EICASLAB:
The software tool for the automatic control design

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EICASLAB

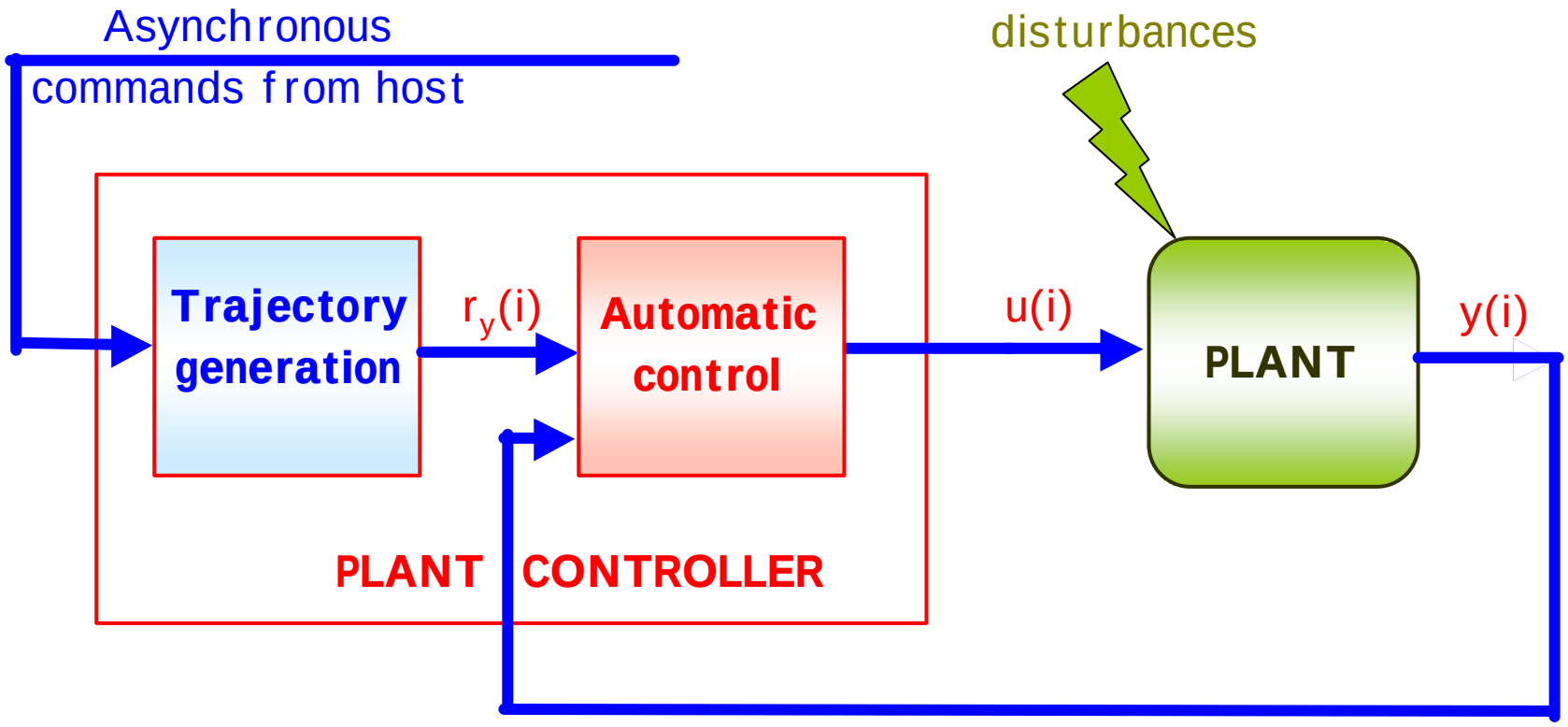
The software tool for the automatic control design

- **The software tool concept**
  - the class of problems addressed
  - the professional aspects
  - the support to the designer
- **The functional architecture**
  - MASTER, SIMBUILDER, SIM and POST
  - the activities in development
- **Major advantages & benefits**
- **Conclusions**

ACODUASIS IPS-2001-42068

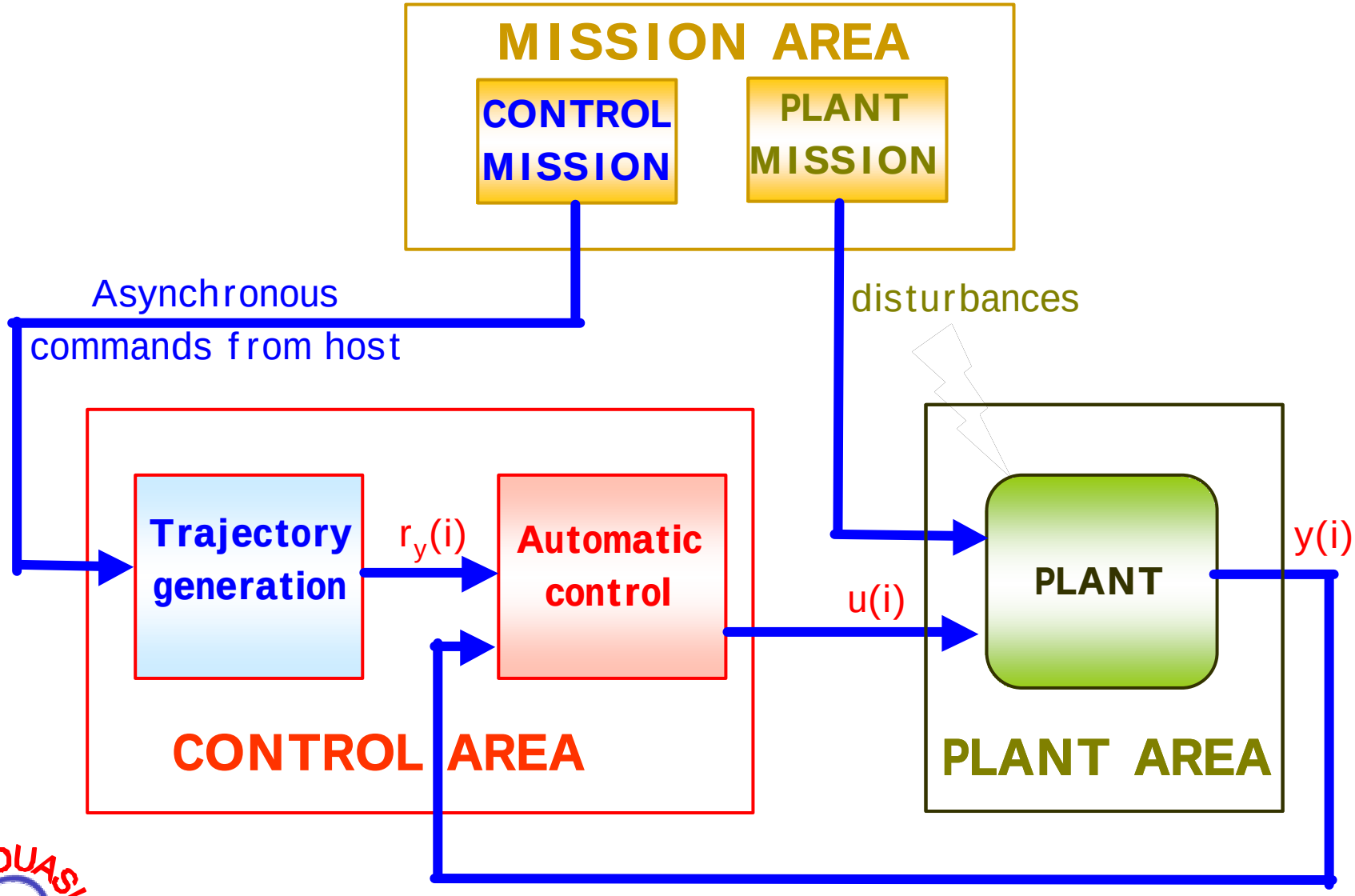
EICASLAB: The software tool concept

THE PROBLEM: The control design of a plant



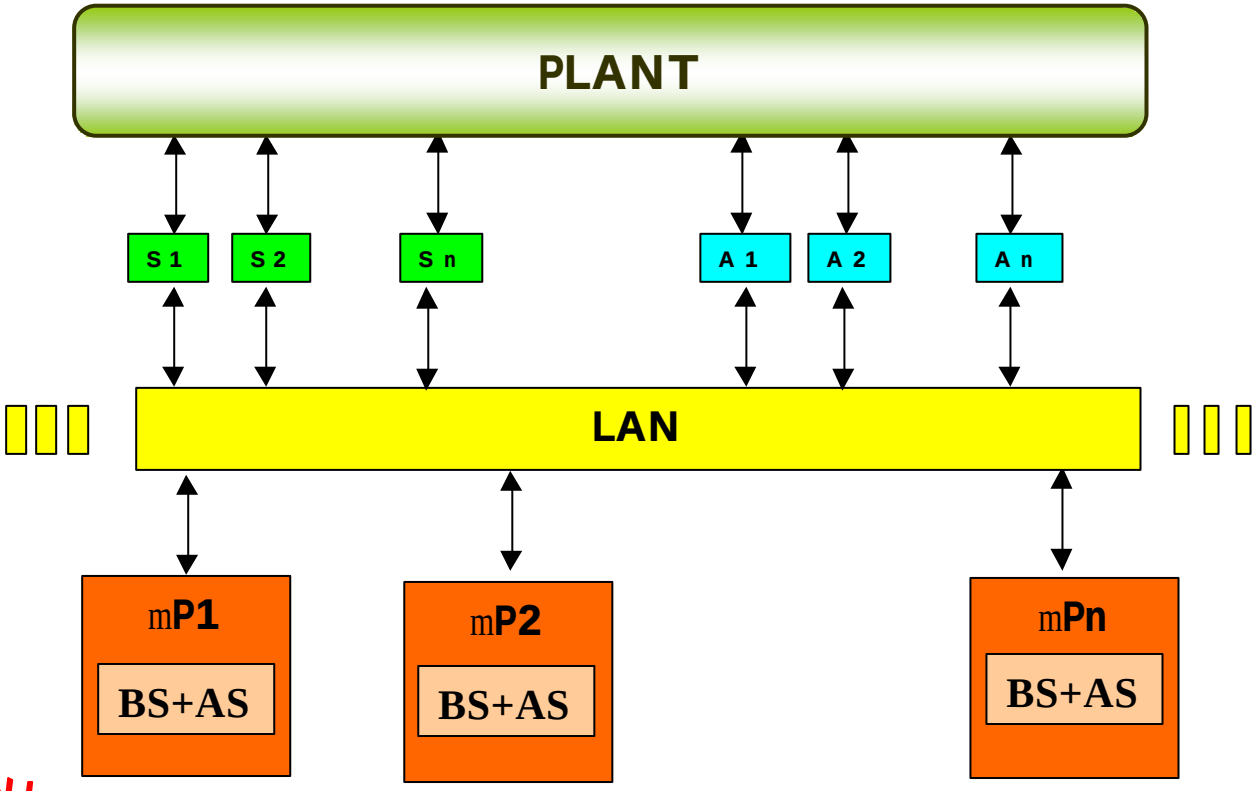
EICASLAB is an environment where the designer can develop, optimize, test all the algorithm & software related to the PLANT CONTROLLER

EICASLAB: The software tool concept



The software tool concept : PROFESSIONAL ASPECTS

EICASLAB is a professional tool taking particular care on the control h/w and s/w architecture



H/W components	
S 1	sensors
A 1	actuators
LAN	Local Area Network
mP	Microprocessor

S/W components	
BS	Basic software
AS	Application software

The software tool concept : PROFESSIONAL ASPECTS

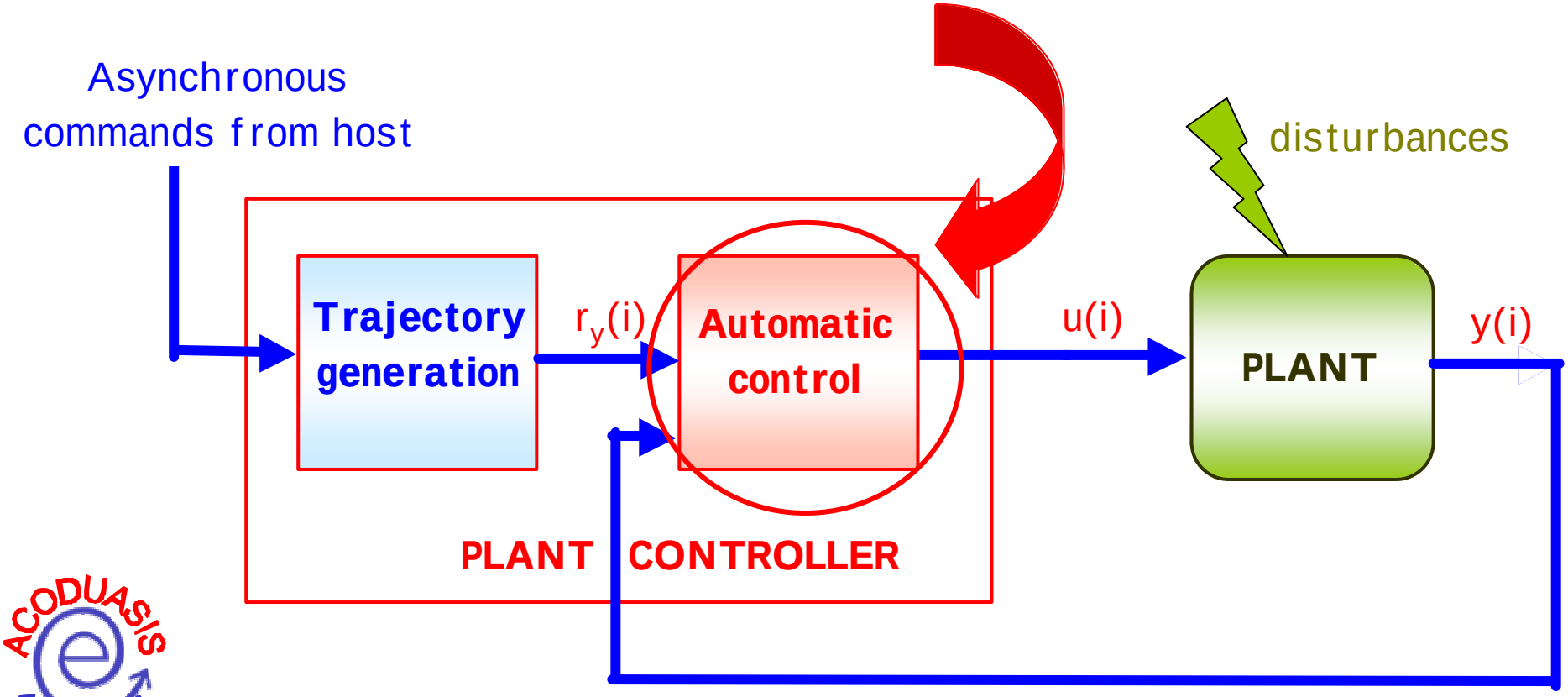
- H/W architectures including multi-processors
  - S/W architectures including multi-level hierarchical controls
    - Control S/W subdivided in functions allocated to the different processors
      - Control function scheduler (sampling frequency, execution time window)
- Data transmission
  - among the control functions allocated to the same processor
  - among the different processors
  - the delay time in the data transmission is considered
- The final "application software" generated in C language is subdivided in files each one related to a specific processor

Professional aspects

The software tool concept: SUPPORT TO THE DESIGNER

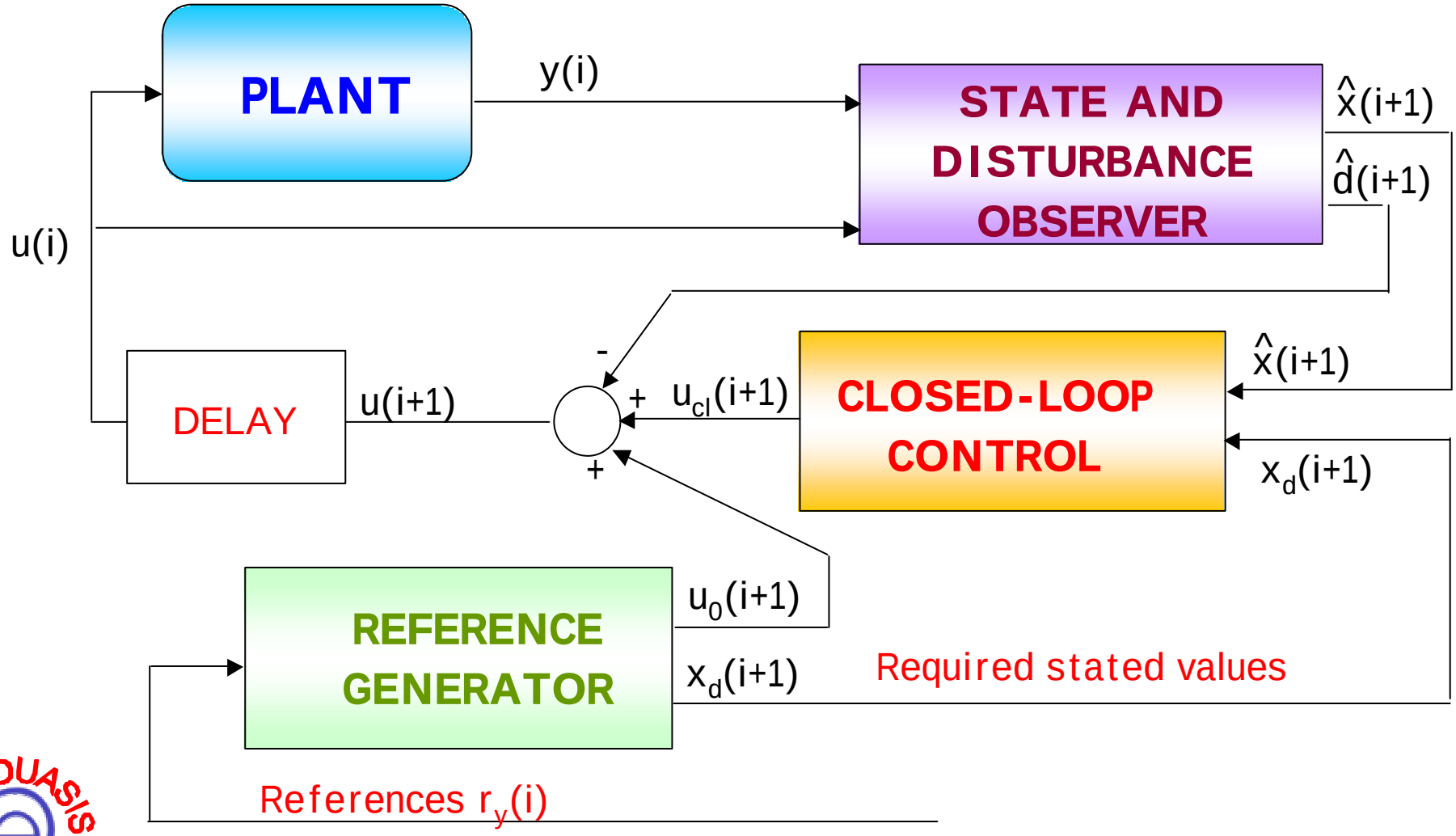
THE AUTOMATED ALGORITHM GENERATION

starting from the plant simplified model
it generates the Automatic control algorithm
according to the innovative methodology

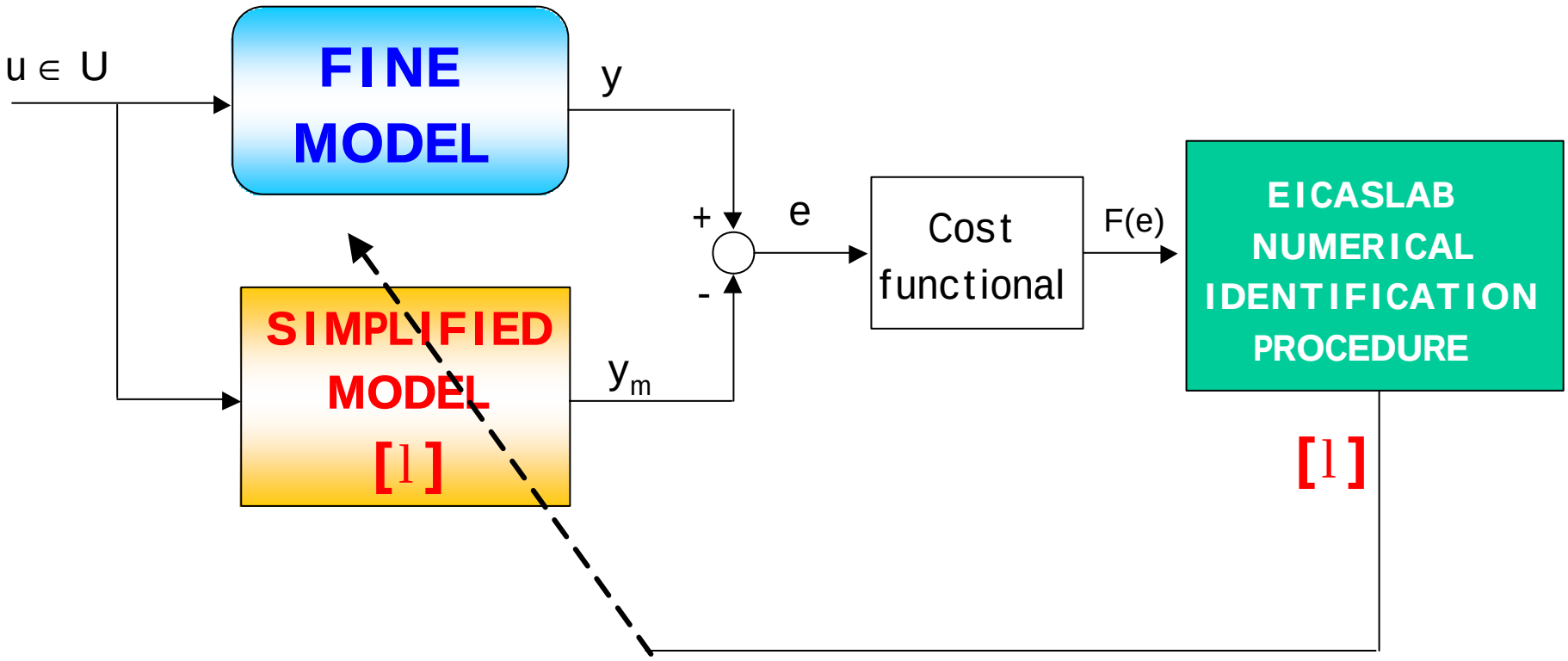


The software tool concept: SUPPORT TO THE DESIGNER

THE AUTOMATED ALGORITHM GENERATION

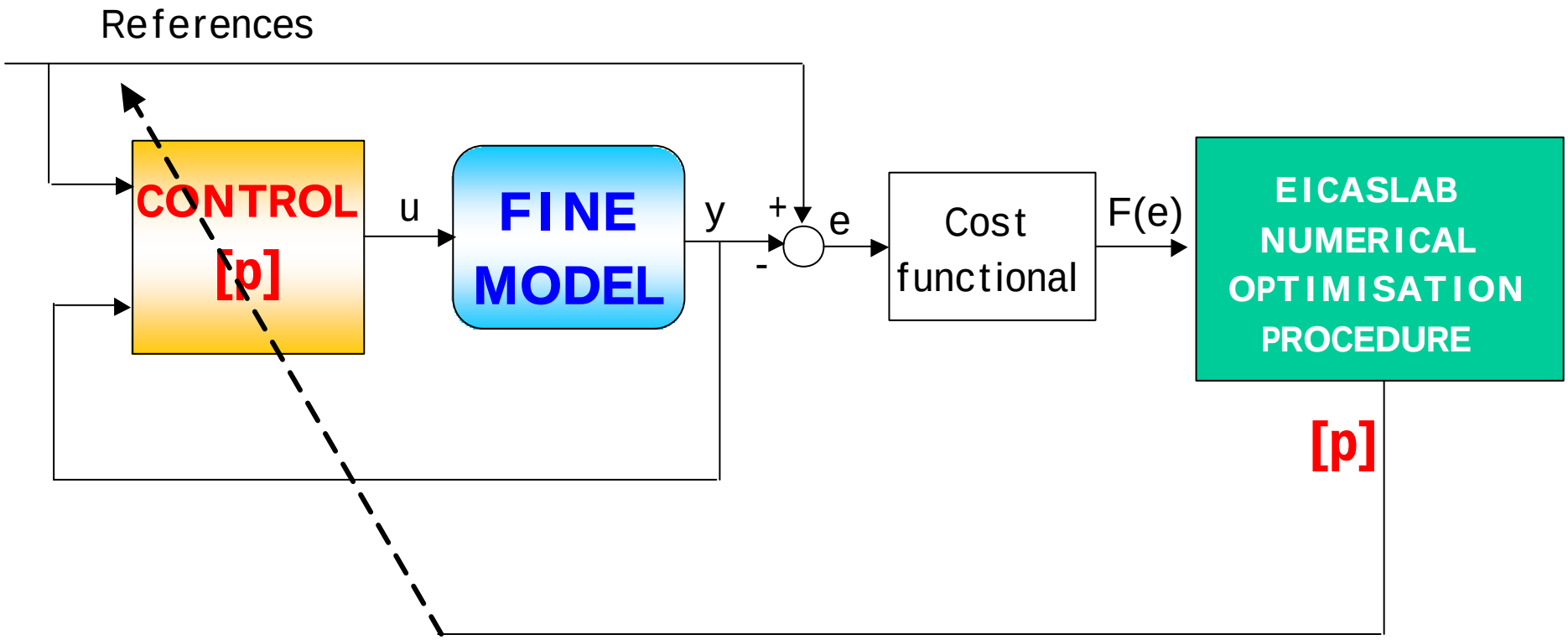


THE MODEL PARAMETER IDENTIFICATION



An original identification method is available in EICASLAB, oriented to estimate the best values of the plant simplified model parameters from the point of view of the control design

THE CONTROL PARAMETER OPTIMISATION



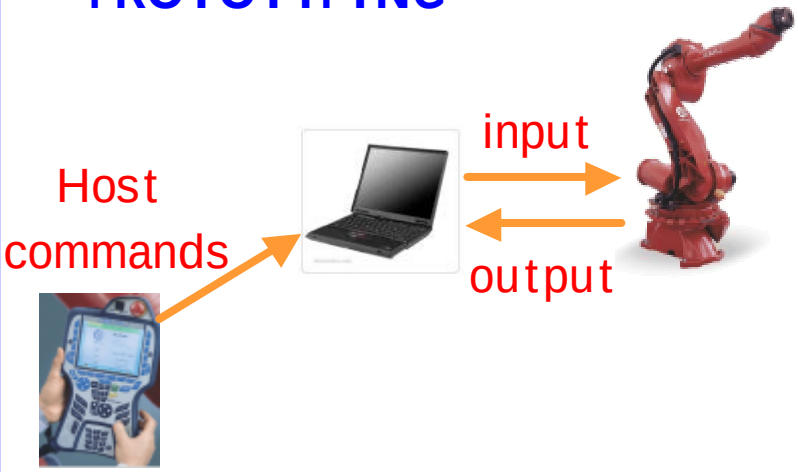
A powerful numerical optimisation algorithm is available, which allows in very reasonable computing time to get the optimum value of a large number of parameters

The software tool concept: SUPPORT TO THE DESIGNER

THE SLOW MOTION VIEW

Review recorded images through **MOVIOLA**

REAL-TIME RAPID PROTOTYPING

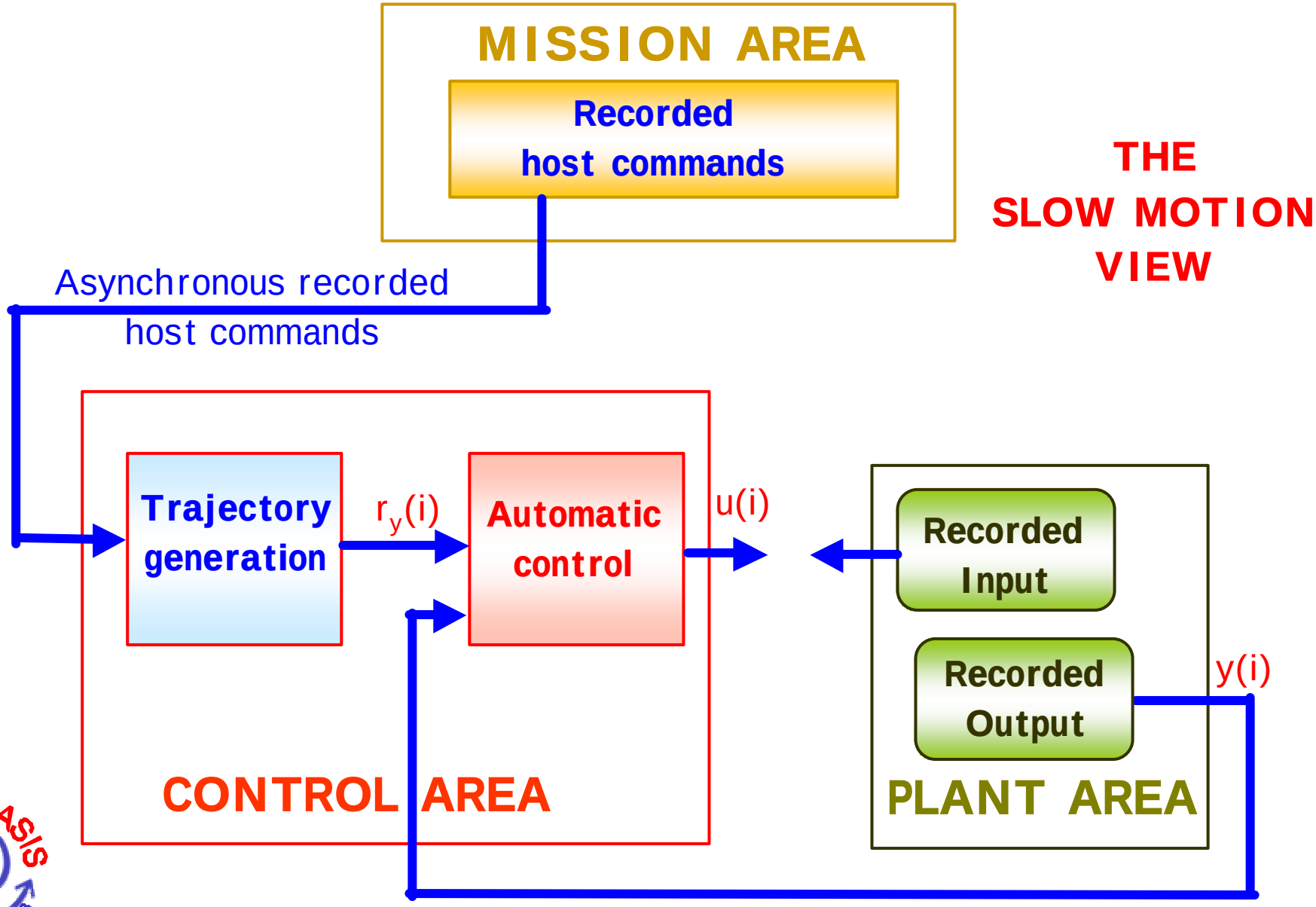


Record:

- I/O data of the plant
- host commands

Repeat the experiment through **SLOW-MOTION VIEW** by EICASLAB

The software tool concept: SUPPORT TO THE DESIGNER



THE SLOW MOTION VIEW

EICASLAB: The functional architecture

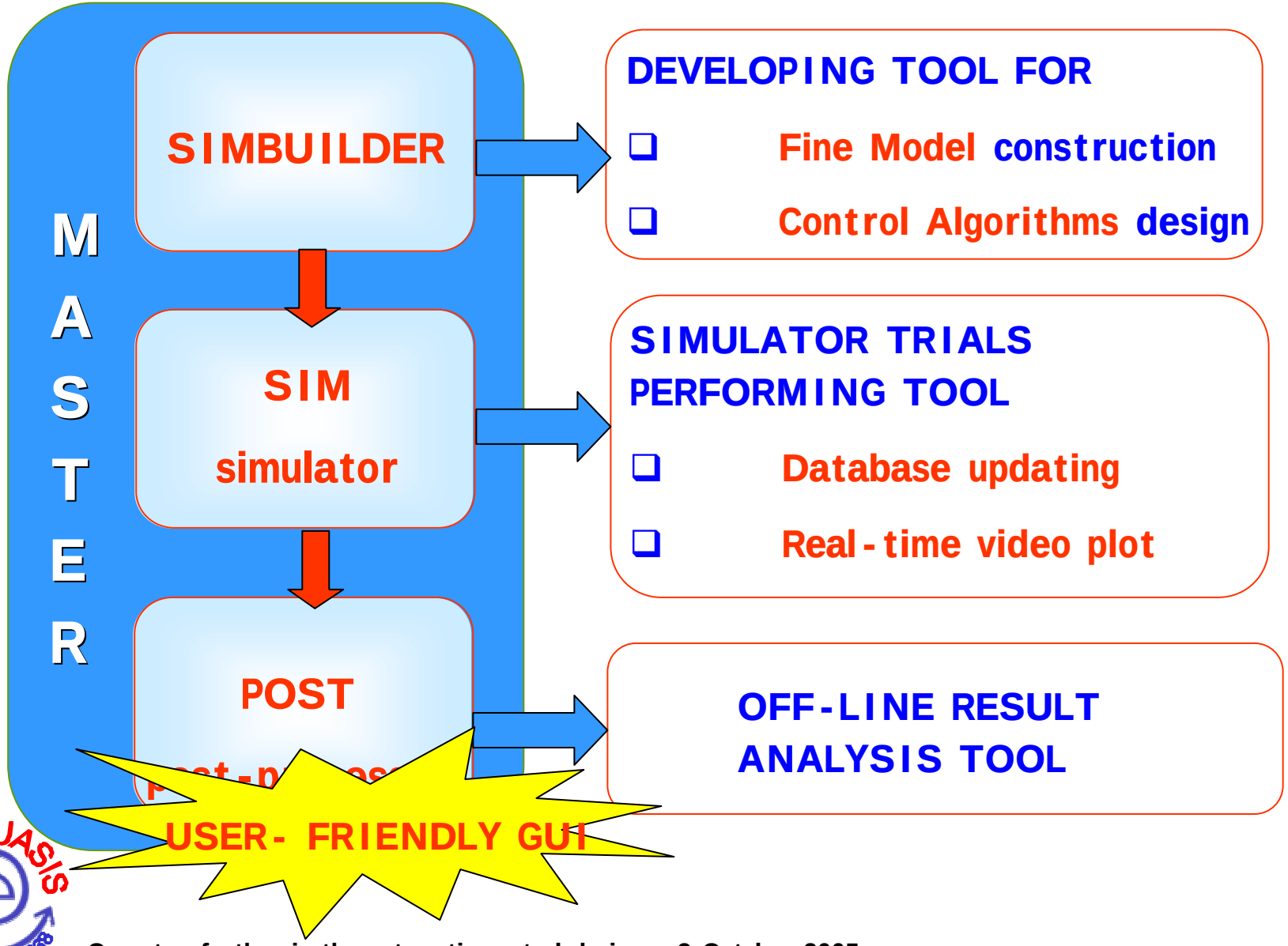
The use of the software envisages 3 different PHASES OF WORK:

THE PROGRAMMING → It allows to program your project

THE PERFORMANCE → It allows the performance of simulation trials

The POST-PROCESSOR → It allows the analysis off-line of the simulation trials

EICASLAB: The functional architecture

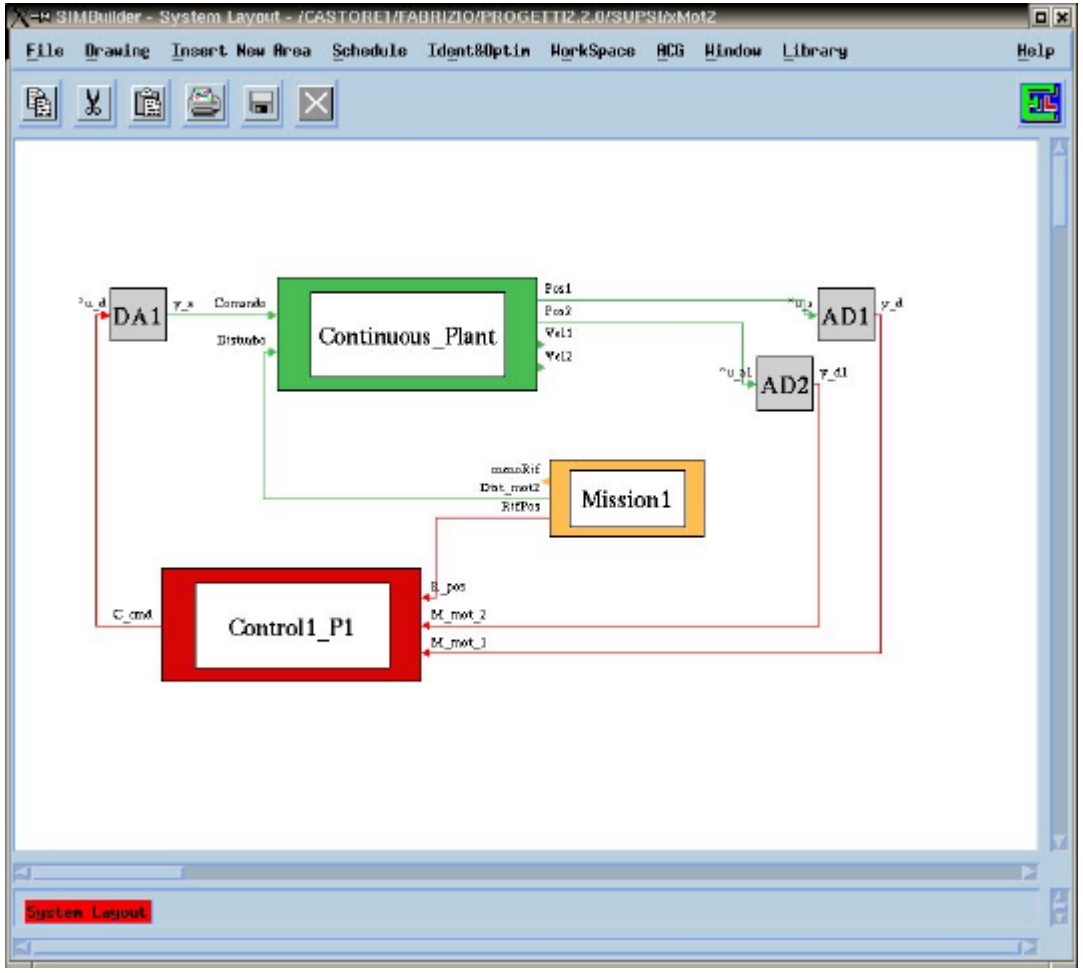


The functional architecture: the SIMBUILDER

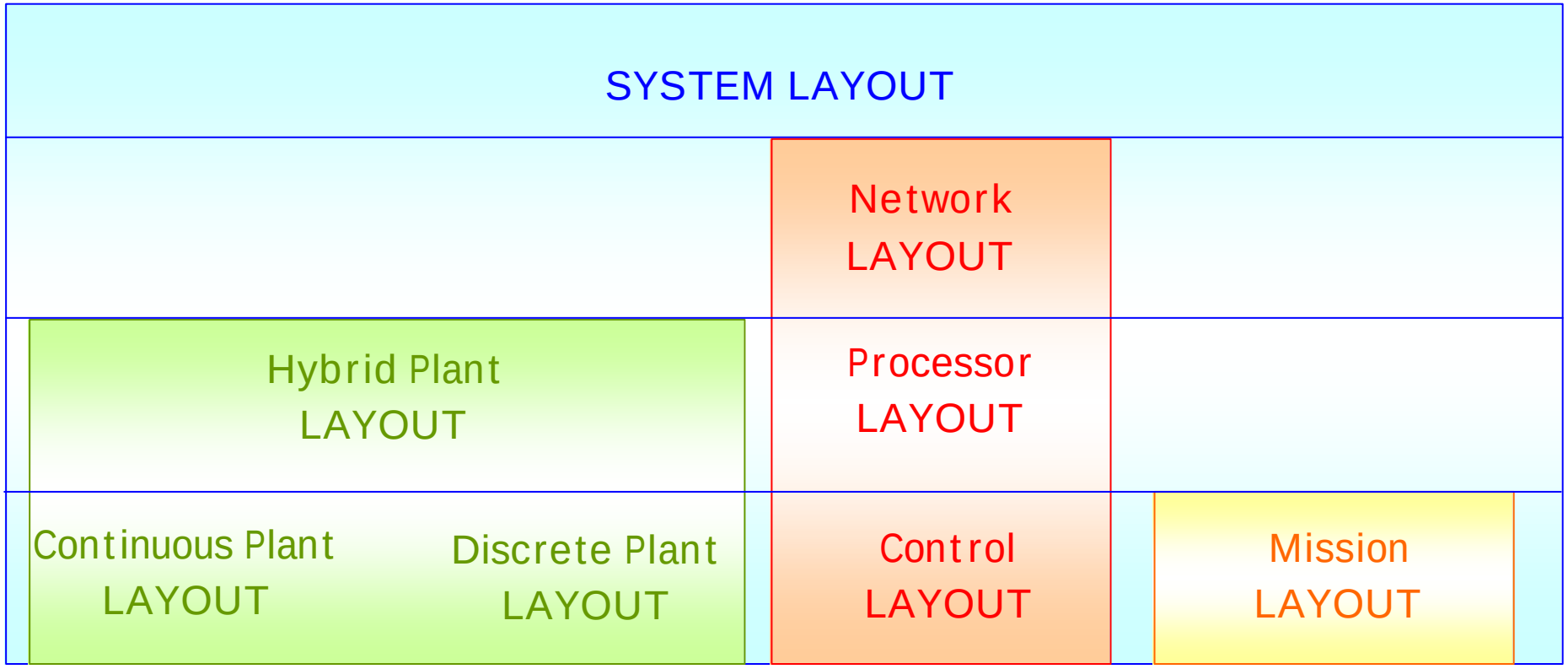
THE GRAPHICAL LAYOUT CONCEPT

The graphical layout is oriented and dedicated to develop the following specific parts of your Project:

- PLANT AREA:
- CONTROL AREA
- MISSION AREA



THE LAYOUT HIERARCHICAL ARCHITECTURE: THE 4 LEVELS



PLANT AREA **CONTROL AREA** **MISSION AREA**

The functional architecture: the SIMBUILDER

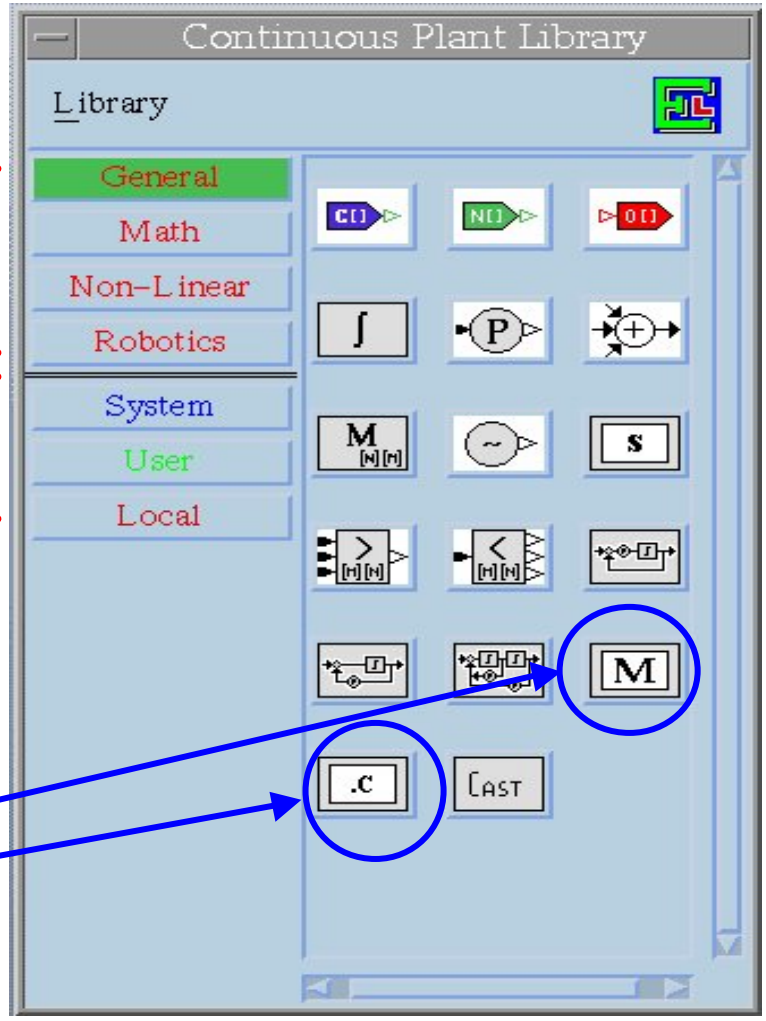
THE BLOCK LIBRARY

It is oriented to the specific layout

SYSTEM LIBRARIES

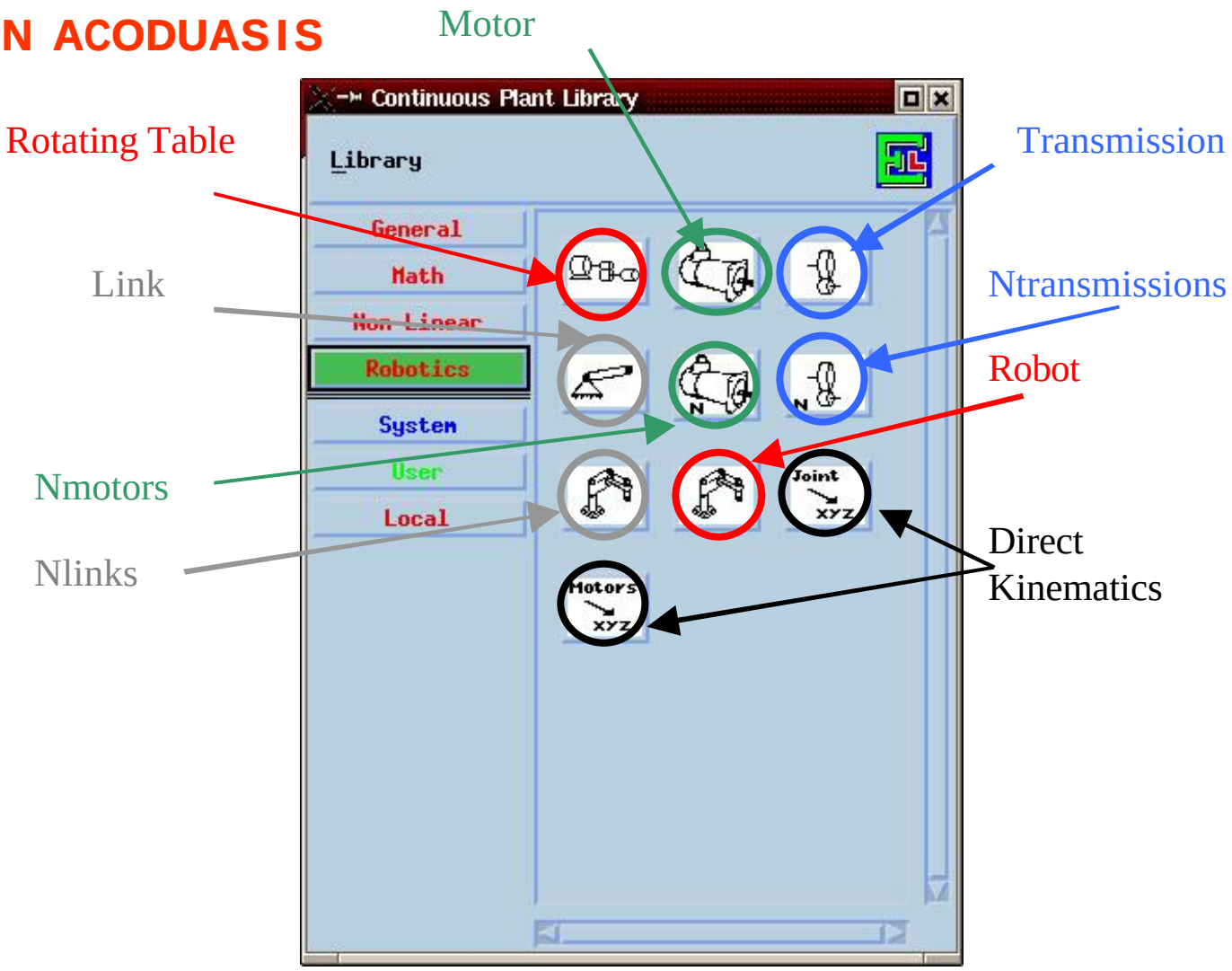
USER LIBRARIES
- SYSTEM
- USER
- LOCAL

The macroblocks
- Graphical
- C



The functional architecture: the SIMBUILDER

THE ROBOTIC LIBRARY DEVELOPED IN ACODUASIS



The functional architecture: the SIMBUILDER

THE PLANT AREA FEATURES

PROGRAMMING BLOCKS

- Continuous Plant
- Discrete Plant
- Experimental Data
- General Hybrid Plant

PROGRAMMING MODE

- Graphic
- C language

Availability of:

- ✓ Libraries oriented to the Fine Model construction
- ✓ Linking with pre-existing projects/code

The functional architecture: the SIMBUILDER

THE CONTROL AREA FEATURES

PROGRAMMING BLOCKS

- Processors
  - one or more control functions
- Network of Processors

PROGRAMMING MODE

- Graphic
- C language
- **AUTOMATED ALGORITHM GENERATION (AAG)**

OPTIMISATION TOOLS FOR:

- IDENTIFICATION OF THE MODEL PARAMETERS
- OPTIMISATION OF THE CONTROL PARAMETERS

CONTROL SOFTWARE CODE FOR THE MICROCONTROLLER

The functional architecture: the SIMBUILDER

THE MISSION AREA FEATURES

PROGRAMMING BLOCKS

- Library
  - Step , Ramp, Sinus, Triangular, Rectangular, Saw-tooth, Stairs
  - Stochastic processes: WNoise, IWNoise, I2WNoise, Band Noise
- User

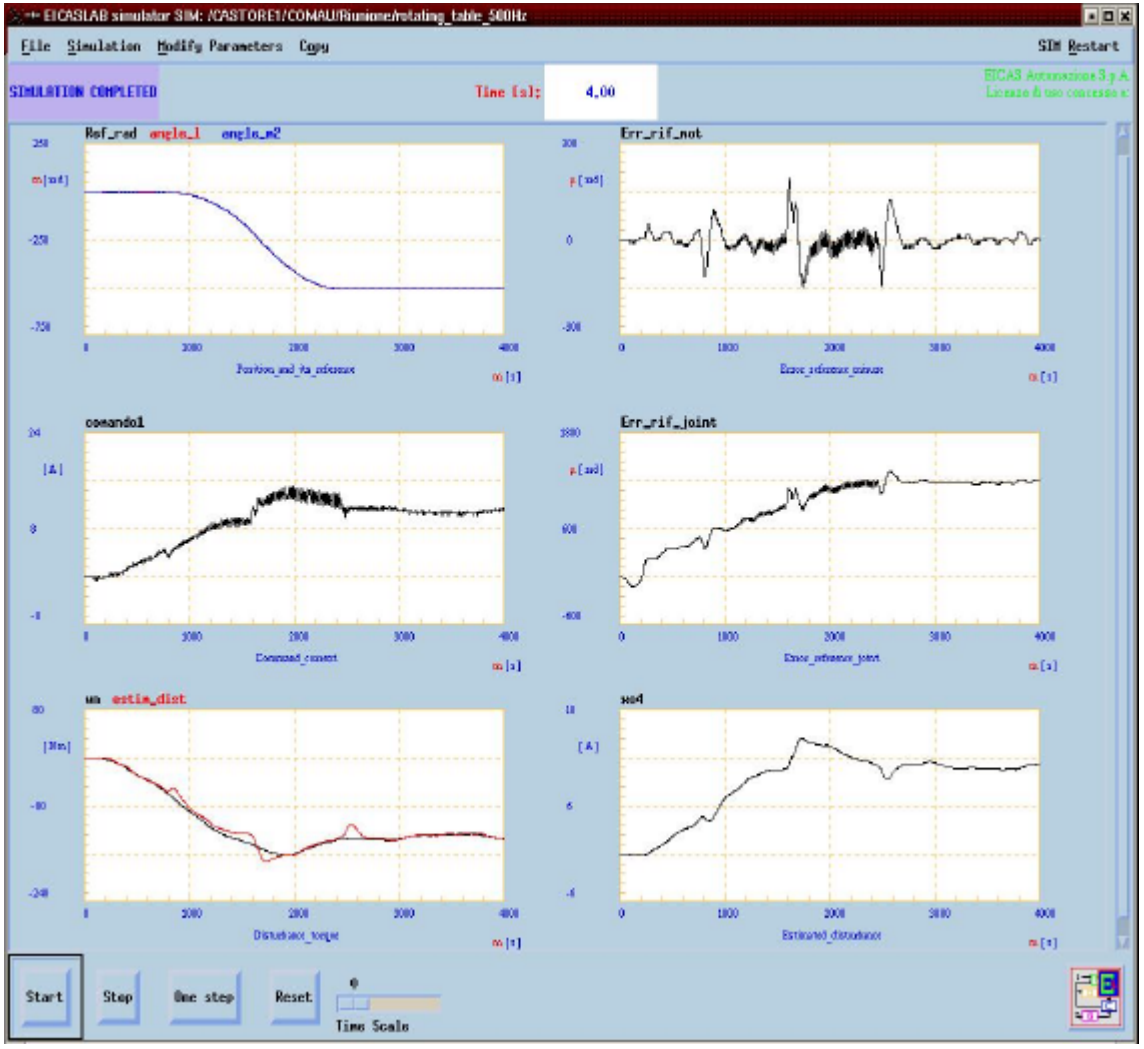
PROGRAMMING MODE

- Graphic
- C language

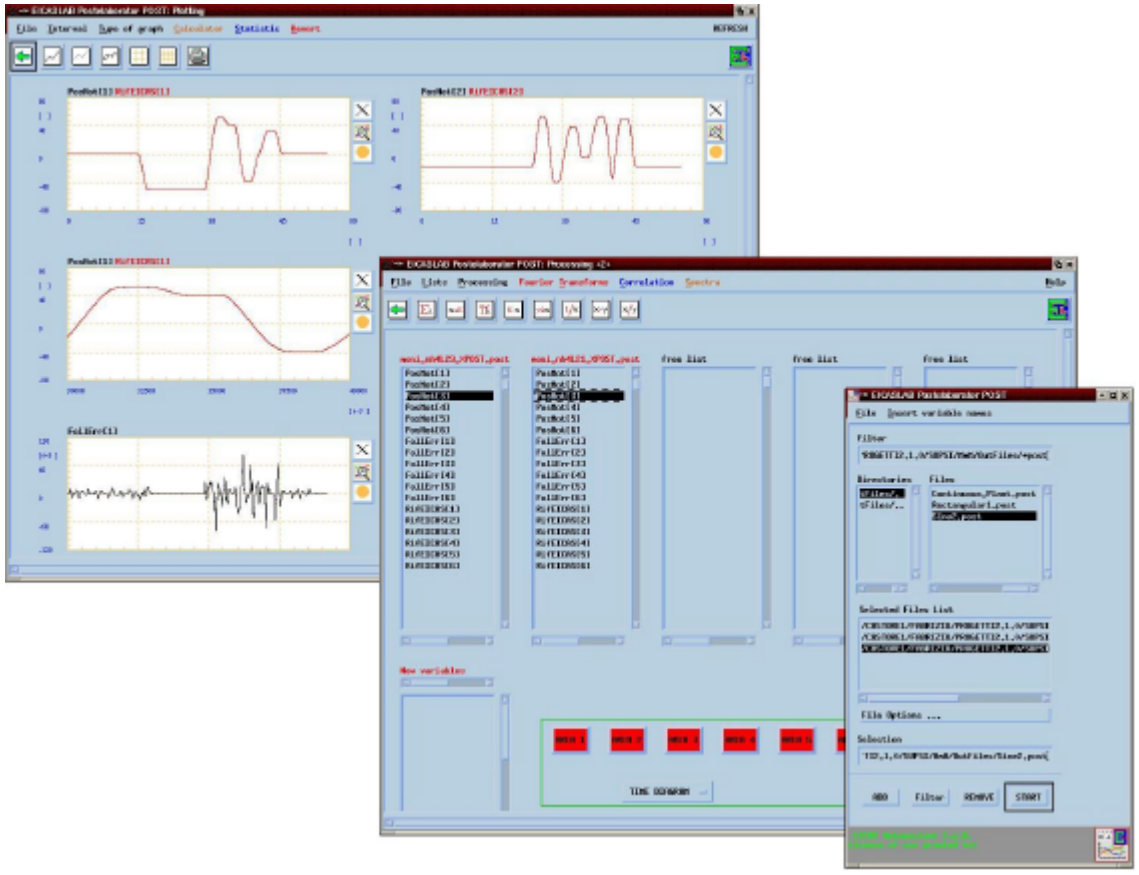
The functional architecture : THE SIM

BASIC AVAILABLE FUNCTIONALITIES

- Run the simulation trials
  - Visualize in real-time the variables
    - Modify the simulation parameters
      - Copy the final state over the initial state



The functional architecture: the POST

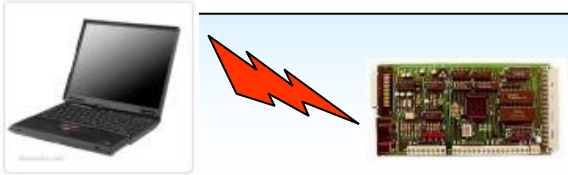


BASIC AVAILABLE FUNCTIONALITIES

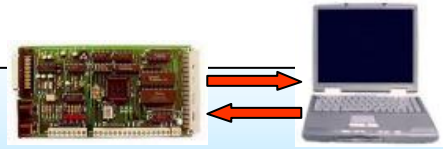
- Visualisation with phase or time diagrams of data stored during the simulation trials
- Data postprocessing
- Saving of new data created with POST on files
- Preparation and creation of files of graphics to be inserted in documents or printed.

EICASLAB: Activities in course of development

DOWNLOADING OF THE CODE ON MICROCONTROLLERS



HARDWARE-IN-THE-LOOP



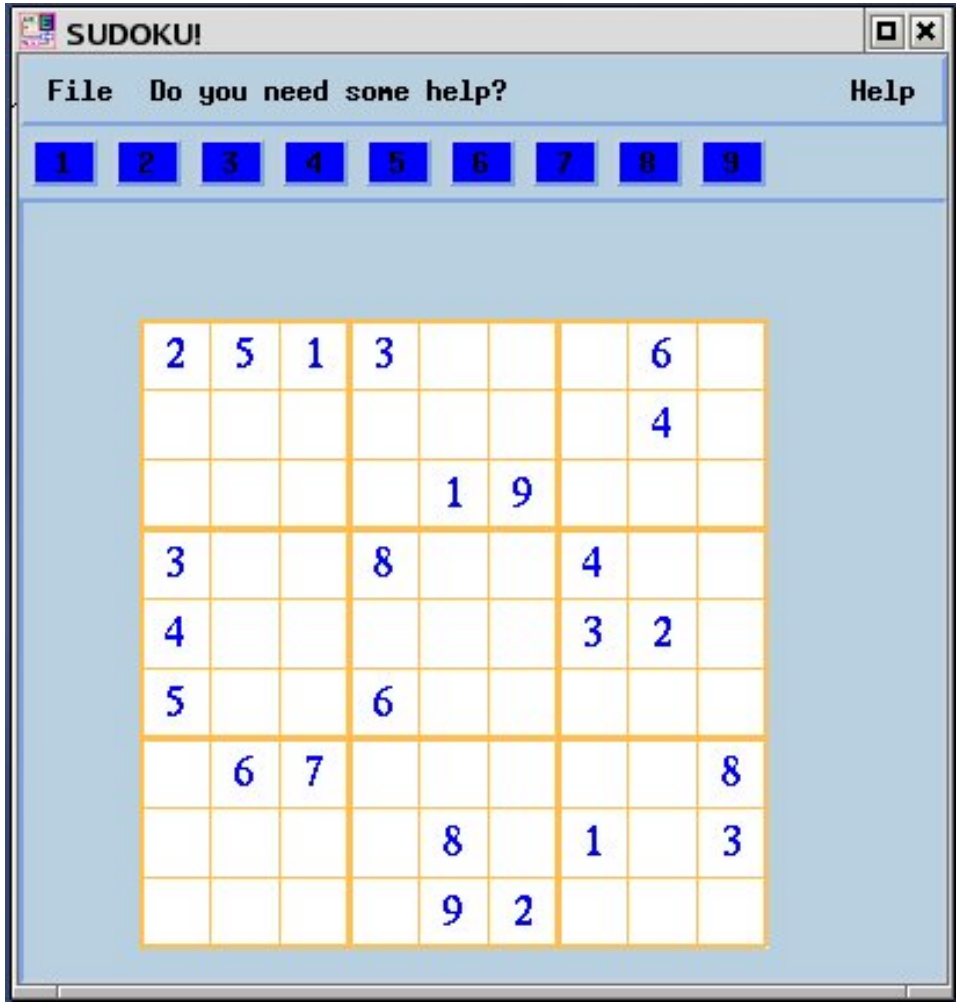
REAL-TIME RAPID PROTOTYPING

EICASLAB: MAJOR ADVANTAGES & BENEFITS

- TO AVOID THE NEED OF DEEP MATHEMATICAL KNOWLEDGE
- TO GIVE LARGER FREEDOM TO THE DESIGNER
- TO REDUCE THE TIME DEMANDED BY CONTROL ALGORITHM DESIGN
- TO REDUCE THE COSTS OF THE DESIGN
- TO DESIGN ONLY STARTING FROM PLANT DATASHEET
- NO SET-UP IN FIELD
- TO INCREASE THE PERFORMANCE EVEN IN COMPLEX CONTROL CASES

WHAT IS COMPLEX IN EICASLAB?

Do you want to find something complex in the use of EICASLAB?



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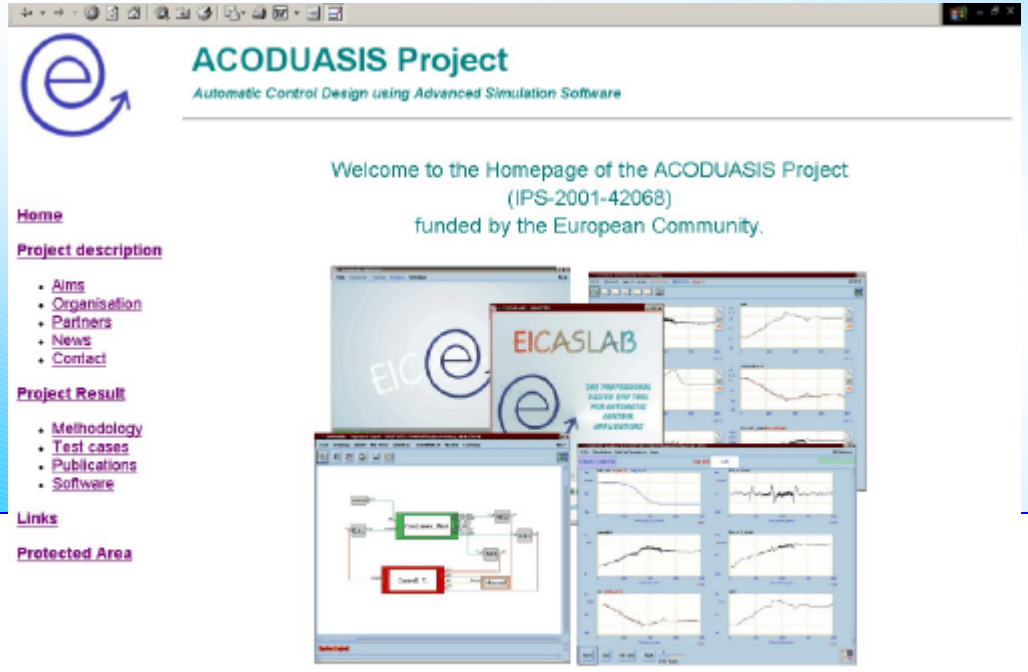
THANK YOU FOR YOUR ATTENTION!

For more information .....

ACODUASIS web-site
http://gate.fzi.de/ids/acoduasis/index.html



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