# EICASLAB™

*The professional software suite for automatic control design and forecasting*

## What is EICASLAB?

EICASLAB – the professional software suite for automatic control design and forecasting – represents an innovative approach to the design of automatic controls in several fields (e.g. robotics, aerospace, automotive, machine tools, special purpose machines...).

EICASLAB supports the automation of industrial processes through powerful tools for modelling plants, designing and testing embedded control system architectures.

EICASLAB assists all the phases of the control design process: from system concept to generation of the code to be transferred in the final target.

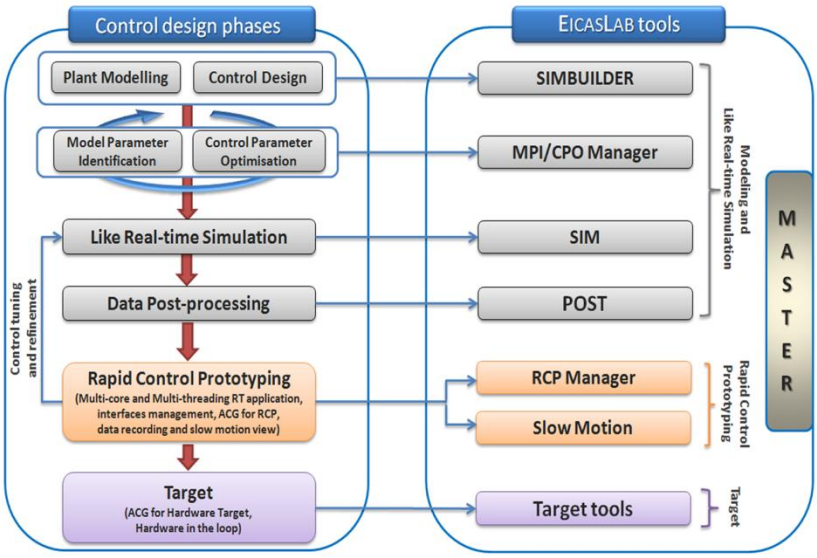
EICASLAB drives you step-by-step in the control design process, offering a specific professional support for the following three phases of work:

- Modelling and Like Real-time Simulation;
- Rapid Control Prototyping;
- Code generation for the final target.

Automatic Algorithm & Code Generation, management of multi-processor architectures and multi-level hierarchical controls, Rapid Control Prototyping and Hardware In the Loop are part of the overall capabilities offered by the EICASLAB suite. All you need is integrated in just one suite.


## How can EICASLAB help you?

EICASLAB covers all phases of the design process. For each phase, specific tools are available with many features and utilities able to support you.





## Benefits

**No need for deep mathematical knowledge.**
EICASLAB is easy to use and does not require specific know-how on mathematical knowledge. The module *Automatic Algorithm Generation* is especially conceived for supporting the development of complex computations.

**Minimise the time needed to develop the control algorithm.**
EICASLAB provides functionalities and in particular *Automatic Algorithm Generation* techniques, which reduce the time necessary to develop the control system, when compared to standard control design techniques.

**Reduce costs of the control design.**
EICASLAB enables to improve the performance of your machine and to reduce the time-to-market, with tangible advantages in term of costs/benefits.

**Design only starting from plant datasheet.**
With EICASLAB the control design is only executed starting from the plant datasheet with guaranteed performance.

**No set-up in field.**
EICASLAB offers the functionality to tune and assess the control performance. In combination with the EICAS control design methodology - supported by strong theoretical fundamentals - EICASLAB offers guaranteed performance without the need of an experimental set-up in field.

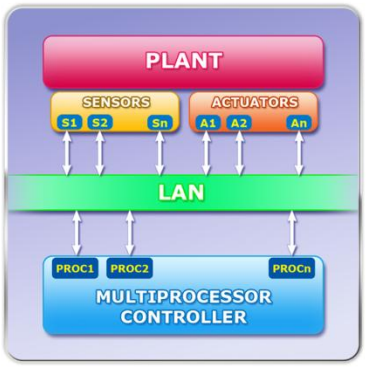
**Larger Freedom for the Designer.**
With the support of EICASLAB the designer is allowed to focus on engineering aspects of the project, like the sensor and actuator selection, the system architecture design etc.

**Increase performance also in complex control cases.**
The innovative technology of EICASLAB provides for better performance than the one reached by using traditional control techniques.

# EICASLAB™ ADVANCED FEATURES

## Multi-processor Architecture

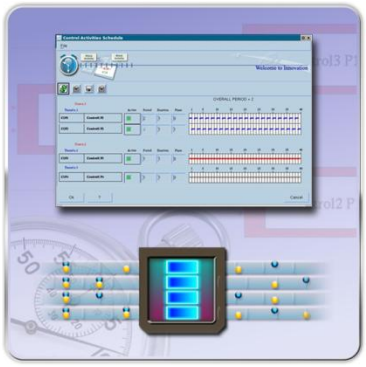
EICASLAB complies with different hardware architectures, including multi-processor and multi-level hierarchical controls. The control software is subdivided into functions, which the designer can allocate to different processors. Each control function has its own sampling frequency, phase and duration.




System Design

## Real-time Scheduling

EICASLAB is based on time scheduling algorithms for managing multi-processor and multi-level hierarchical control architectures at any level of complexity. The core of the time scheduling algorithms is the EICASLAB scheduler that defines the order of the operations to be executed in both **Like Real-time Simulation** and **Rapid Control Prototyping** phases.



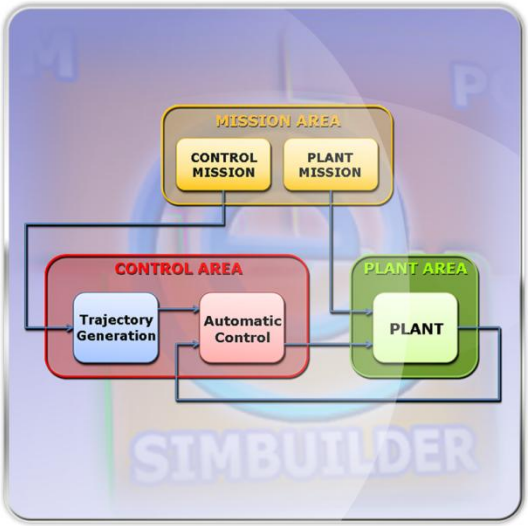
System Design

## Pre-organised Working Areas

EICASLAB is an environment where the designer can develop, optimize and test all the algorithms and software related to the "plant controller", including both the "automatic control" and the "trajectory generation".

To perform such a task, EICASLAB offers the following three pre-organised working areas:

- the Plant Area, devoted to model the plant to be controlled;
- the Control Area, devoted to implement the overall control algorithms;
- the Mission Area composed by two parts, respectively:




  - the Plant Mission devoted to generate the disturbances acting on the plant;
  - the Control Mission devoted to generate the references of the highest hierarchical level for the control.

For assuring a professional approach to the system modelling, every Working Area is associated to a set of graphical layouts each one equipped with a specific and oriented library fully customizable by the user.

System Simulation

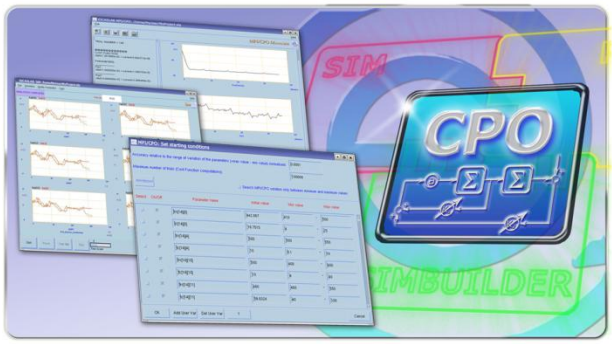
## MPI: Model Parameter Identification

The EICASLAB MPI supports the plant modelling. It allows obtaining the most appropriate values of the model parameters from experimental data acquired on field. The MPI is based on an EICAS proprietary numerical algorithm (a variant of the "conjugate gradient" method) that works by minimising the cost function of the model error defined by the user.


Control Design

## CPO: Control Parameter Optimization

The EICASLAB CPO helps tuning the control parameters. As the MPI, the CPO is based on an EICAS proprietary numerical algorithm that works by minimising the cost function of the control error. The user has to define the variables to be optimised, the cost function and the trial in which the optimisation should be performed.




Control Design

# EICASLAB™ ADVANCED FEATURES

## AAG: Automatic Algorithm Generation

The EICASLAB AAG is specifically oriented to implement the EICAS control design methodology. Starting from the control system requirements and from a simplified model of the plant to be controlled, EICASLAB AAG automatically generates the code of the whole control algorithm. The EICAS methodology gives a specific relevance to the plant state observer (whose task is extended to predict also the disturbances acting on the plant) and to the reference generator (used for computing the open-loop action). The control is then performed by the resultant of three actions: the open-loop action, the plant disturbance compensation and the classical closed-loop action.


Control Design

## ACG: Automatic Code Generation

The code for implementing your algorithms in a microprocessor architecture is composed by Application Software (AS) - target independent - and Basic Software (BS) - target dependent. EICASLAB offers Automatic Code Generation (ACG) modules to generate the Application Software of the designed control algorithm and - if required - the Basic Software for both Rapid Control Prototyping purposes and specific Hardware Targets. The ACG for Rapid Control Prototyping supports the Linux RTAI and Linux with RT-Preempt patch real-time operating systems.


Code Generator

## RCP: Rapid Control Prototyping

The final goal of EICASLAB consists in generating the real-time software code to be transferred in the final hardware network of targets that will pilot the plant to be controlled.

To test and validate the overall real-time software code, before transferring it in the final target, EICASLAB offers a powerful **ACG Rapid Control Prototyping Module**, based on a **Real-Time Scheduler**, **Multi-core** and **Multi-threading programming techniques**, that - starting from the control system architecture designed in EICASLAB – is able to generate a special real-time software code (AS + BS) to be transferred on a **PC with a Linux RTOS directly connectable to the plant to be controlled**.

Specifically the Rapid Control Prototyping module integrated in EICASLAB allows:

- to configure and manage the interfaces of the PC platform, offering fully customisable libraries of built-in interfaces and protocols;


- to configure the real-time scheduling of the overall control activities;
- to execute in real-time the RCP trial piloting the plant through a specific professional tool – the RCP Manager – including an easy and friendly GUI and offering capabilities for:
  - controlling and managing the RCP process in real-time;
  - enabling diagnostic reports aiming at warning of possible faults/problems arising during the RCP trial execution;
  - visualising on the screen the dynamic behaviour of the variables of interest for a real-time monitoring;
  - recording on the PC disk all the variables of your interest to be then post-analysed through the POST tool and/or used for performing the off-line repetition through the Slow Motion tool;
  - interacting in real-time with your control by commanding and modifying parameters.

Control Tuning

## Slow Motion

The EICASLAB Slow Motion tool is typically used in combination with the RCP and allows the off-line repetition of experimental trials executed on field for advanced debugging and tuning purposes. Specifically, the Slow Motion tool:

- processes the plant I/O and the host commands data sent to the controller, recorded during the experimental trial (f.i. during the RCP process);
- runs the same control code executed on field, allowing the analysis (step-by-step and variable-by-variable) of the control software performance.

Control Tuning

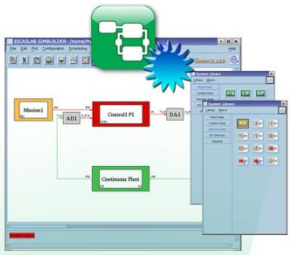
## Hardware In the Loop

Once the control software code is installed in the final Hardware Target (ACG for specific Hardware Targets), the Hardware In the Loop (HIL) tests may be performed, consisting in piloting – instead of the actual plant - the plant simulated in EICASLAB and running on your PC, suitable configured and connected through the necessary hardware interfaces with the final Hardware Target.

Control Tuning

# EICASLAB™ HELPS YOU DESIGN & CONTROL

SIMBUILDER

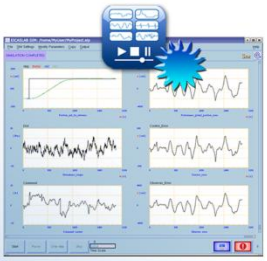


System Design Tool

MASTER

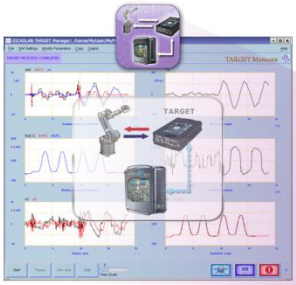

EICASLAB Tools Manager

SIM



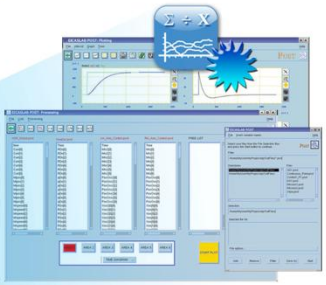
"Like Real-Time" Simulation Tool

TARGET MANAGER




Target Manager Tool

POST

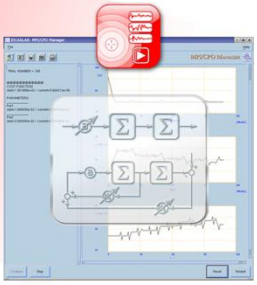


Post-processing Analysis Tool


HIL MANAGER


Hardware In the Loop Manager Tool

MPI/CPO MANAGER

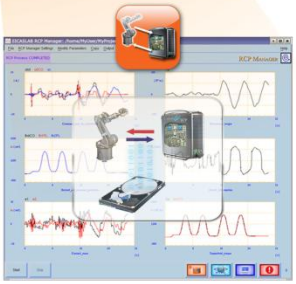


Identification/Optimisation Tool

SLOW MOTION

Slow Motion View

RCP MANAGER



Rapid Control Prototyping Manager Tool

EICASLAB BASE

## System Requirements

Linux: any distribution, kernel 2.6.x or later
Microsoft Windows: XP, 7, 8, 10

x86 processor architecture
1Gb RAM
1Gb disk space

## EICASLAB™ Licenses


EICASLAB is available in three licenses, fully customizable:

*Commercial License*
*Academic License*
*Student License*

excellence and passion in automatic control design

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