

BETA ARM

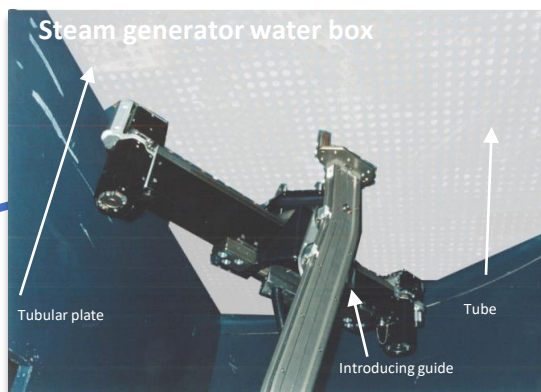
Based on a real system for teaching industrial engineering sciences

From the real BETA ARM

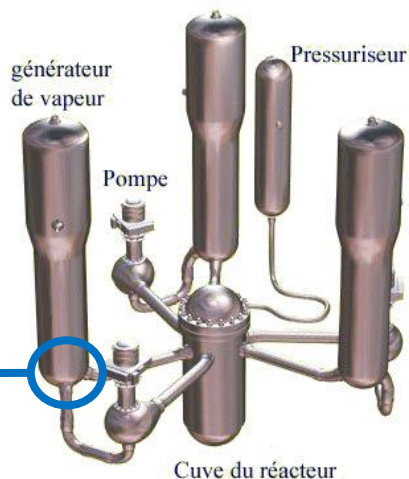
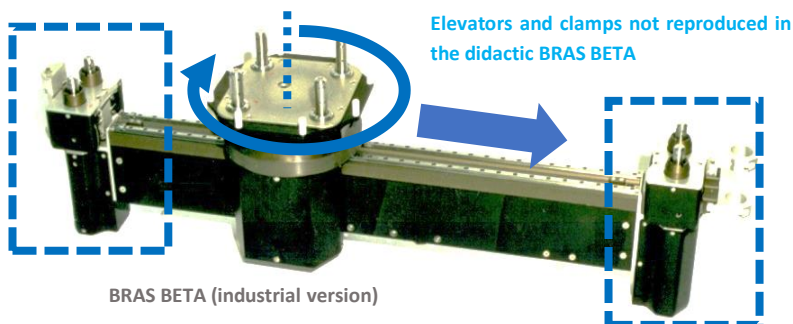
(Maintenance system for steam generator tubes in a nuclear power plant)

Field : Nuclear power plant maintenance

Functions : Eddy current testing of steam generator tubes in a nuclear power plant



BETA ARM in situation of introduction in the water box of a Steam Generator

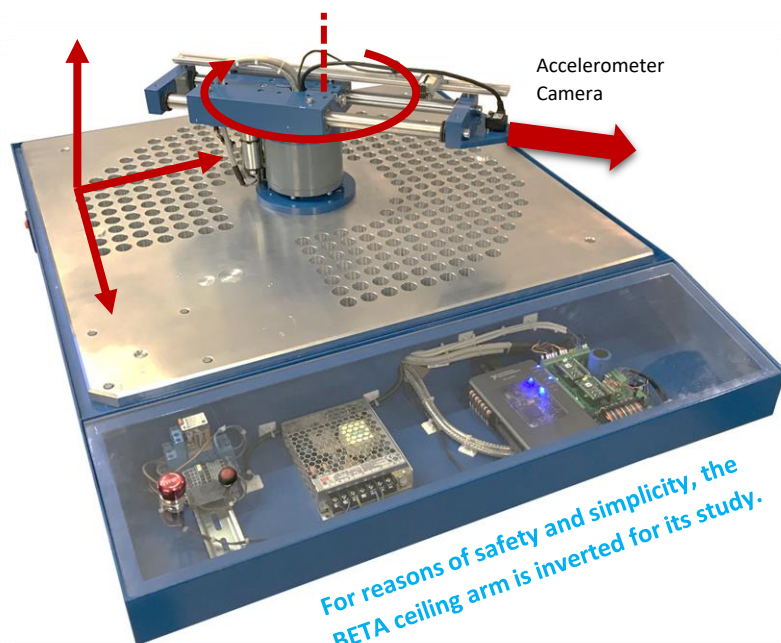


Industrial requirements:
precision and speed

Travel speed → 400 mm/s
Rotation speed → 180°/s

To a didactic system

Training bench for control



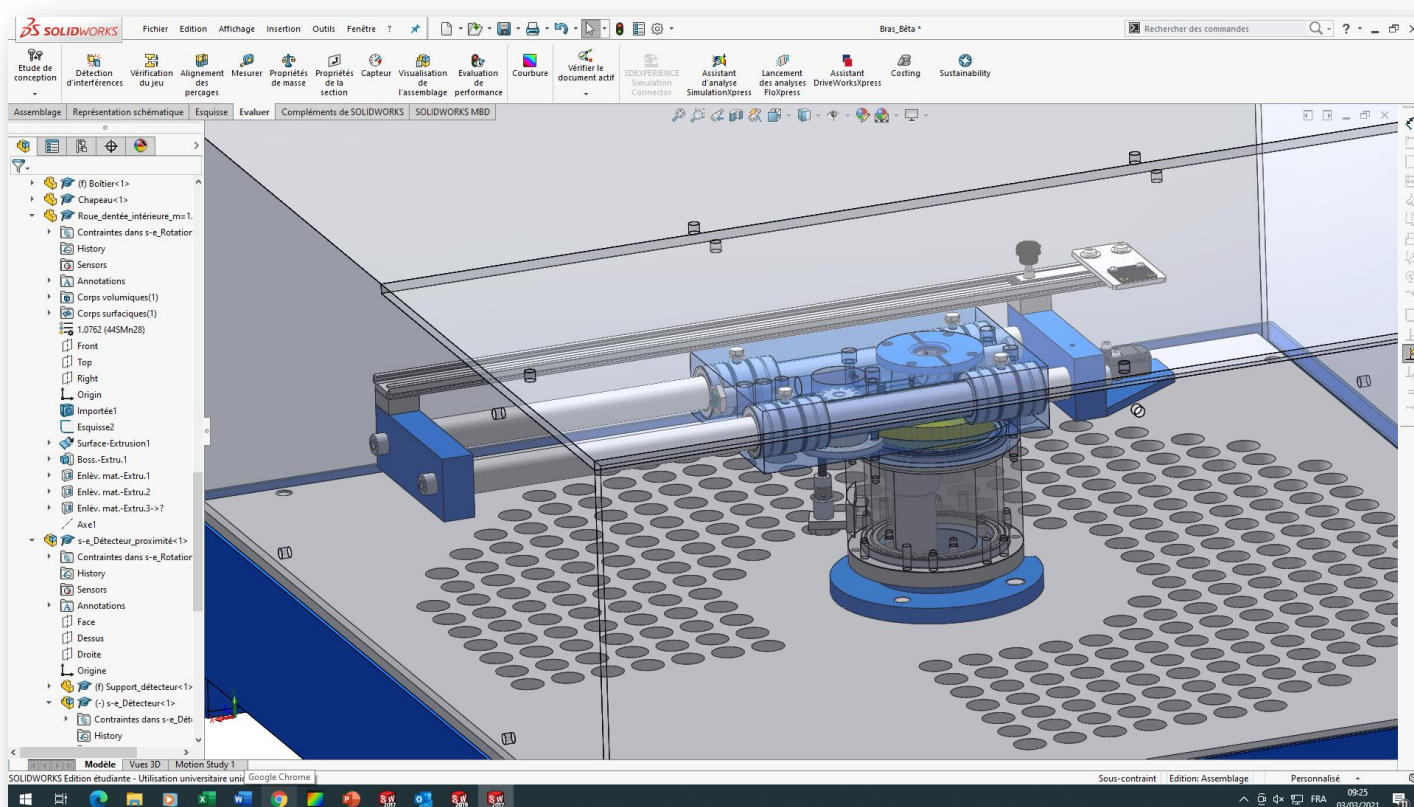
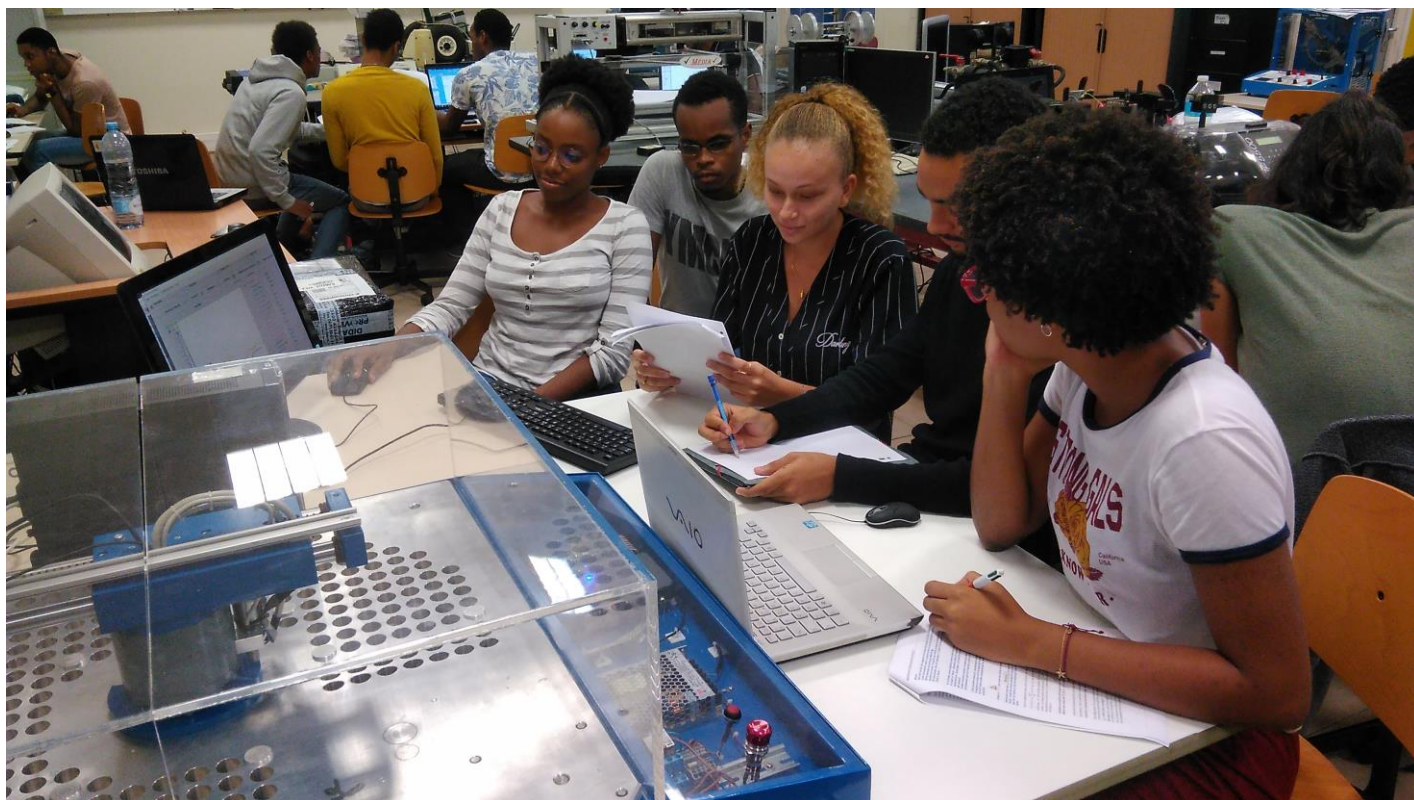
For reasons of safety and simplicity, the BETA ceiling arm is inverted for its study.

The training bench includes :

- ✓ A BETA ARM (L 500 mm), a 690 x 690 mm perforated plate (304 holes)
- ✓ A control unit including 2 servo-control boards and control and acquisition software
- ✓ A technical file (industrial and didactic)
- ✓ A pedagogical file with hands-on activities

Reference : S2I//100

The didactic **BETA ARM** enables the control sensor to be positioned in line with the tubes to be controlled, according to an established load plan. It features 2 position-controlled movements, translation and rotation. It is equipped with a camera to check positioning accuracy and an accelerometer to quantify the real performance.



BETA Industrial and Didactic arm kinematic chains

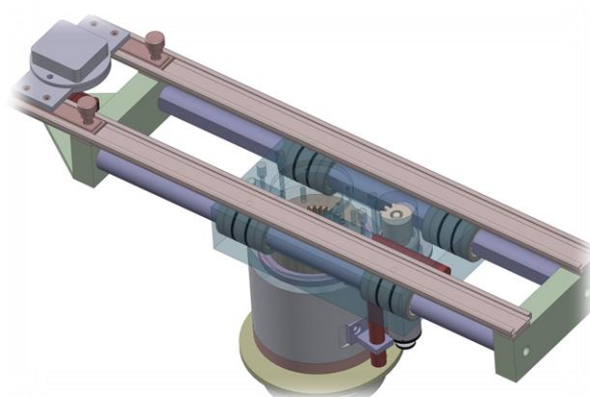
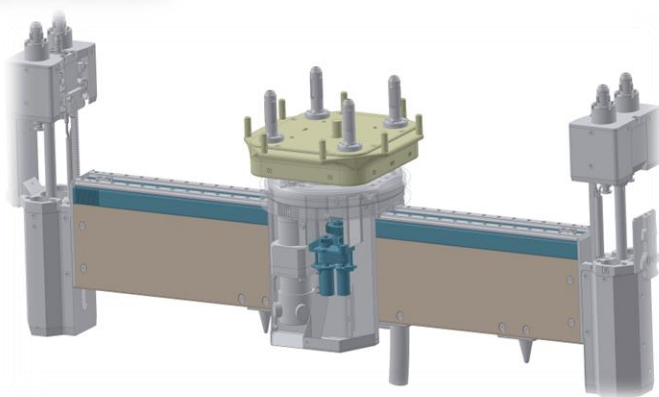
From Industrial BETA ARM



to Didactic BETA ARM

Position control with trapezoidal speed law

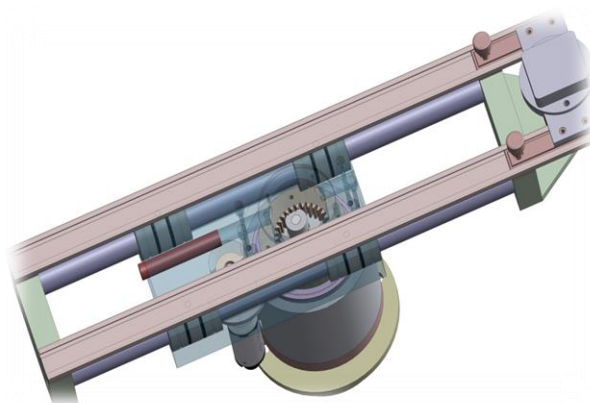
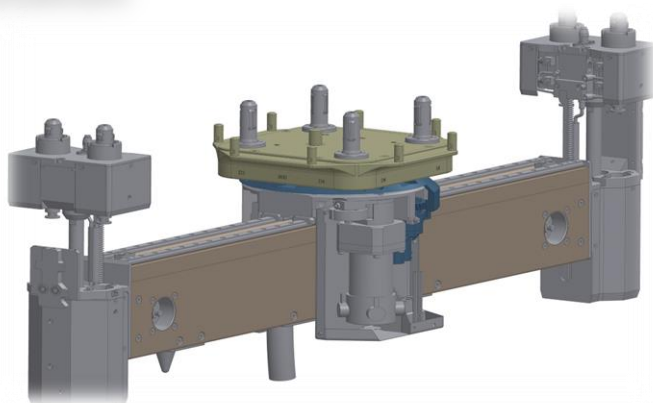
Translation



Translation = 600 mm
 MOTOR: Type RS210 L "ALSTOM" rotation speed 3000 rpm.
 REDUCER: Ratio 1/88
 CODING : The beta arm is equipped with two types of coding:
 ROUGH: thanks to a 10-turn potentiometer MEGATRON 2110 2 KOHMS
 FINE: in-box resolver SAGEN 08RXO800113

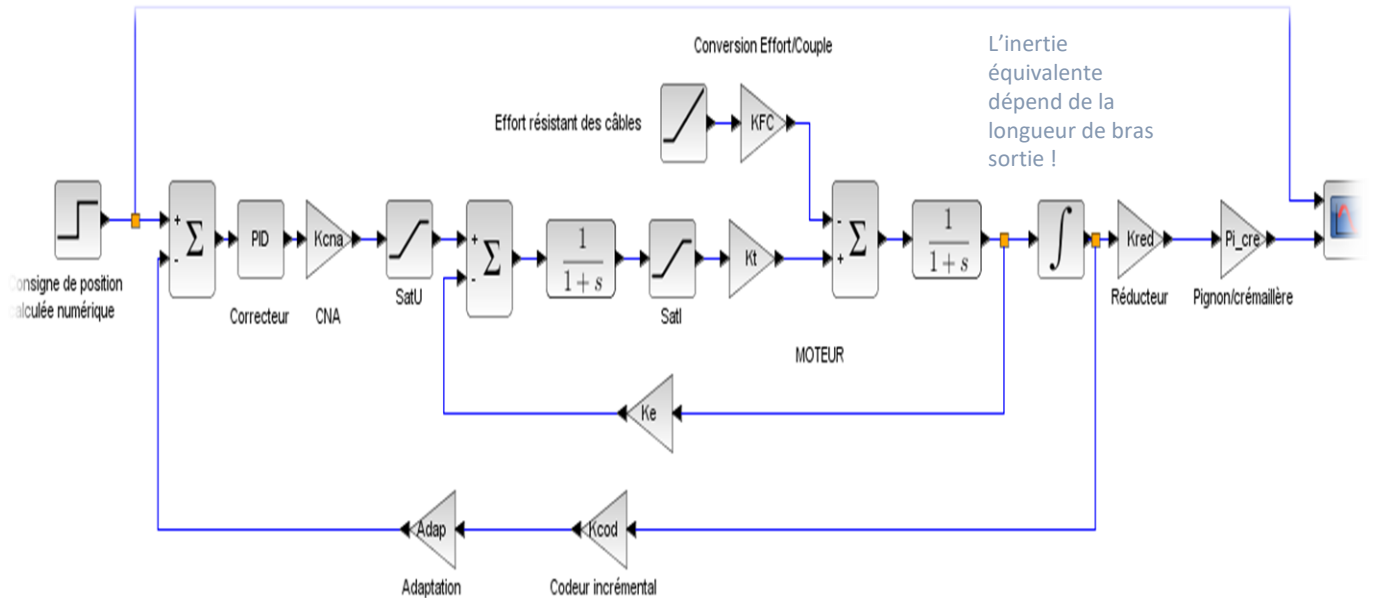
Translation = 200 mm
 MOTOR : Maxon 24V 8930 rpm
 REDUCER : Ratio 1/26
 CODING : Encoder Maxon 1024 Imp/T

Rotation

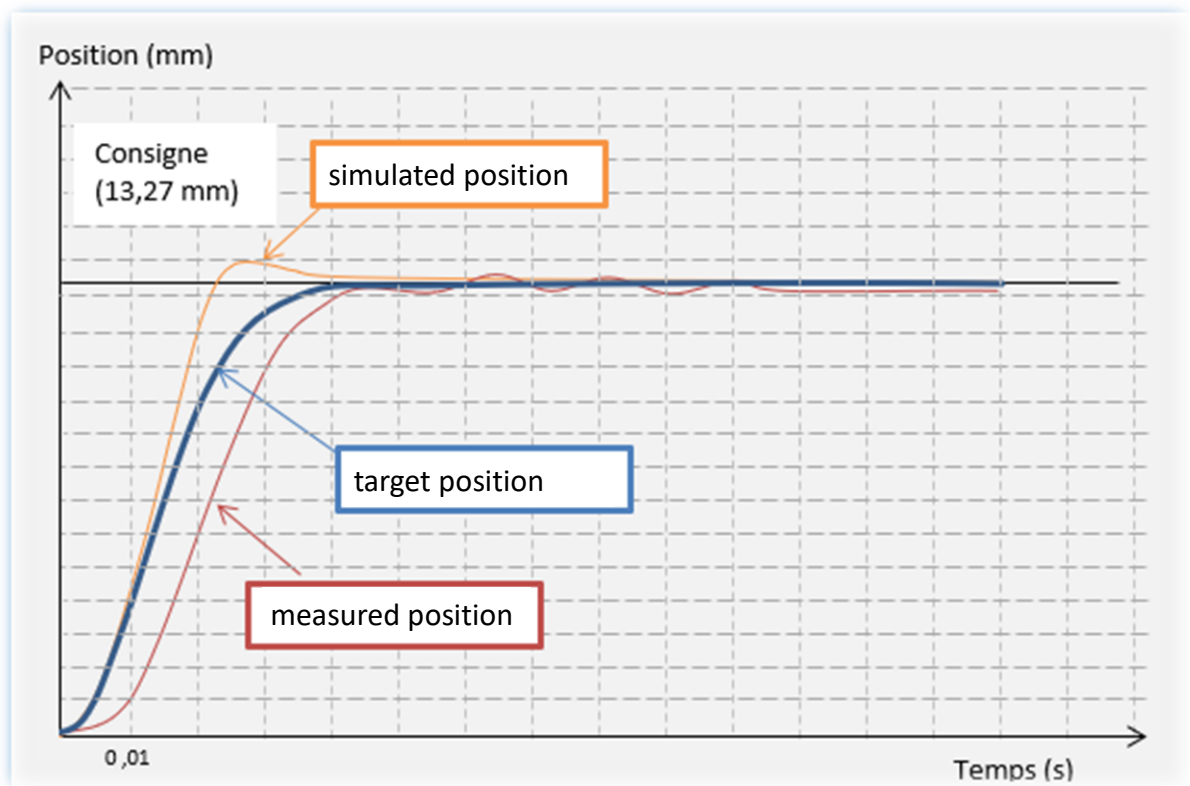


Turret rotation + 185°, -185°
 MOTOR: Type RS 230 G "ALSTOM_PARVEX" rotation speed 3000 rpm.
 REDUCER: ratio 1/100.
 CODING :
 ROUGH: thanks to a 10-turn potentiometer MEGATRON 2110 2 KOHMS
 FINE: in-box resolver SAGEN 08RXO800113

Rotation = 300°
 MOTOR : Maxon 24V 8930 rpm
 REDUCER : Ratio 1/103*12/30
 CODING : Encoder Maxon 1024 Imp/T



Block diagram (identical for translation axis and rotation axis)

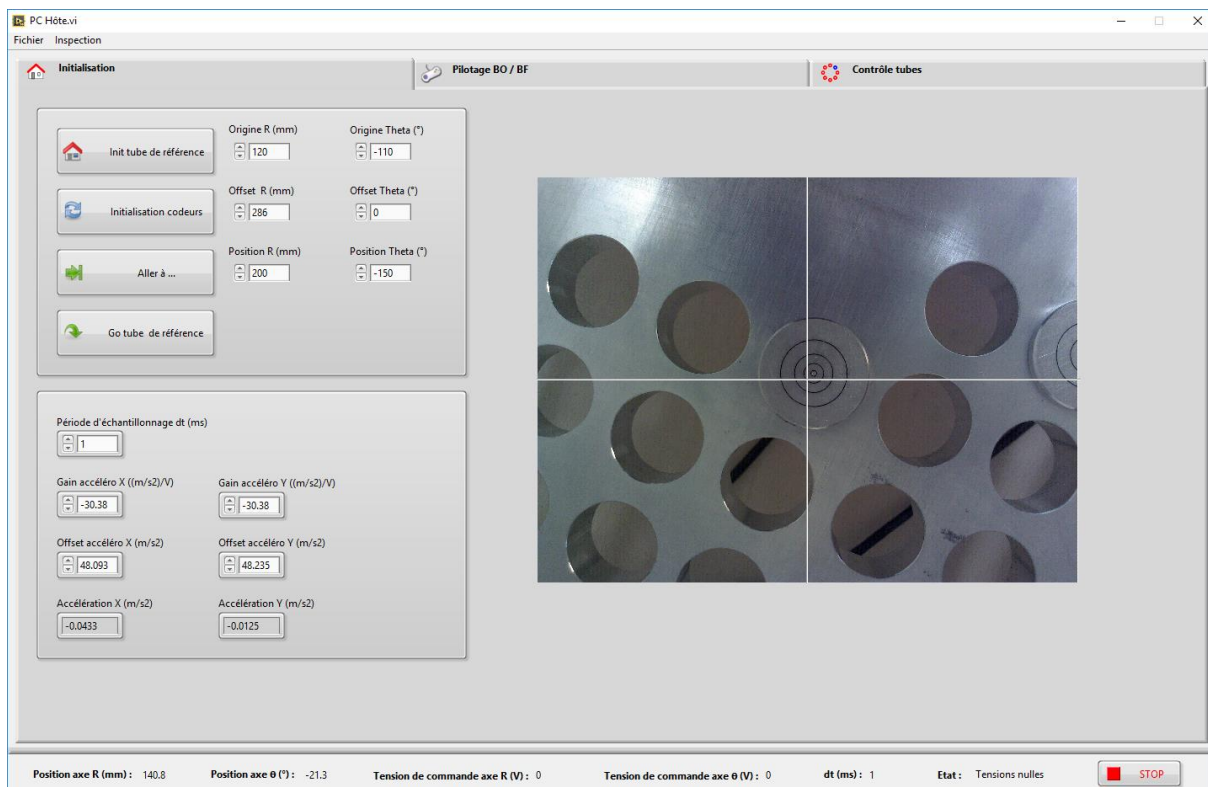


Comparative curves Beta Arm axis

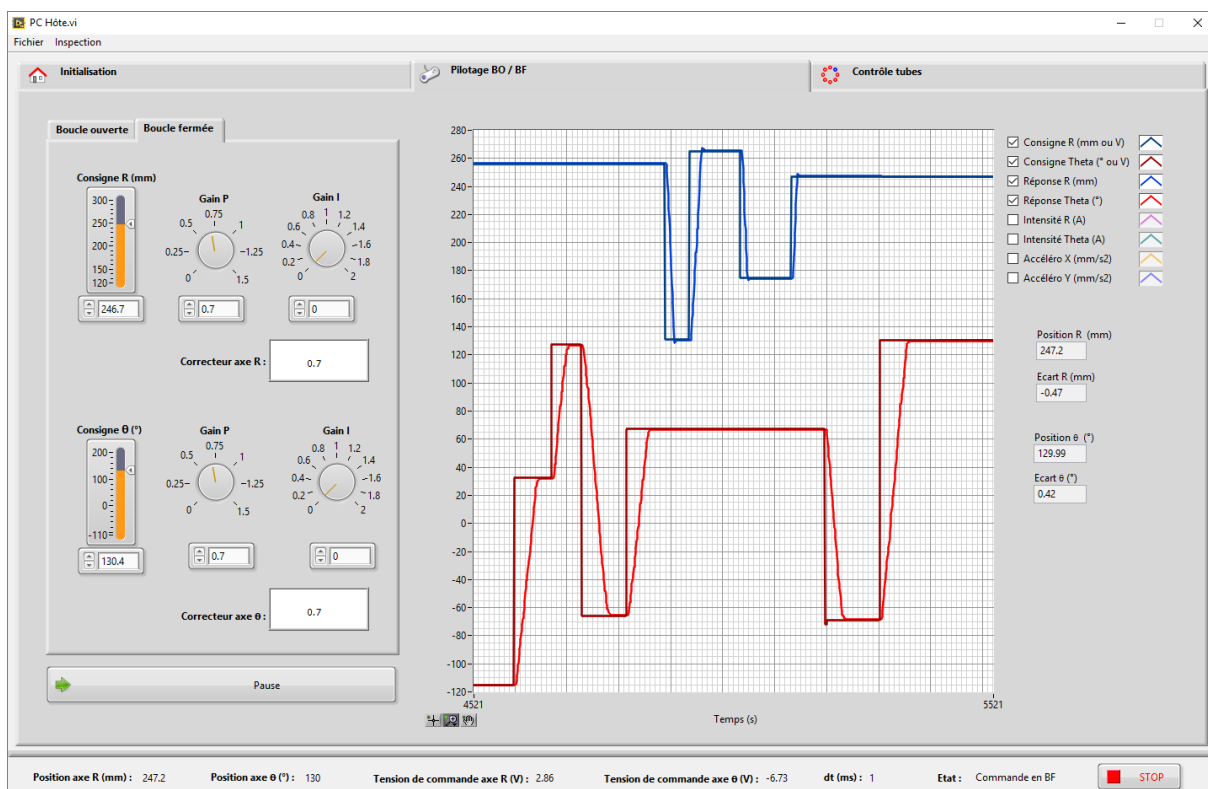
The BETA ARM HMI is built on the LabVIEW platform. It enables to :

- ☐ draw up a control plan to discover the function in use
- ☐ characterize each axis separately, then simultaneously study the behavior of axis servo-controls under real load
- ☐ visualize real, target and simulated behavior curves in real time, display them and adjust correctors to match real to model.

Software functionalities



Axis set-up and position control by camera

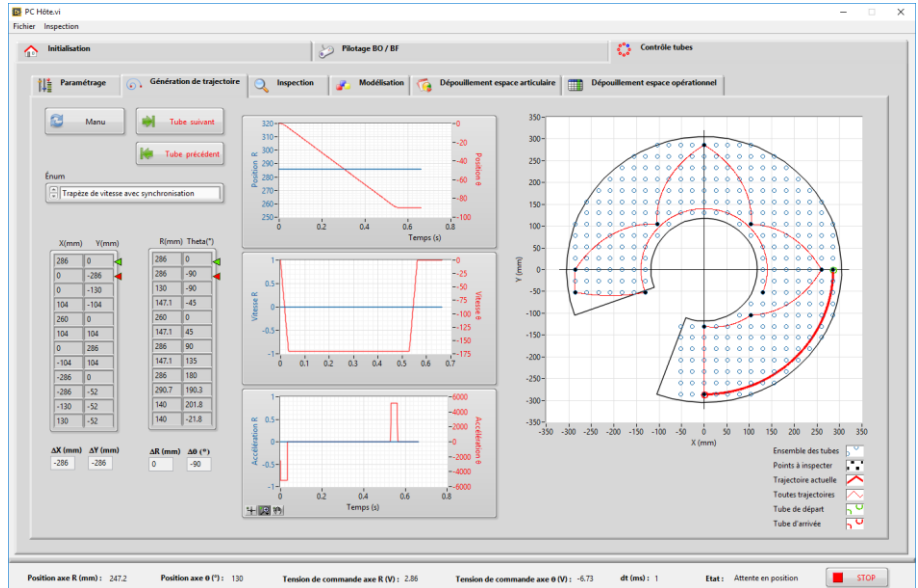


Open-loop or closed-loop axis control

Control plan programming
Visualization of trajectories
according to setpoint type

Step with or without
synchronization

Ramp with or without
synchronization

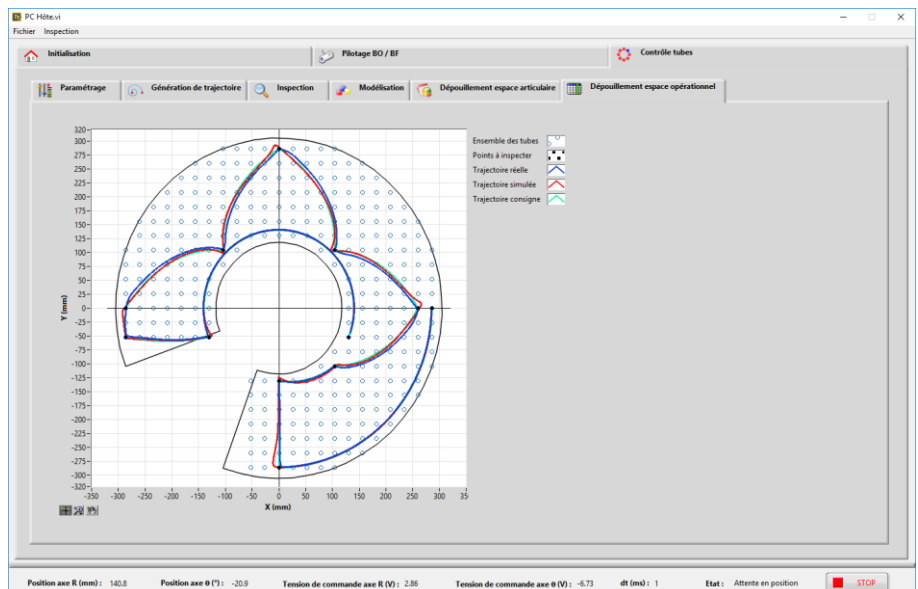


Superimposed axis-by-axis
display of Time/Distance
curves

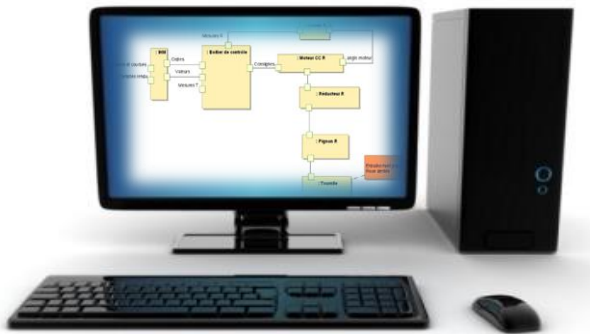
(set, simulated, real)



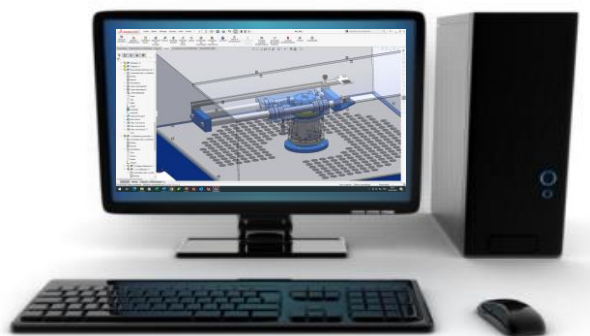
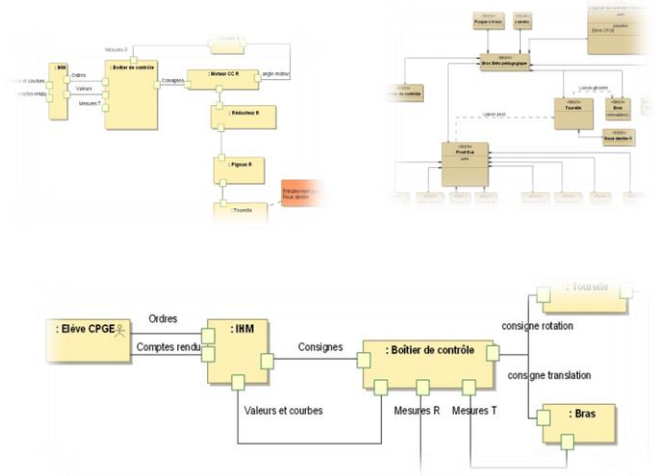
Superimposed display in
camera center trajectory plane
(set, simulated, real)



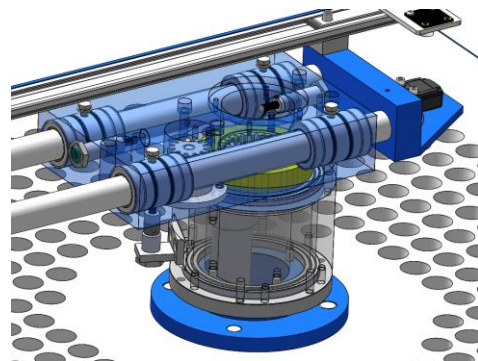
Examples of activities



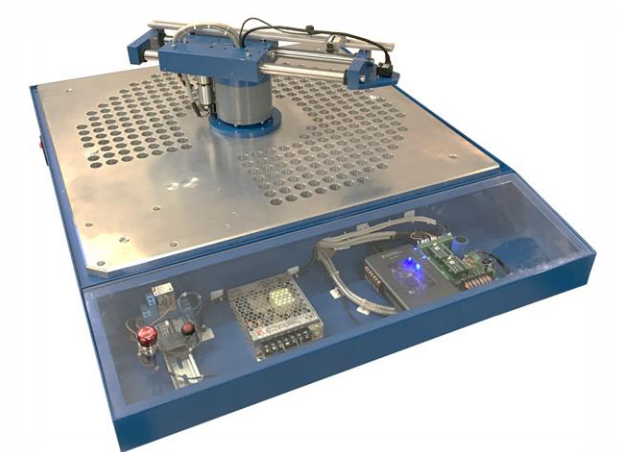
SySml diagram analysis



Solidworks-Meca3D modelling



Movement control



Training activities with the didactic BETA ARM

The training use of BRAS BETA for the teaching of industrial engineering sciences is carried out to cover the engineer's methodology, which allows to:

- ✓ verify the expected performance of a system, by assessing the difference between specifications and experimental results
- ✓ propose and validate system models based on tests, by evaluating the difference between measured and simulated performances
- ✓ predict the performance of a system based on modeling, by evaluating the difference between simulated performance and the performance expected in the specifications

