REVOLUTION status

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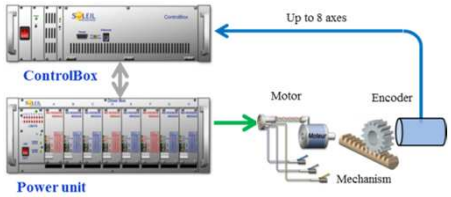
REVOLUTION status

- Context of REVOLUTION at SOLEIL
- CLASSIC controller evolution
- HIGH-PERFORMANCE controller standardization
- Conclusion

Context of REVOLUTION at SOLEIL

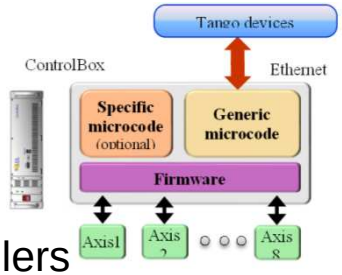
Revolution: Reconsider **V**arious contr**OL**lers for yo**U**r mo**tion**

→ **Motion controller upgrade project currently in progress at SOLEIL**



Status :

- Standardized hardware and software architecture
- Wide and homogenous installed base of motion controllers
  320 operational ControlBox - 85% of axis controlled by CB



Motivation :

- Very low long-term risk of obsolescence of our standardized motion controller : GALIL DMC-2182

- New motion control applications become more complex and demanding
  More performance
  More advanced functionnalities

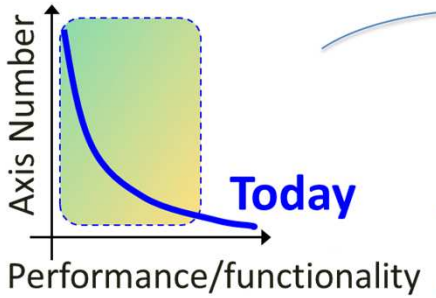
Context of REVOLUTION at SOLEIL

Strategy: Change Model

To conciliate the existing installed base with new requirements

Current model:

One standardized controller for any application



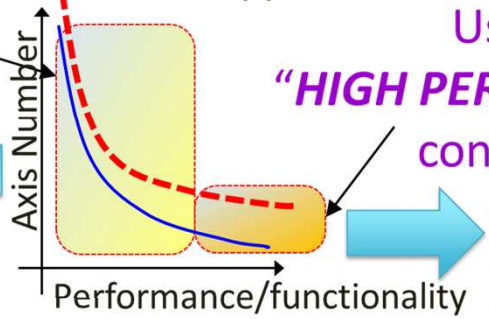
Pareto principle

Tomorrow

Distribution of Motion applications

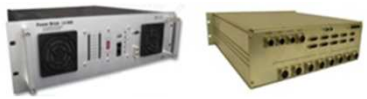
Use of *"CLASSIC"* controller

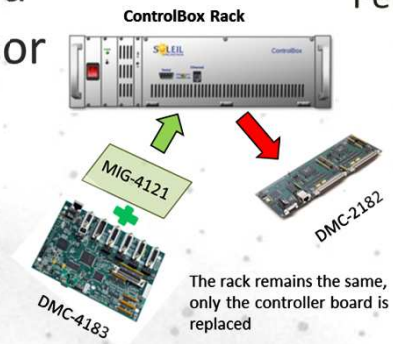
GALIL controller upgrade
DMC-2182 will be progressively replaced by its natural successor DMC-4183



Use of *"HIGH PERFORMANCE"* controller

DELTATAU Setup development
Power PMAC in Power Brick
LV format selected after a long evaluation process





CLASSIC controller evolution

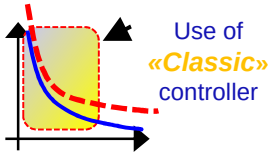
- Hardware and software developments are mostly done to be fully compatible with current architecture
  - Hardware:
    - Interface board (MIG-4121) developed for rack internal pinout adaptation

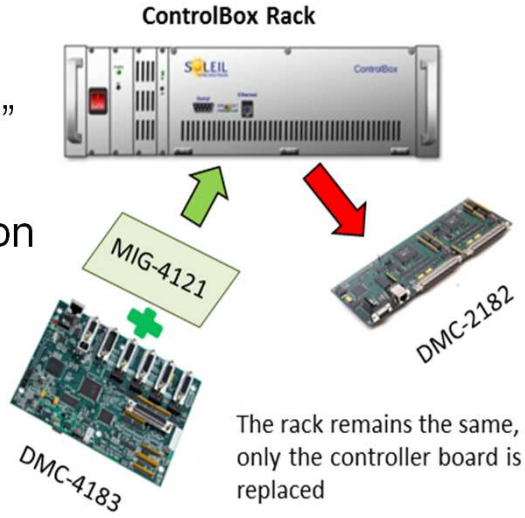
    -> Validated
  - Galil embedded software:
    - New feature of Galil firmware: “Continuous CLOSED-LOOP” on stepper motors

    -> Validated in the lab, one non-reproducible bug identified on one beamline, being investigated
    - New microcode for the new firmware

    -> Ongoing
  - Tango device:
    - Device to be adapted to be compatible with new feature Continuous closed-loop

    -> To be developed

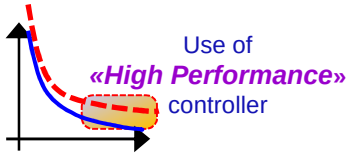




HIGH-PERFORMANCE CONTROLLER STANDARDIZATION

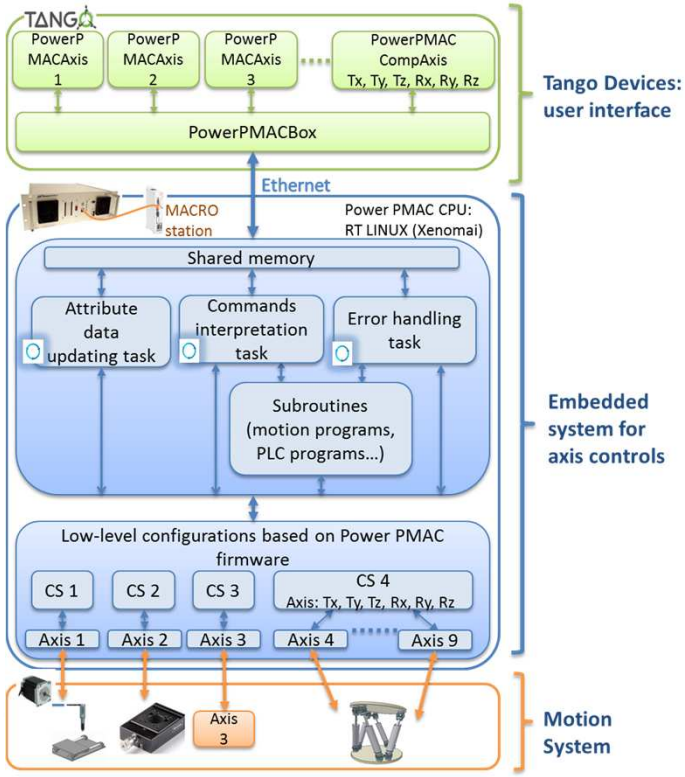
Control architecture

- Hardware and software architectures defined in order to implement required applications
  - 8-axis controls
  - Built-in amplifier
  - MACRO network
  - standard connectivity



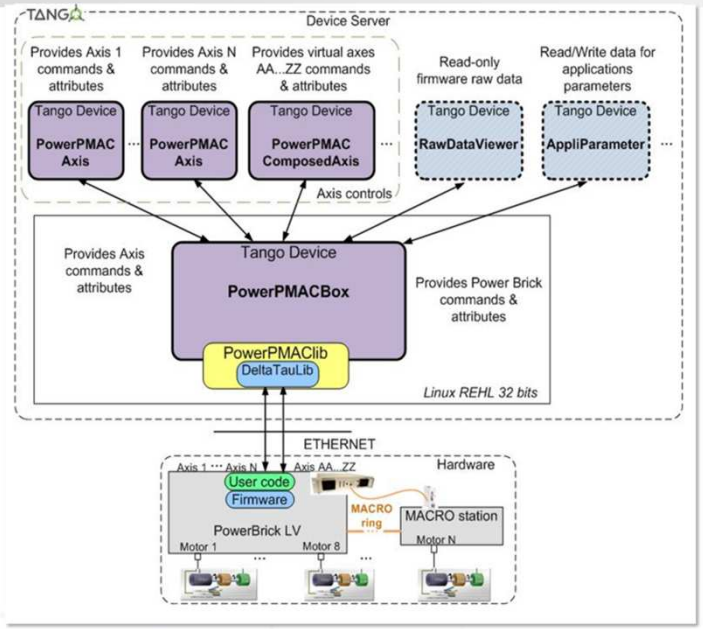
Standardized control architecture goals:

- **Consistency and usability**
  - Architecture close to the existing one
- **Performance benefits**
  - Most process functions embedded into low-level in order to abstract the system complexity for the high-level software
- **Easy to use and maintain**
  - Some standard functionalities for the hardware low-level configuration and in the embedded software developed

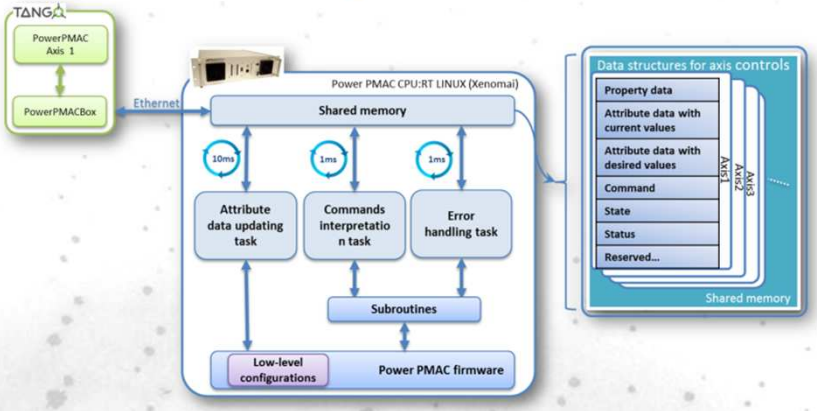


Axes control architecture with an example of motion system

High-level / embedded software architecture



Software high-level architecture



Embedded software tasks

Tango Devices:

- Controller and (physical & virtual) axis controls
- Diagnostic & parametrizing tools

Libraries:

- Communication library
- SOLEIL-made library
  - ➢ **Link to the data structures stored in the shared memory of the controller**

Embedded software:

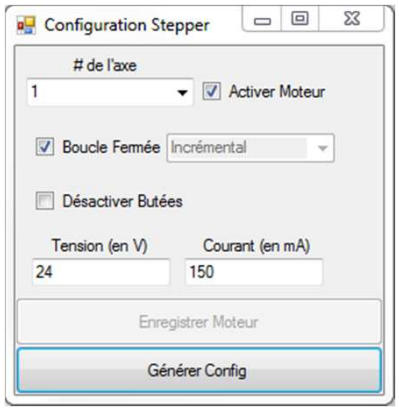
➢ **Interface for Tango axis controls**

Features:

- Interpretation of commands, only run if operating conditions allow
- Attribute data updating, parameters changed only within allowed conditions
- Error handling

Embedded subroutines and low-level settings

- Embedded subroutines implementation
  - Some generic processing programs :
    - Motion programs for reference-position initialization
    - Duty cycle PLC program for motor stops within a certain period
    - Vacuum mode PLC program to switch motor current depending on the motor status (moving or stopped)
- Low-level configurations for operations and archives
  - GUI tool developed to automatically generate configuration files according to preselected parameters: channel number, motor type, encoder type, motor current etc.
  - Procedures for installation and maintenance



Hardware configuration files generator tool

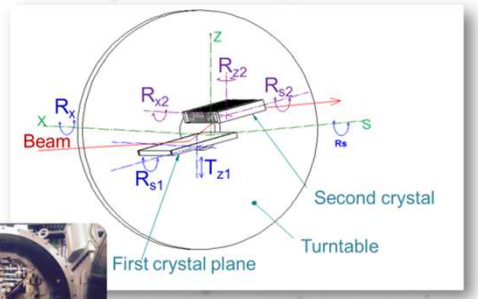
SAMBA beamline application test

DCM control upgrade

- To provide direct energy control → continuous energy-scan operation
  - ✓ Configured for 7 main axes (R_x, T_{s2}, T_{z2}, C1, C2, R_{z2}, R_{s2})
  - ✓ Low-level settings validated
  - ✓ Kinematic equations implemented
    - Equation between E(photon energy in eV) and the angle θ (°) of the main axis Rx

$$E = hc\frac{1}{\lambda} = \frac{hc}{2d}\frac{1}{\sin(\theta)}$$

    - Remaining motors synchronized with Rx



$$T_{s2} = \max(T_{s2}^{Min}, \frac{H}{2\sin(\theta)});\ T_{z2} = \frac{H}{2\cos(\theta)}$$

$$C_1(\frac{1}{R}) = A_{1,0} + A_{1,1}\frac{1}{R};\ C_2(\frac{1}{R}) = A_{2,0} + A_{2,1}\frac{1}{R}$$

$$\frac{1}{R} = \frac{1}{2\sin(\theta)}(\frac{1}{p} + \frac{1}{q})$$

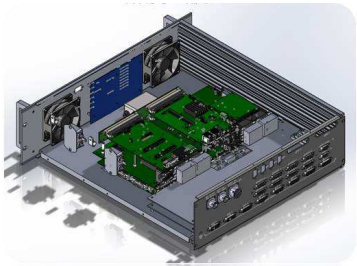
$$R_{s2} = P_n(\theta, c_{R_{s2}});\ R_{z2} = P_n(\theta, c_{R_{z2}})$$

$$p_n(\theta, c) = \sum_{i=0}^{n} c_i\theta^i \quad c = \begin{pmatrix} c_0 \\ c_1 \\ \vdots \end{pmatrix}$$

- Tests scheduled with Tango Devices

Conclusion

- **REVOLUTION status**
  - ➔ New **CLASSIC** controller: Hardware, Firmware functionally validated
  - ➔ **HIGH PERFOMANCE** controller: First test with Tango devices in progress
- **New strategy of changing model being implemented**
  - ➔ New **CLASSIC** controller: operational **continuity** ensure.
  - ➔ **HIGH PERFOMANCE** controller: control **upgrade** applications
    - ❑ Monochromator, Flyscan, Nanoprobe and Goniometer...
- **New complimentary product Power Brick controller specified**
  - ❖ Same CPU(Power PMAC) without built-in amplifier
  - \+ Control upgrade direct and easy
  - \+ Same tool settings & skill-sets without extra development



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