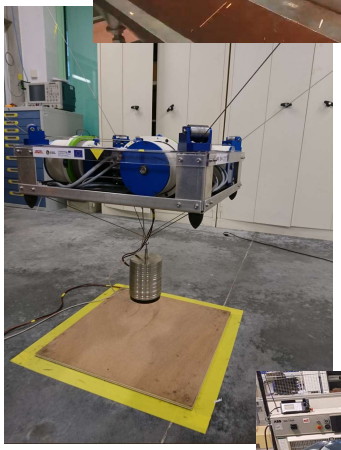

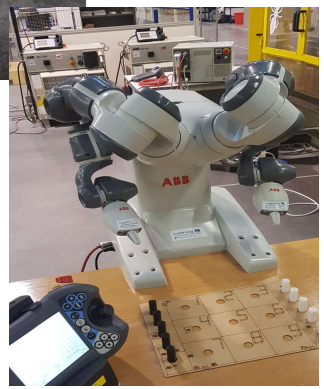

Robotic Assistance to Industrial Processes

Hybrid Force - Position Control of Cobot through External Port

Université de Lorraine
Laboratoire Conception Fabrication et Commande EA4495

Online, 29.04.2021

Agenda

1. Program
2. Robotic Assistance to Industrial Processes
3. Presentation of UC Birkenfeld
4. Robotics : Towards Programming by Demonstration
5. Workshop A: Calibration of a 2D Camera on a robot flange
6. Workshop B: Intelligent Robotic System for Solving Dissection Puzzle

Agenda

1	Program
2	Robotic Assistance to Industrial Processes
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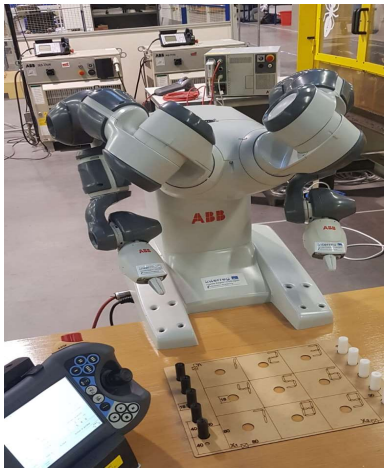
Program Robotix-Academy Roadshow 29/04/2021

Program		
9h00 – 9h15	Welcome	
9h15 – 10h15	**Robotic Assistance to Industrial Processes**	J-F ANTOINE; A. KUMAR; M. TAGHBALOUT; V. PAPOT; F. LEONARD
10h15 – 10h30	Coffee Break	
10h30 – 11h30	**Robotics : Towards Programming by Demonstration**	Robin PELLOIS
11h30 – 12h30	***Presentation n°3 (UC Birkenfeld)***	Sebastian GROSS
12h30 – 13h30	Lunch Break	
13h30 – 15h	**Workshop A: Calibration of a 2D Camera on a robot flange**	Ali KANSO
15h – 16h30	**Workshop B: Intelligent Robotic System for Solving Dissection Puzzle**	Ali KANSO
16h30	Closure	

Click here to join the Roadshow

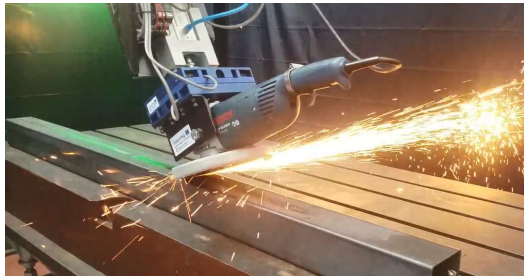
Agenda

Robotic Assistance to Industrial Processes



Hybrid Force - Position Control of Cobot through External Port

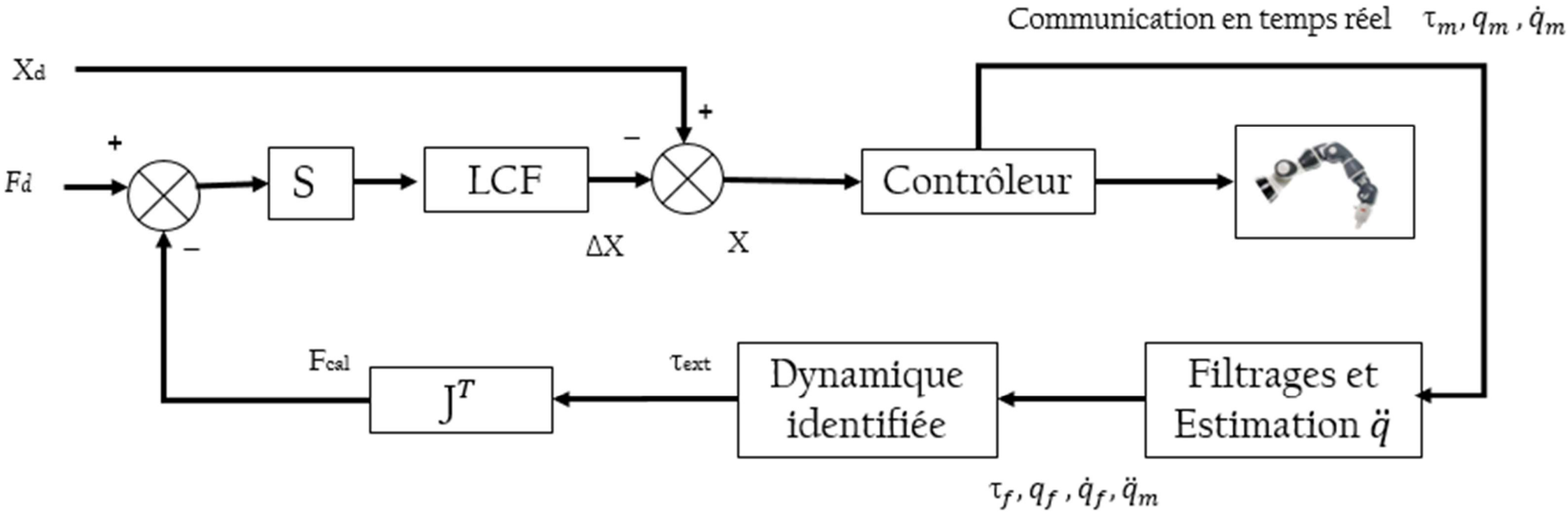
Cable Driven Parallel Robot for Agile part handling



Robotic Grinding of large casting part

Robotic Assistance to Industrial Processes

Hybrid Force - Position Control of Cobot through External Port

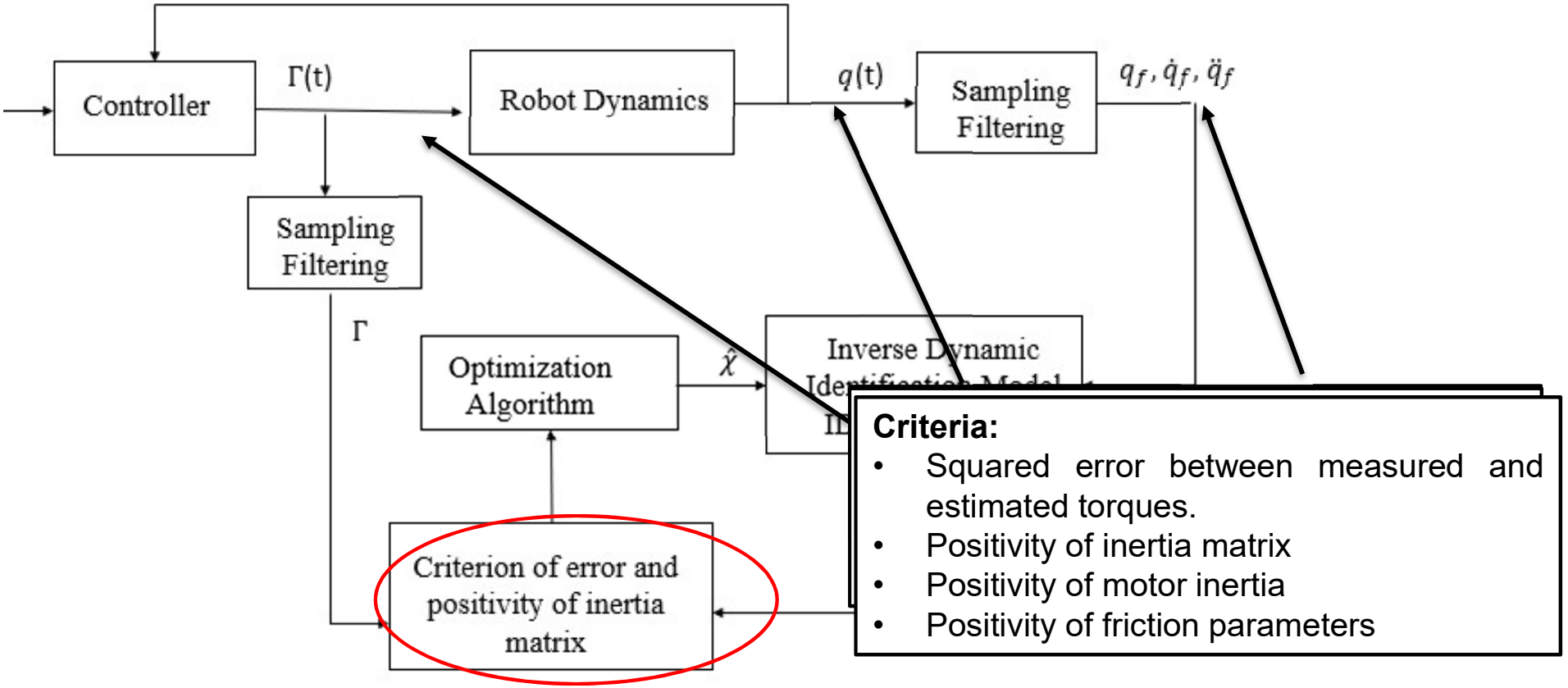


Proposed control diagram

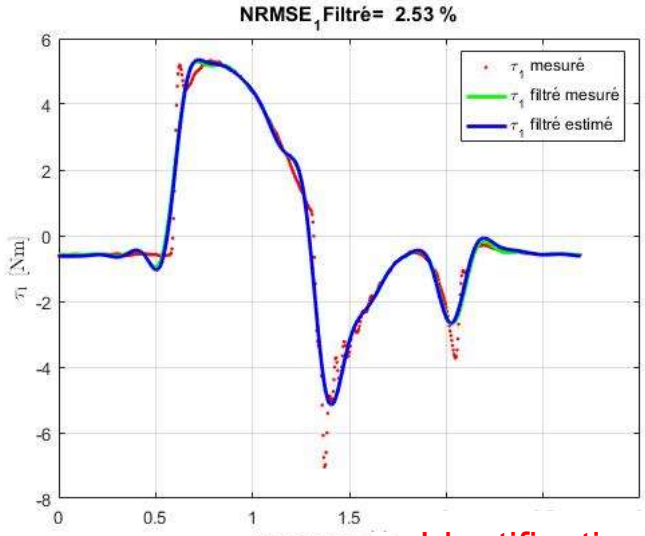
Robotic Assistance to Industrial Processes

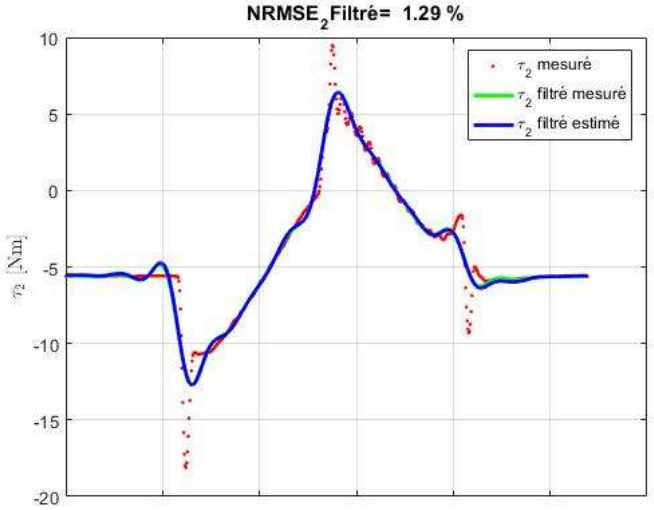
Hybrid Force - Position Control of Cobot through External Port

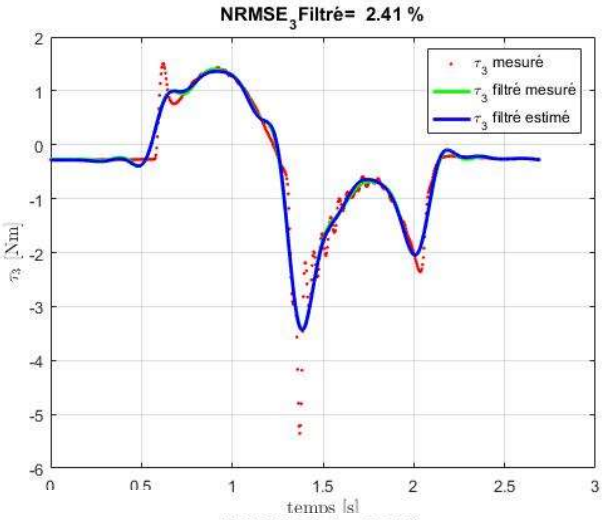
First step : Identification method with the parameter optimization algorithm



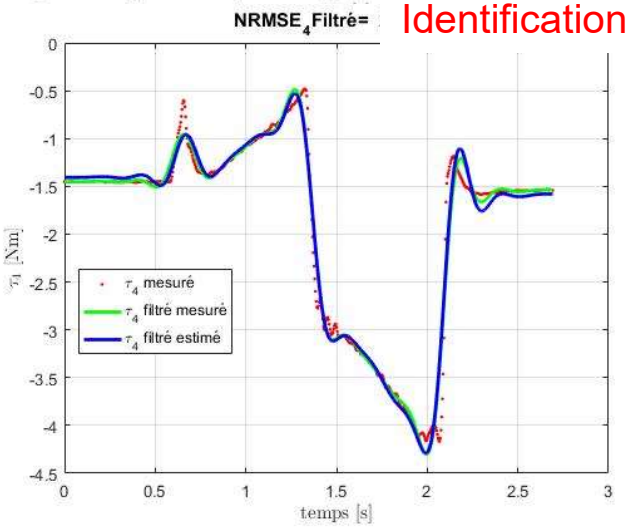
Robotic Assistance to Industrial Processes

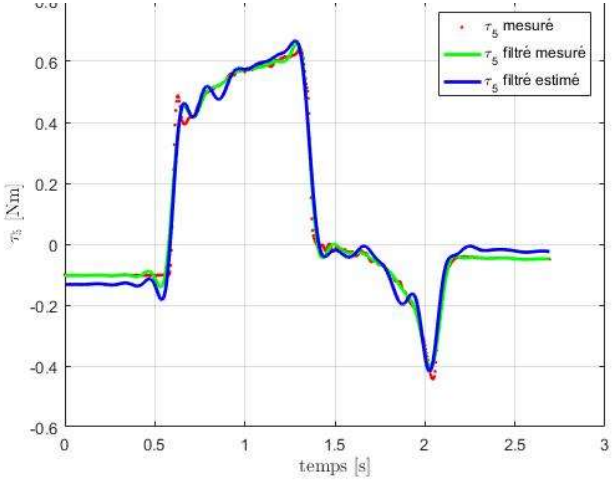


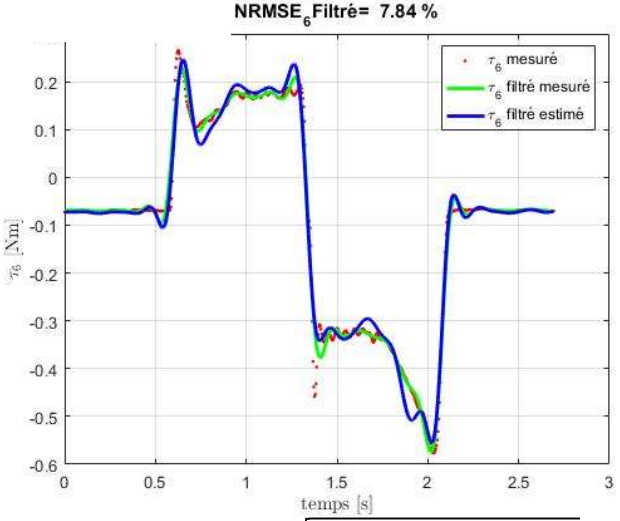




Identification of 57 parameters with a good % accuracy







Comparison of measured, filtered and estimated joint torques

with : $\boldsymbol{NRMSE} = \mathbf{100} * \sqrt{\sum_j \left(\left(\Gamma_{fj} - \Gamma_{ej} \right) / \Gamma_{fj} \right)^2}$

Hybrid Force - Position Control of Cobot through External Port

Second step : Effort measurement :

using dynamic robot modeling and identification we have :

$$\tau_{mot} = M\ddot{q} + H + \tau_{fric} + \tau_{ext}$$

therefore:

$$\tau_{ext} = \tau_{mot} - \tau_{inertia} - \tau_{Cori-cent-grav} - \tau_{fric}$$

In addition, we have:

$$F_{ext} = \left(J^{\mathrm{T}}\right)^{-1} \cdot \tau_{ext}$$

F_{ext} force and torque, applying to the end-effector
τ_{ext} the external torque corresponding to the 7 links.

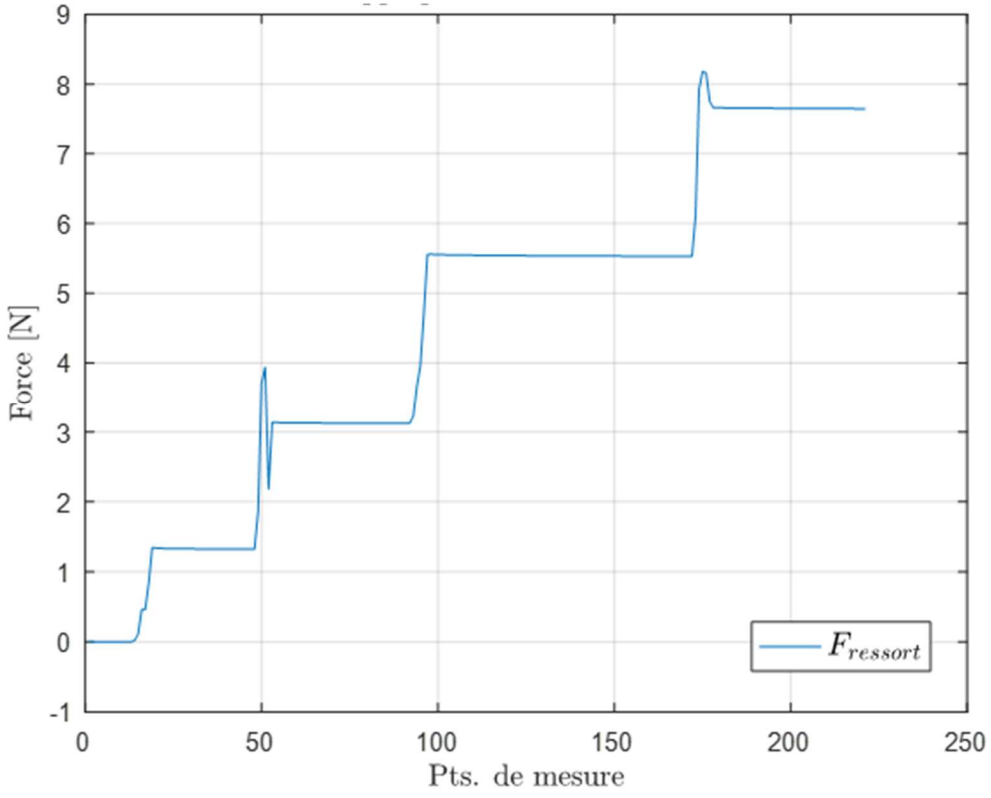
with :

$\tau_{inertia} = M(q) \cdot \ddot{q}$
$\tau_{Cori-cent-gra} = H$
q joint position
M: Inertia matrix
H: Centrifugal, Coriolis and Gravity torques
J : Jacobian

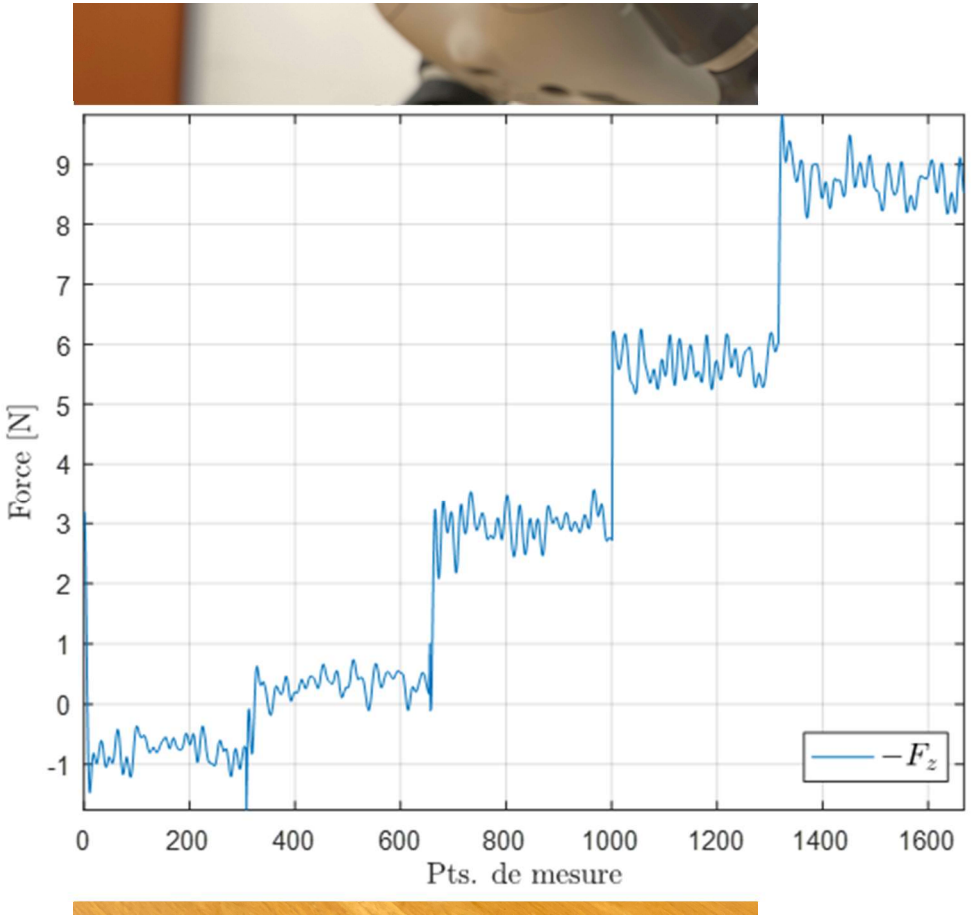
Robotic Assistance to Industrial Processes

Hybrid Force - Position Control of Cobot through External Port

Force calculation validation :



Forces applied on the spring along Z



Forces applied on the robot along Z

Robotic Assistance to Industrial Processes

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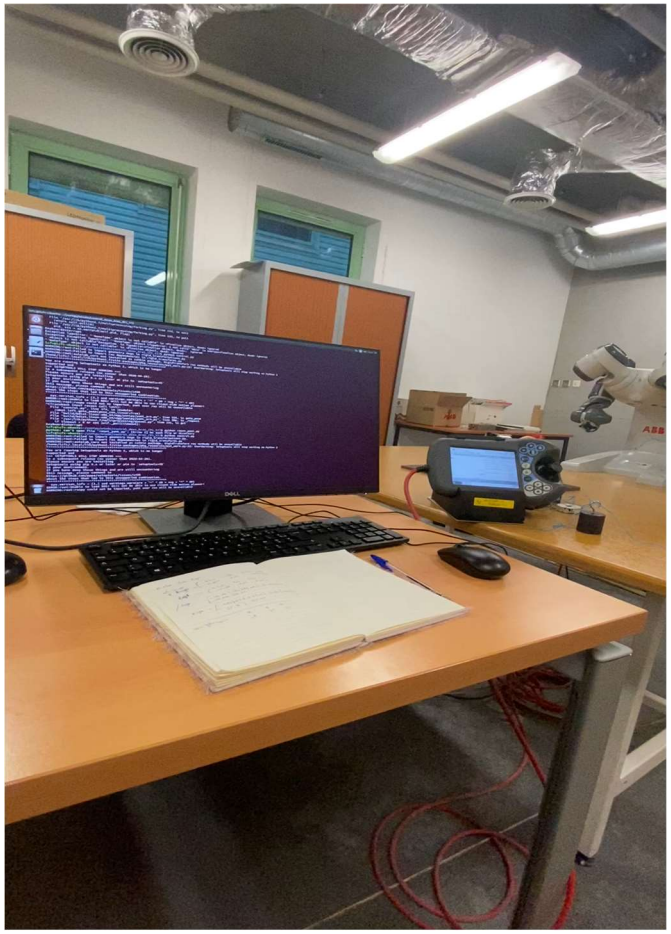

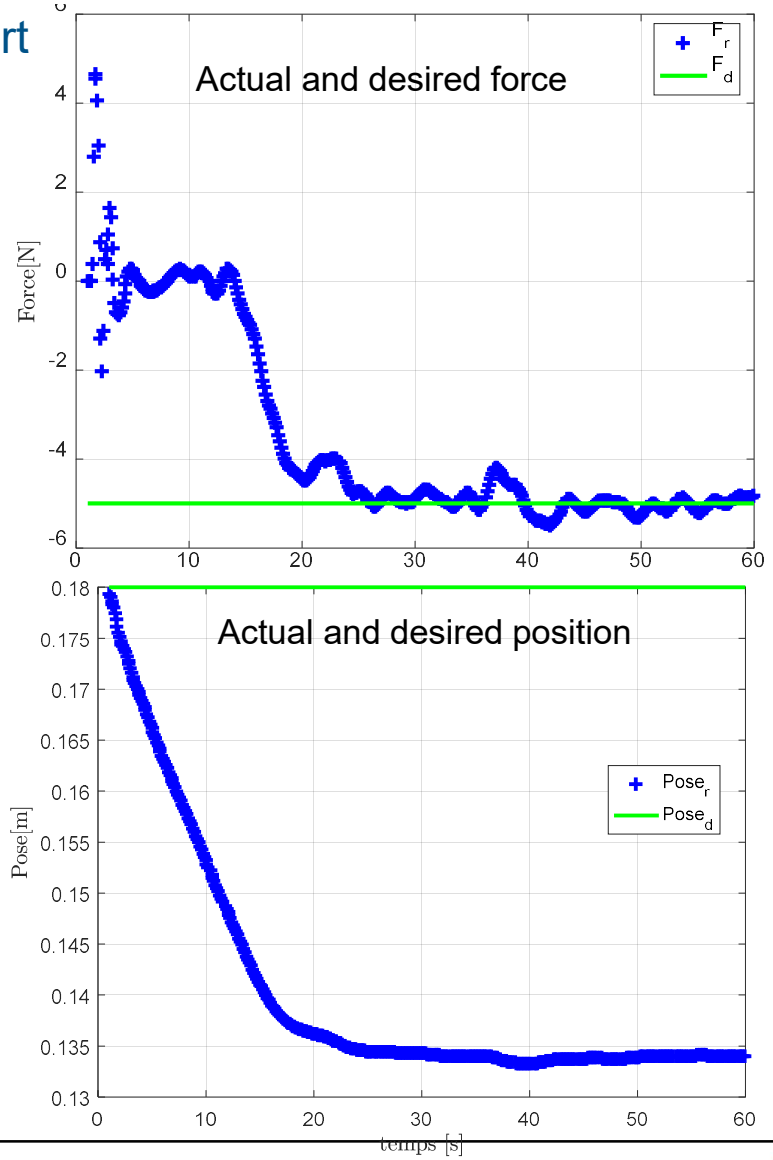

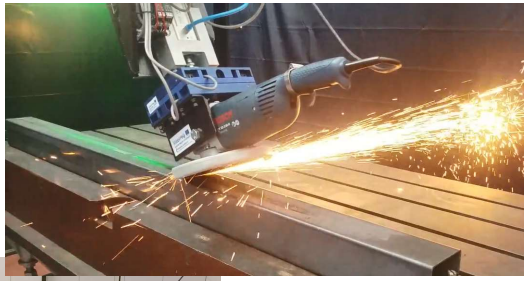

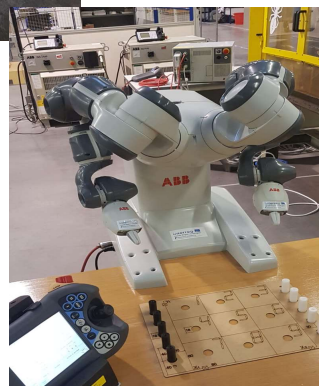

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