Servo systems and Process control

ERD xxx 800 : D_Scil

AUTOMATIC GENERATOR OF REAL TIME CORRECTOR

D_Scil is a software module for the automatic generation of code based on a set of functioning diagram blocks defined and simulated with **Scilab/Xcos®**. It can be implemented in a servo system, and compares dynamic simulated and real results.
D_Scil is the result of a collaboration between Scilab-entreprises® and Didalab.

Pedagogical purpose :

- **Identifying the system in open loop** (Time constant, static gain, order of the system.. on ERD100S, ERD150S, ERD004S…),
- **Modeling and simulating with Xcos** the process in Open Loop,
- **Validating the model** by comparing the results « simulation/reality»,
- **Creating an adapted corrector** (P, PID, RST, fuzzy logic, neuronal…), simulating the closed loop system,
- **Generating the real time corrector** and implementing in the target,
- **Comparing and validating the results** of the simulation and the experiments of the process in closed loop.

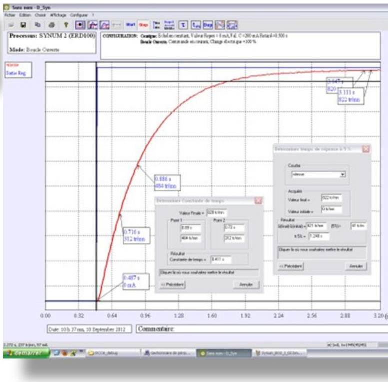
Target curricula :

Level 2 : Bachelor degree ; **Level 3 :** Bachelor and Master degrees, Engineer school

Description of the chapter :

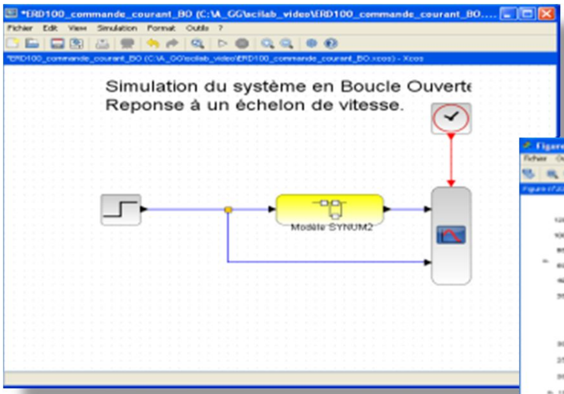
D_Scil places the student in a very realistic development context of an industrial R&D office.
The following paragraphs show the chronological steps of the implementation of D_Scil module.
These presentations are based on Synum2 (ERD100), but they can be implemented on each of the operating units listed at the end of this document.
For more information, you can see the demonstration video on our website in the chapter : Electrical Engineering/Servo & process control/quick prototyping.

1 - Identification in open loop of the real process

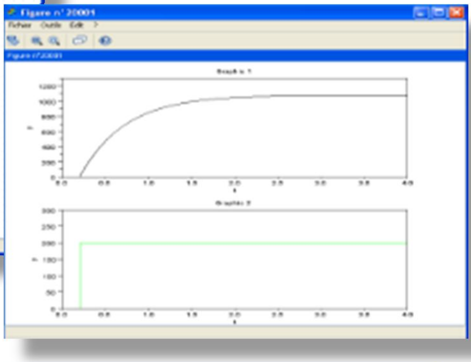


The first thing to do is to find : static gain, time constant, dominant order. With the software integrated in the system (D_CCA), you can test in open loop and find the time constant easily.
Static gain :∞=3,05
System with a first dominant order of this kind:

$$\frac{N(p)}{Sr(p)} = \frac{\infty}{1+\tau p'} \; ; \tau \cong 0{,}32s$$

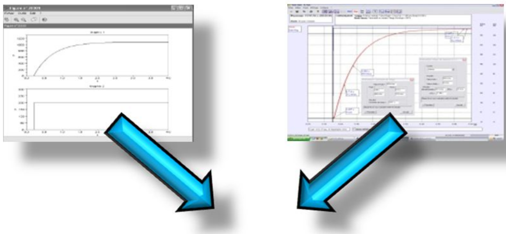


Creating the model in open loop with Scilab/Xcos module and implementing the measured values in the phase n°1 (Identification).

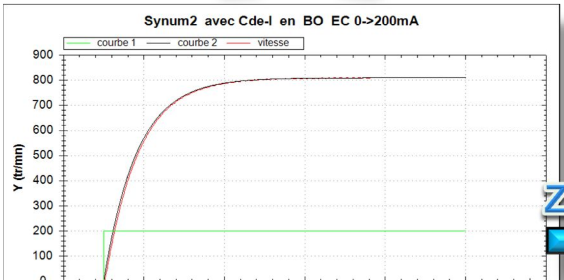


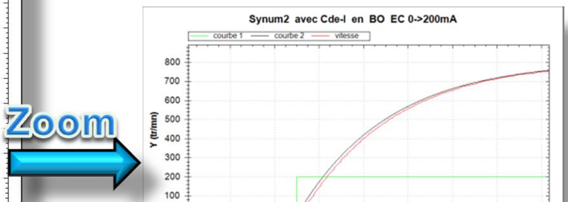
With Xcos, you can then launch the simulation and draw the dynamic response curve of the system with a se value.

3 -Validation of the process model in open loop



Verification by comparing the time results of the simulation and the experiment.
With D_Scil, you can import the curves of the time results of the experiment in open loop with the real system and the results of the simulation in order to proceed to the comparison and then validation the model in open loop.





With a **zoom** on the axis, you can put int evidence a gap in th modelisation, (syster of the second order,

4 – Synthesis of the corrector & simulation of the closed loop process with Xcos

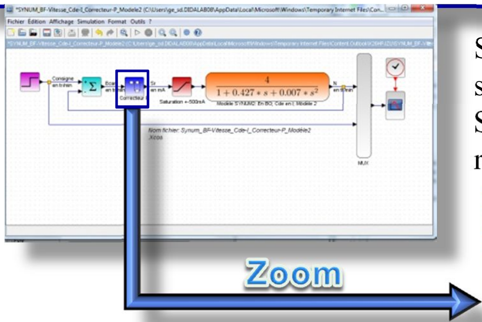
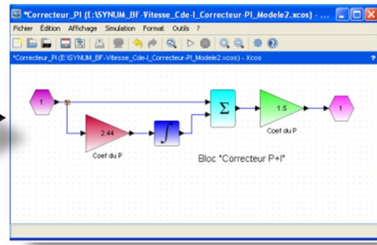
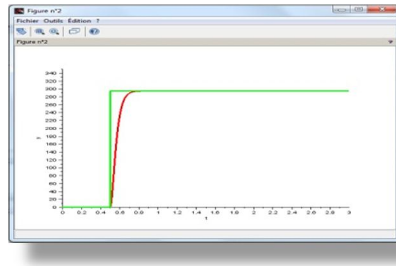


Diagram of the process in closed loop with PI corrector

Searching an appropriated corrector to the system : (P, PI, PID, RST, state return…). Creating and adjusting this corrector.
Simulating the process with its corrector and generating the time response curves in closed loop with Xcos.

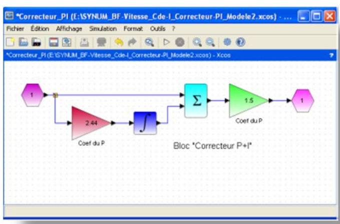


Zoom on the corrector



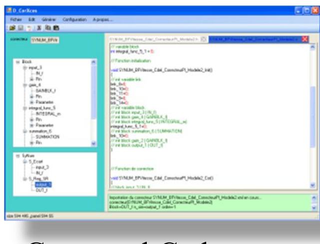
Result of the dynamic simulation of the system in closed loop

5 - Generation & implementation of the corrector

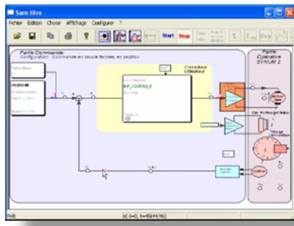


Corrector with Xcos

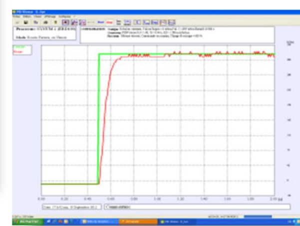
Transfering the corrector studied with D_Scil, generating the real time code corresponding to this corrector.
Implmenting the corrector in Didalab automatic engineering environment (D_CCA), recovery of the time curves of the closed loop system.



Generated Code

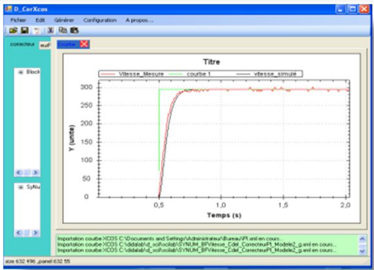


Implemented Code in D_CCA



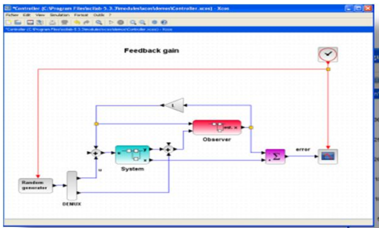
Result of the experiment with Synum2

6 – Model validation by comparing diagrams

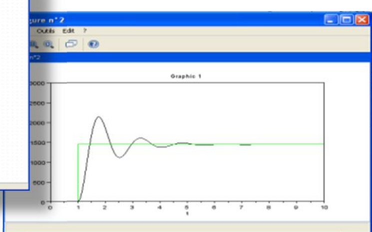


Validating the corrector by comparing of the results of the simulation and the experiment, and if necessary, adjusting the corrector, or searching another corrector with Scilab.

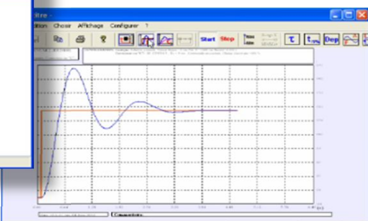
Further examples

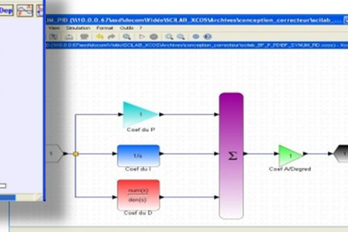


Corrector with feedback



Simulated curve with PI corrector with overflow

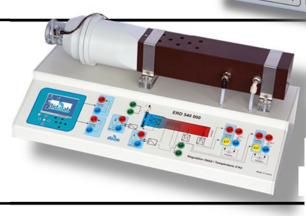




Real response with PI

Different versions of D_Scil :

There are many different versions of **D_Scil** in order to answer to the needs of training and research in the autom
engineering, process control and power electronics
See below the list of available versions.

ERD xxx 800, D_Scil Automatic generation of real time corrector:			
Description	Complete package	Optional (alone)	Equipment
Synum3, Analogue and digital Speed and position servo-system: High quality DC motor, adjustable dry and fluid frictions, current or voltage control…	**ERD100S**	**ERD100800**	
Axnum, Servo controlled digital axis: Industrial axis with reducing gear, voltage/ current control, travel ends control, emergency stop…	**ERD150S**	**ERD150800**	
Process Control **Air flow and temperature process control**, distrubances of the flow and the heating power…	**ERD540S**	**ERD540800**	
Process Control : **Water level and flow process control,** pure delay, disturbances on the flow and on the level… 1 or 2 columns	**ERD551S** **ERD552S**	**ERD550800**	
Air presure process control: Pressure process control with built-in control and acquisition, 1000 cm³ experiment tank, disturbance by leak, display manometer, proportionnel electrovalve for filling…	**ERD560S**	**ERD560800**	
Chopper and 1-phase and 3-phase inverter : Chopper: serial, 1, 2 or 4 quadrants, overfitted double serial, 1-phase inverter: full wave, PWM, +E/-E, +E/0/-E, 3-phase inverter: full wave, PWM, +E/-E, +E/0/-E, Evacuation branch for the braking energy, Securities, temperature probe, control of the motor excitation, short-circuits…	**EP660S**	**EP660800**	
Development in progress: **Autonomous and smart robot** Practical works to come, Speed and position control, Search and preservation of balance, Calculation of trajectory, Recognition and speech synthesis, Wifi Communication , Energy c ontrol, Win CE embedded…	**ERD800S**	**ERD800800**