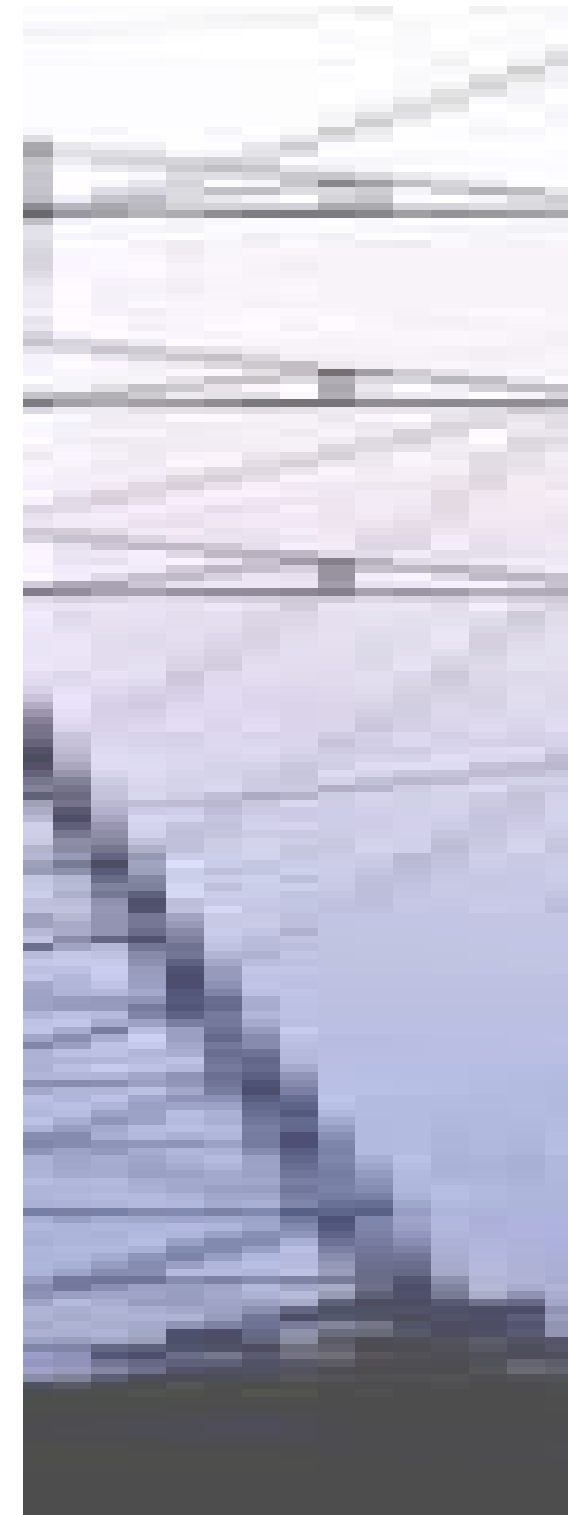
# MCLab in Critical Infrastructures

**SAPP, IRRIS, Safeguard, SafeTunnel, Icaro (10 M€)**

Design and safety verification of control and communication systems for critical infrastructures

**Ministry of Defense - TOD** - Formal verification of a protocol for automatic compensation of line delays.

**POR FESR Aerospace - Satellite Driven Fire Simulator (250 k€)**. Faster-than-real-time simulation based forecasting of fire propagation.





# MCLab in Smart Grids

**EC FP7 SmartHG (3.5 M€)**

Energy Demand Aware Open Services for Smart Grid  
Intelligent Automation



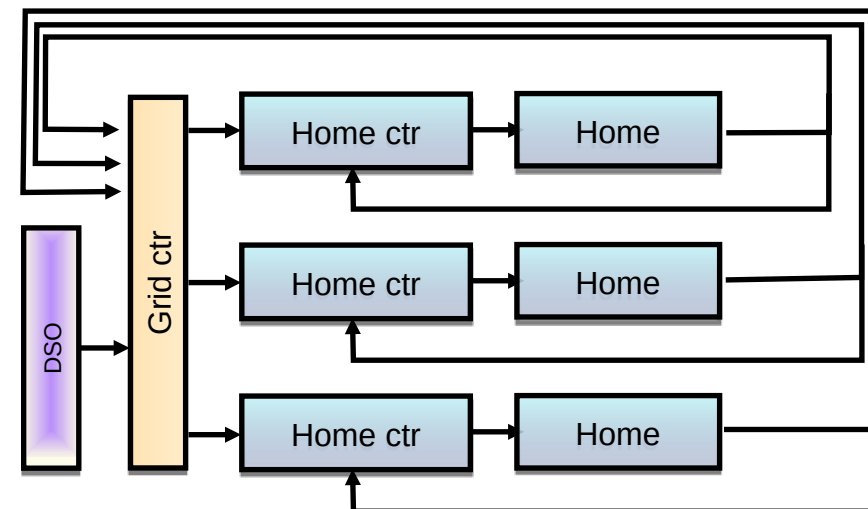
**Coordinator:** Enrico Tronci



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Design and formal verification of hierarchical **control policies** for the Smart Grid

SmartHG benefits: optimisation of grid **management**, minimisation of energy **cost** and CO2 **emissions**



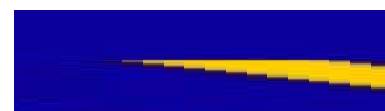
institute  
**IMdea**



AARHUS UNIVERSITY



A.V. LUTKOV HEAT AND MASS TRANSFER INSTITUTE OF  
THE NATIONAL ACADEMY OF SCIENCES OF BELARUS



**PanoramicPower**<sup>TM</sup>

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# MCLab in Medicine

## EC FP7 Paeon (2.5 M€)

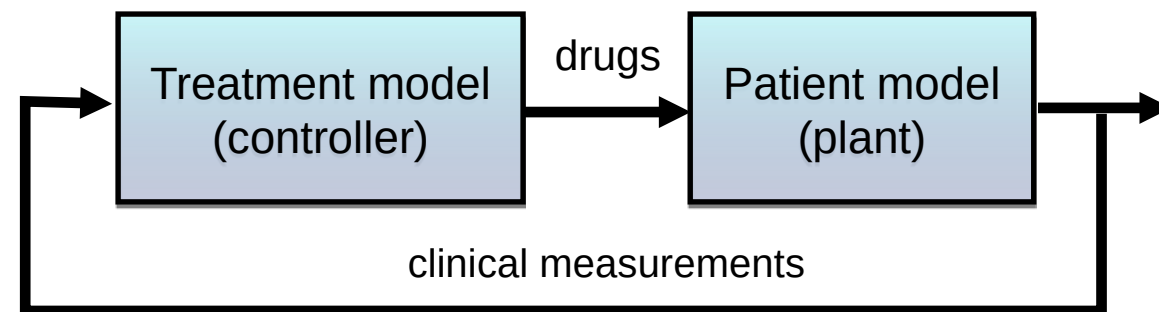
Model Driven Computation of Treatments for Infertility Related Endocrinological Diseases



**Coordinator:** Enrico Tronci  SAPIENZA  
UNIVERSITÀ DI ROMA

Computational models of **human physiology** (virtual physiological human).

Simulation-based verification and synthesis of **personalized** clinical treatments



UniversitätsSpital  
Zürich

HOCHSCHULE  
LUZERN



MHH

Hannover Medical School



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# Contacts

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