Telescope and Instrument Software and Control Activities at INAF Capodimonte TESTA lab

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+

many others in the previous decades

Talk Overview

TElescopi e STrumenti per l'Astronomia

(o almeno *proviamo* a mettercela)

Overview of past and present

Talk about

- ❑ Control software
- ❑ Control
- ❑ Software
- ❑ Electronics

- ❑ *Project Management*
- ❑ *System Engineering*
- ❑ *Active Optics*
- ❑ *Integrated Modeling*
- ❑ *Integration, commissioning*
- ❑ *….*

Where it all began

TNG - The good old days ('90s)

➢ Tracking Control Az, Alt, Rot (x2)

➢ M3 Control

➢ Software, Servo Control, Electronics, Integration, Commissioning

❑ PDOS Real-time O. S.
❑ VME bus

Servo Control Software still working every night

1994 'desk'

The ESO ecosystem

The (old) ESO standards

- ☐ Real-time VxWorks
- ☐ VME bus
- ☐ HP-UX
- ☐ C,C++,TclTk
- ☐ CMM version control
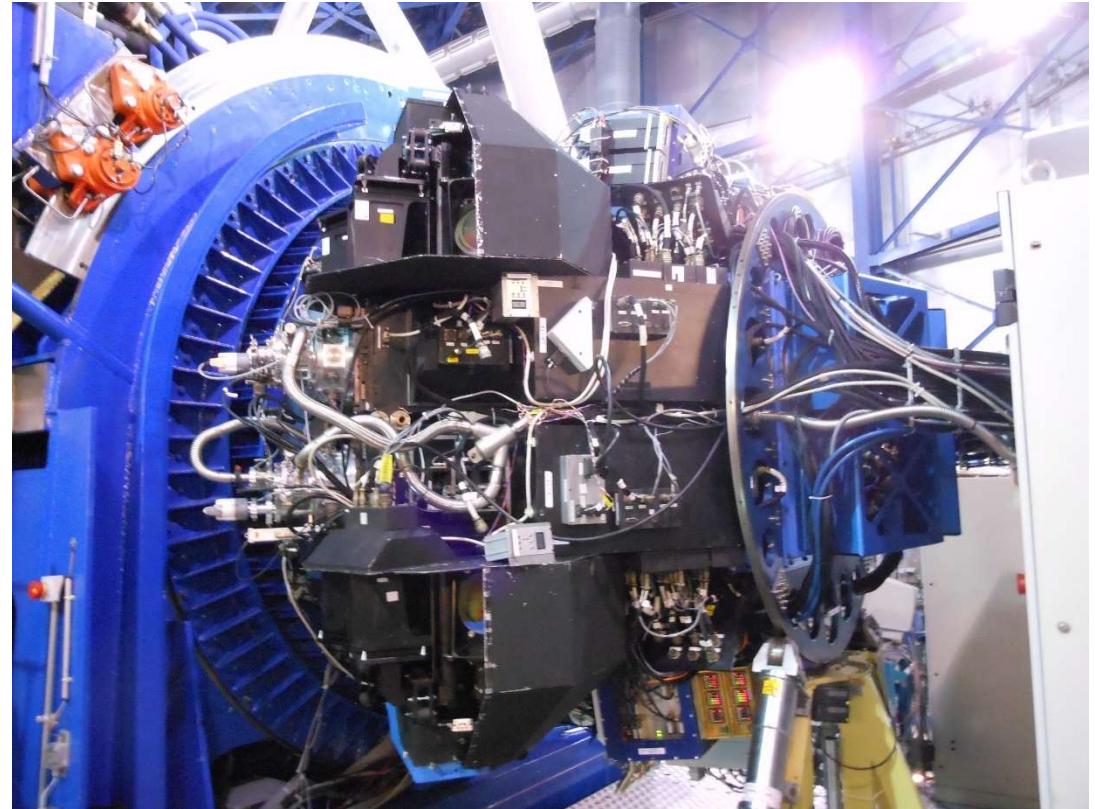

- ✓ Software
- ✓ Electronics
- ✓ Integration
- ✓ Commissioning
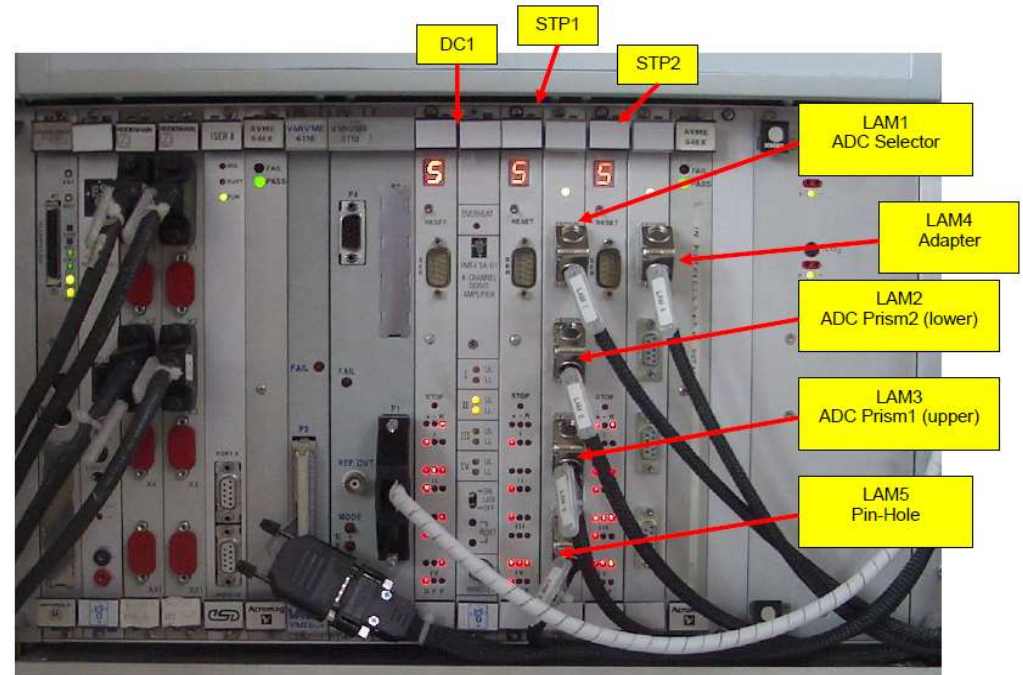
Involvement in ESO projects since 1996

VIMOS @VLT

- 4 spectrographs
- 52 motors + lamps, etc.
- Real-time control sw of hw functions
- OS
- Control Electronics

A decade with the VST

- 8 Local Control Units VxWorks real-time O.S.
- 1 Scientific Linux WS
- 60 software modules
- 10 control cabinets
- CAN Bus network

- ➢ Point&Track (Az,Alt,Rot,AG) SW
- ➢ AO (WFS, M1, M2) SW
- ➢ ADC SW
- ➢ Probe SW
- ➢ Etc.

+ everything else

Very big project, very small staff (2-3 for SW)

From VME Control
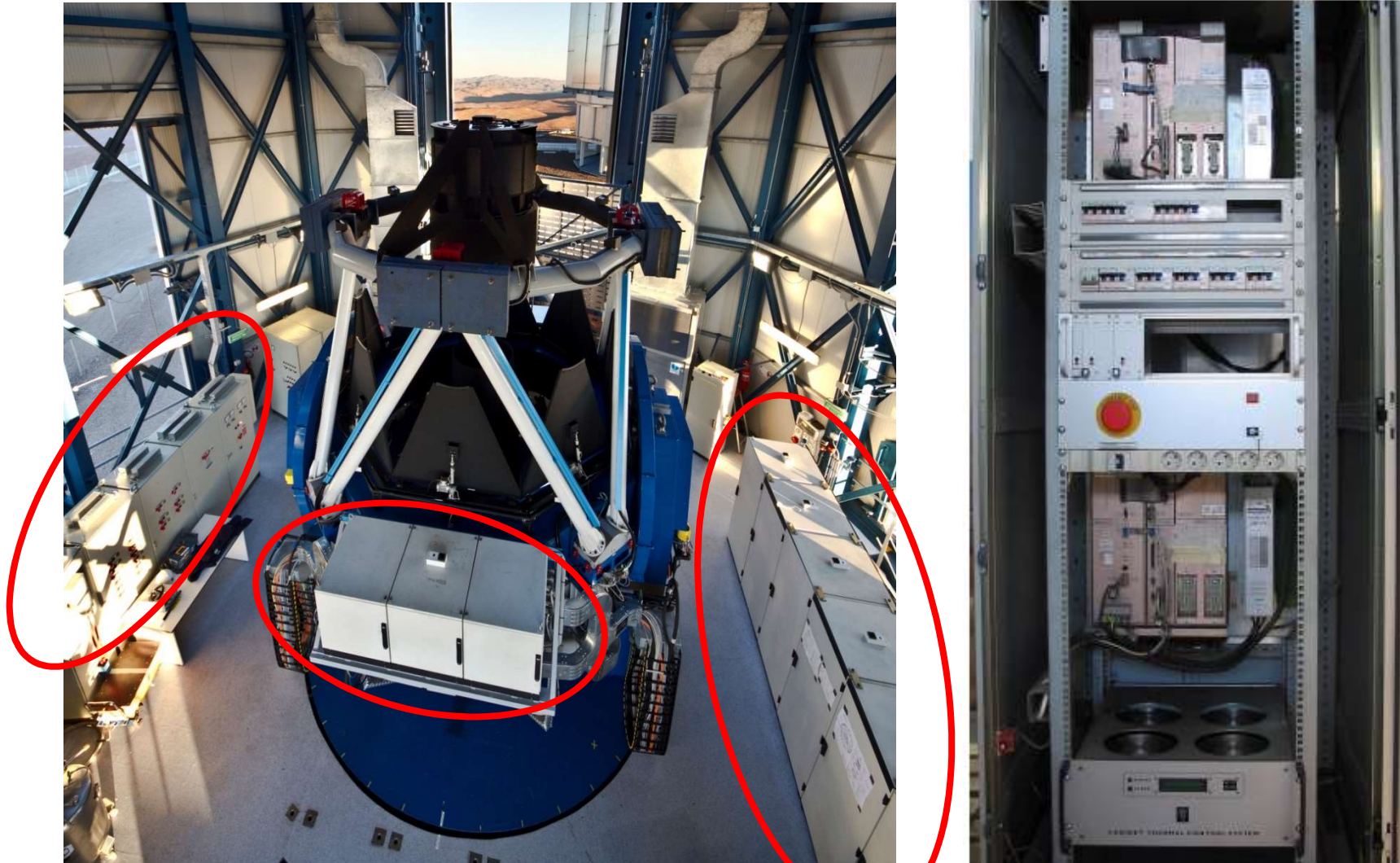
To Beckhoff PLCs

SOXS (Son Of X-Shooter)
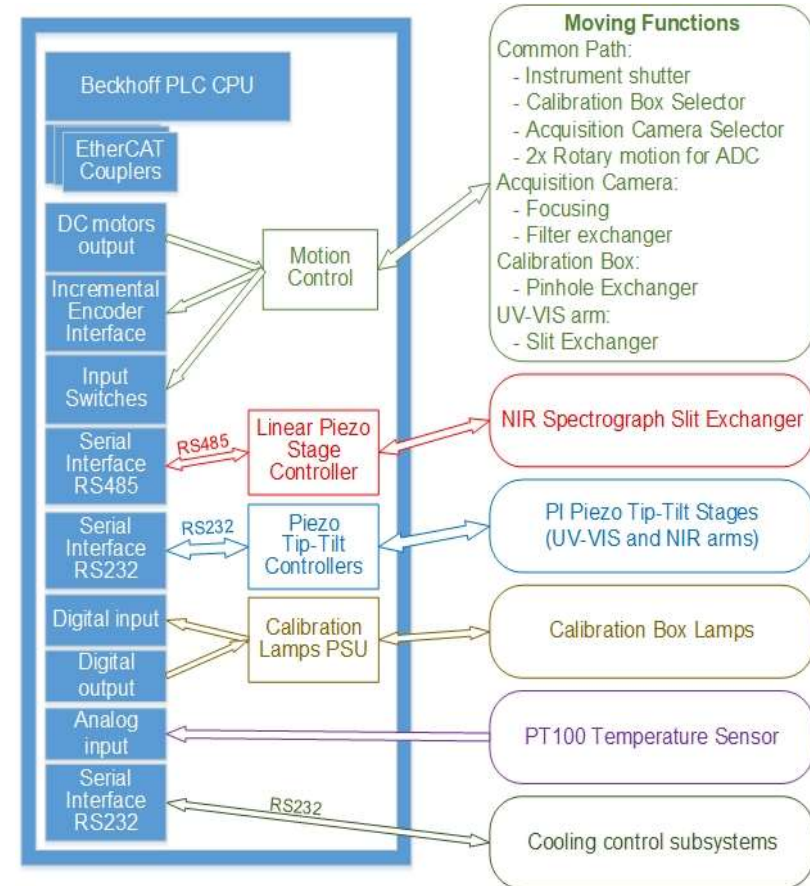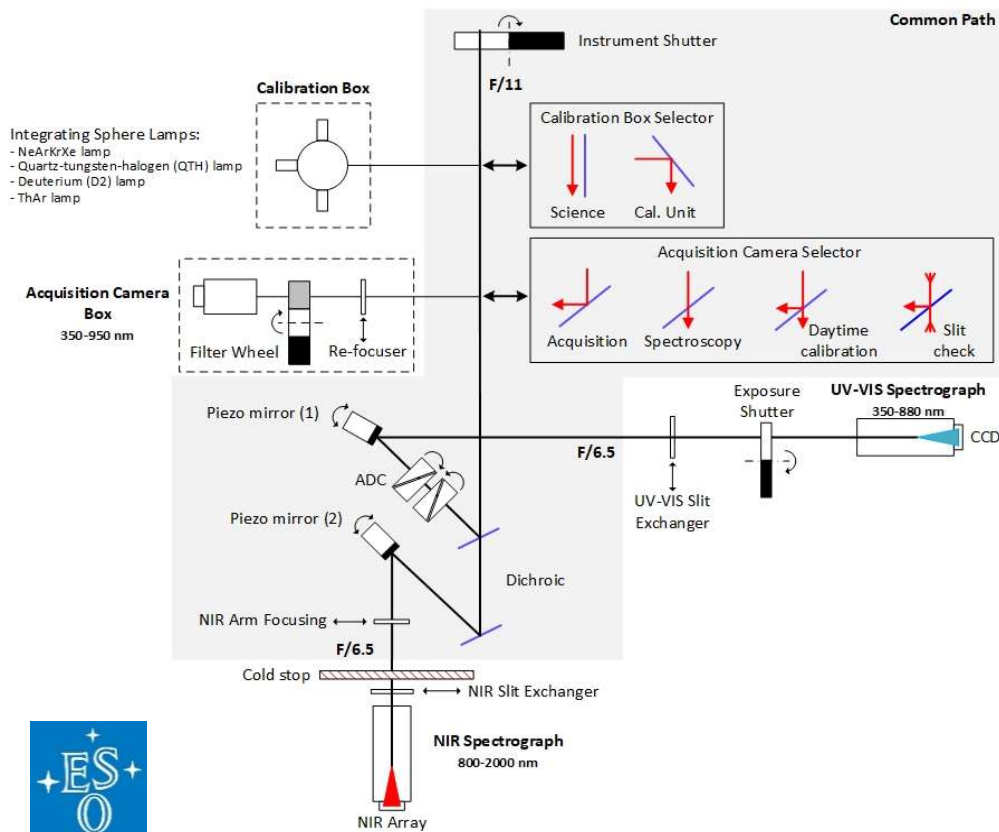
To Beckhoff PLCs

SOXS (Son Of X-Shooter)
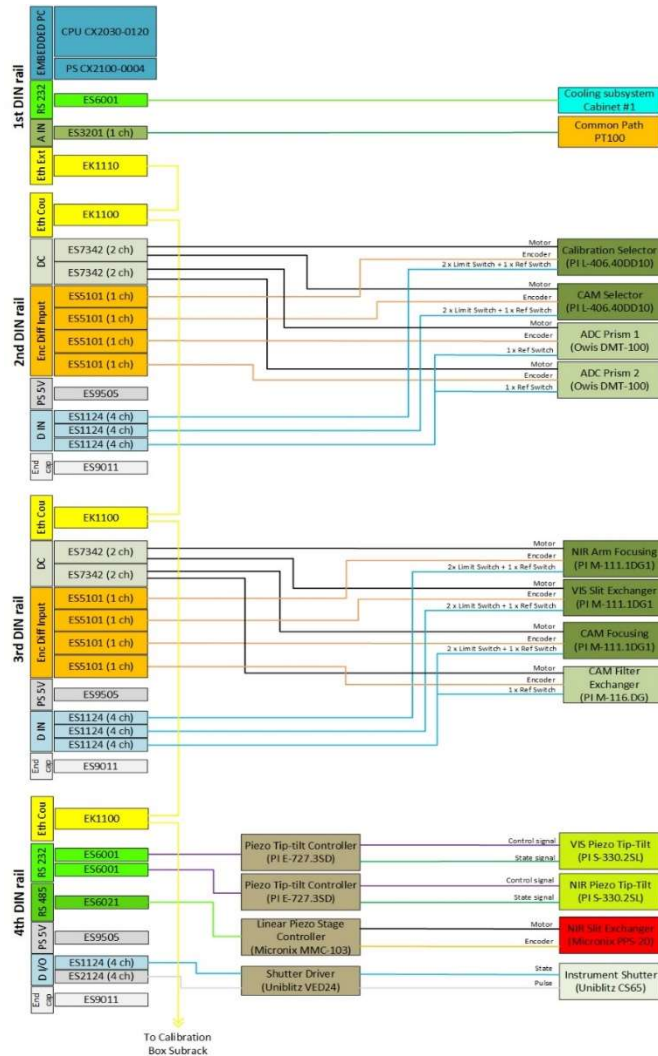
- [ ] CPU - CX2030 series (CX2030-0120)
- [ ] Power Supply module - CX2100-0004
- [ ] Software - TwinCAT 3.1

ESPRESSO heritage

To Beckhoff PLCs

SOXS (Son Of X-Shooter)
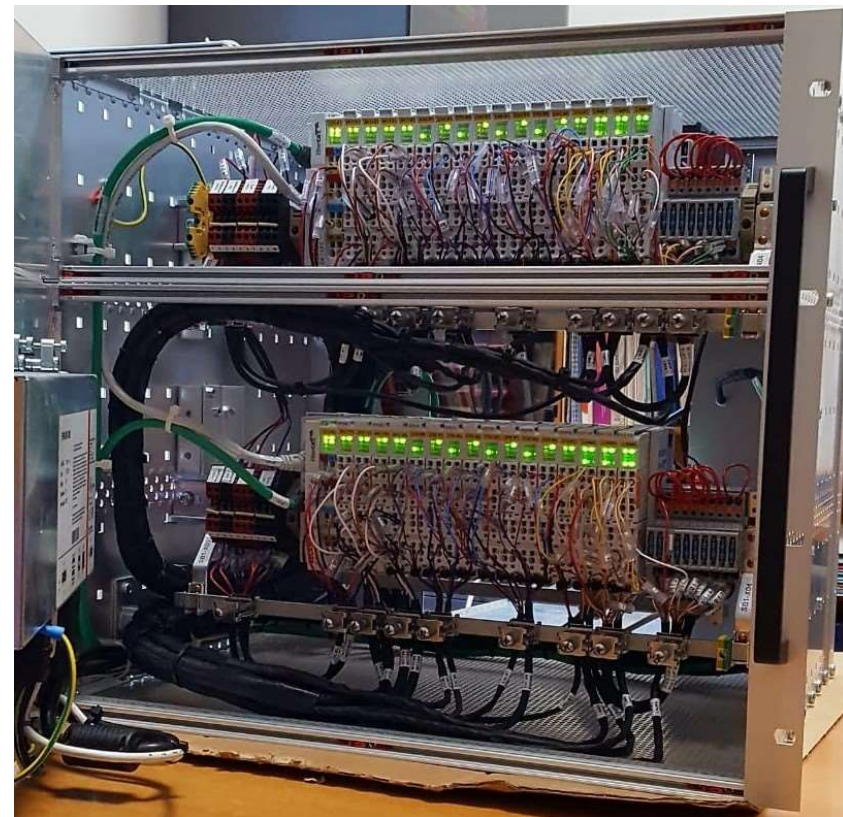
To Beckhoff PLCs

MCAO Assisted Visible
Imager and Spectrograph

ESO
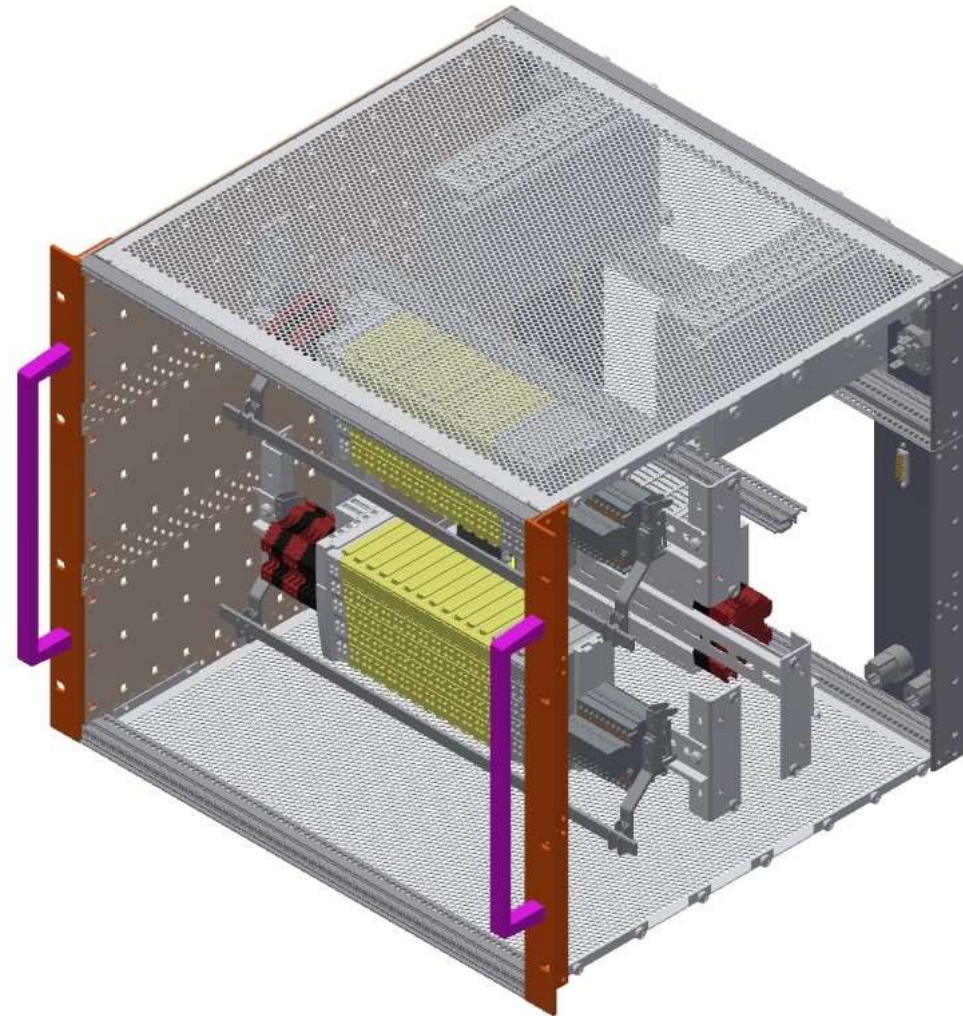
Active Optics

☐ CAN Bus Network

☐ PIC Microcontrollers

Space EGSE
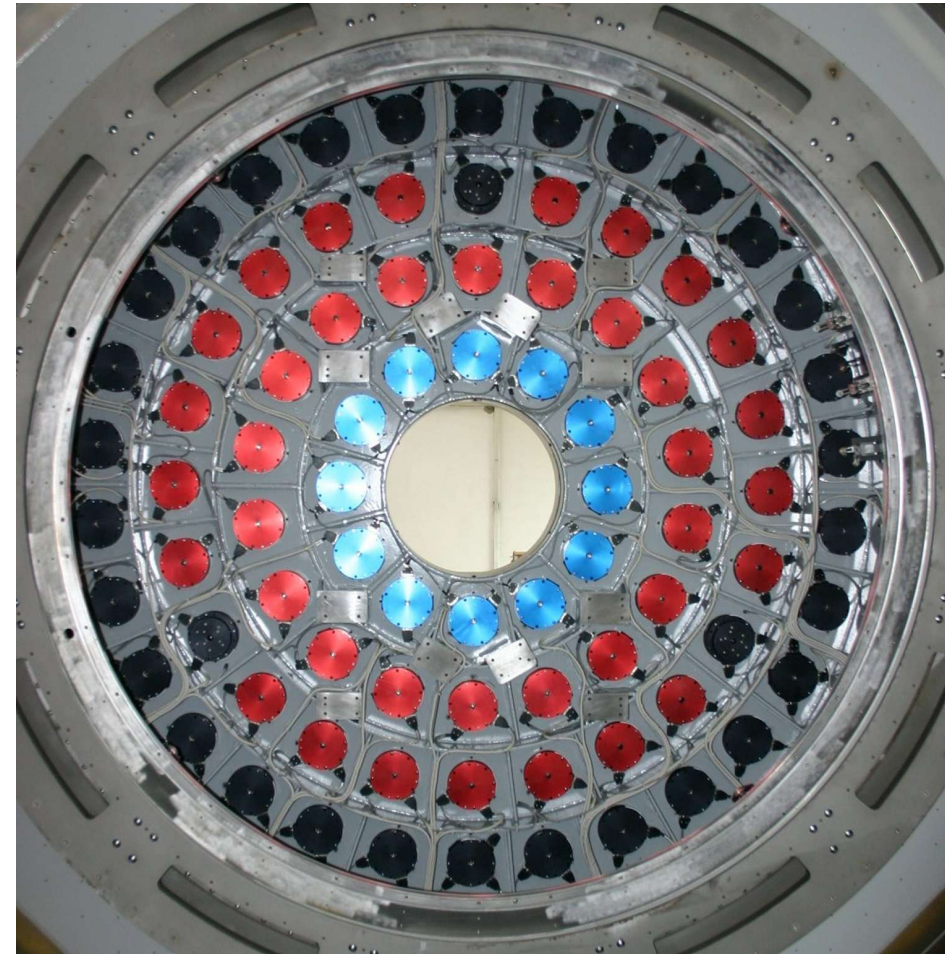
ExoMARS DREAMS

☐ CANOpen protocol

☐ CANoe

☐ CAPL programming
  language

ExoMARS DREAMS

☐ PDS4

☐ Java + Eclipse

Control SW Prototyping
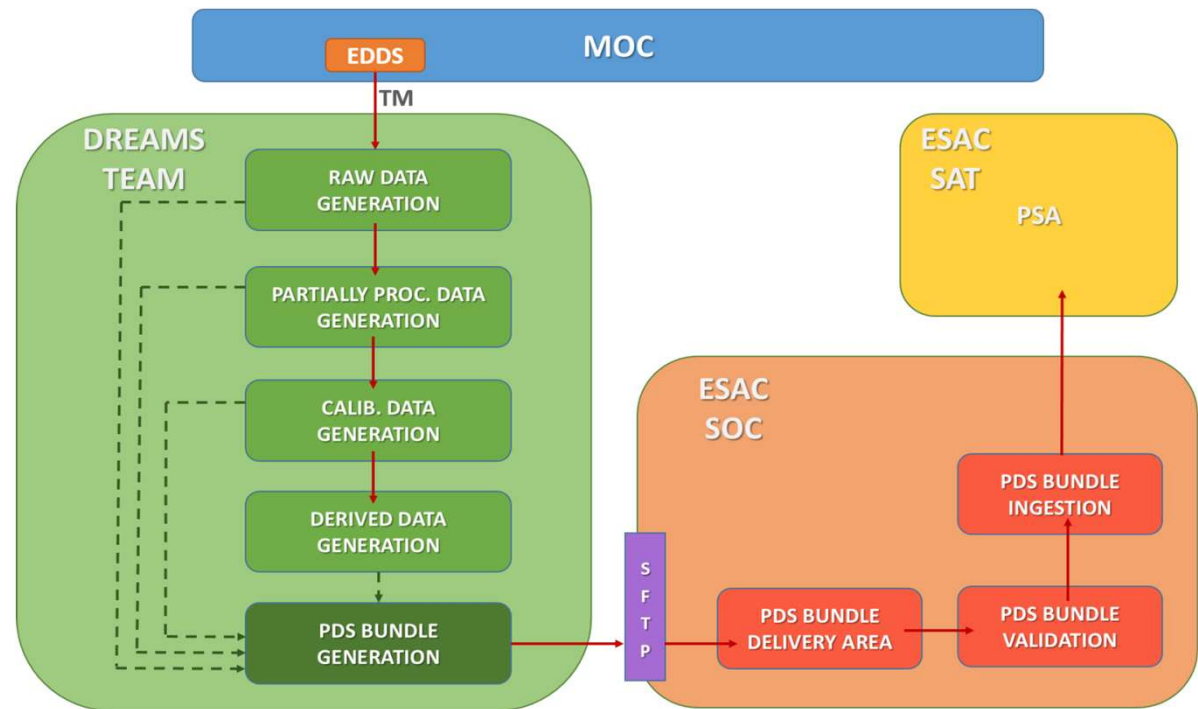
Example:

Active Optics Software

☐ SW Prototyping

☐ Control simulations

☐ Integrated modeling
(Ansys-Zemax-Matlab)

☐ Data analysis (e.g.
tracking, active optics)

Many thanks to INAF-ICT for procuring
Matlab & Simulink

Observatory Ctrl Software

Telescope & Instrument Control Monitoring (VST+ΩCAM)
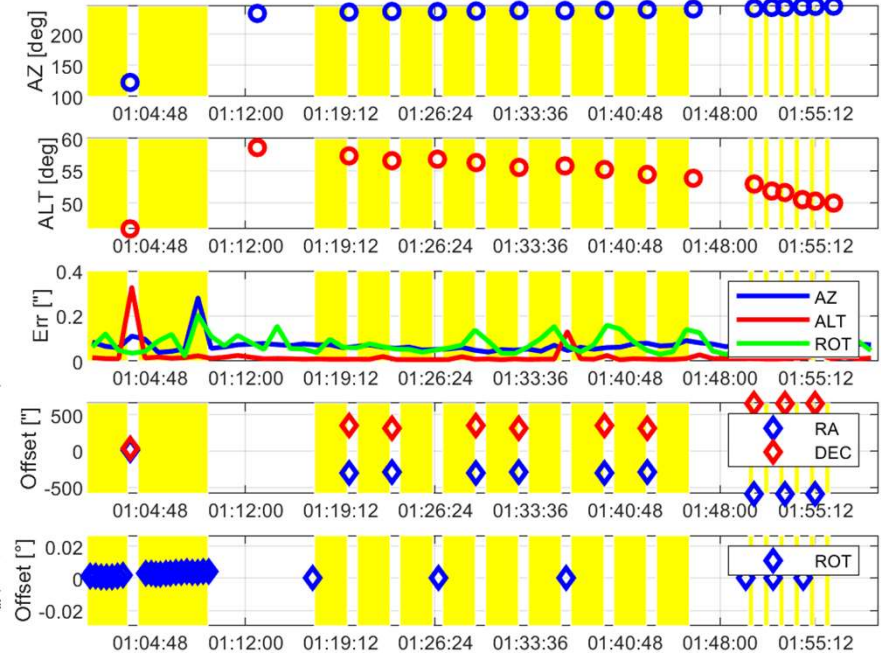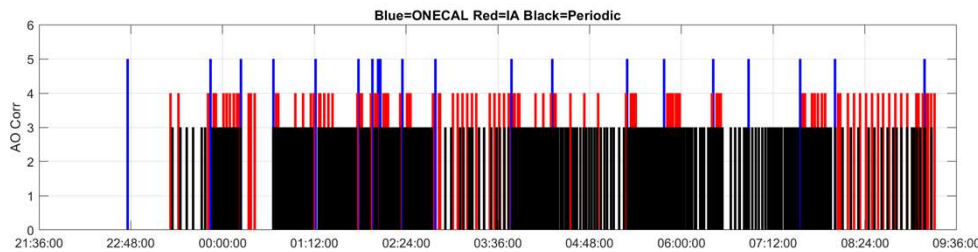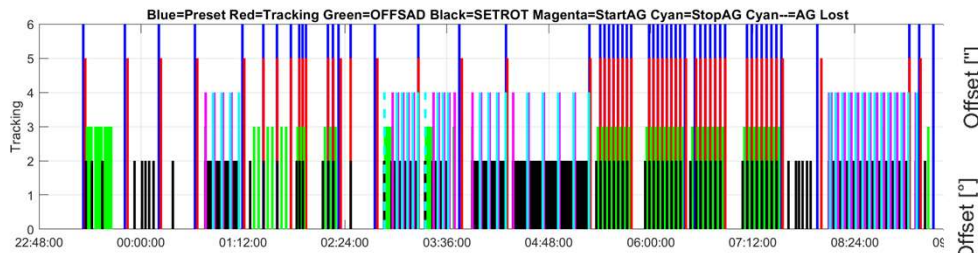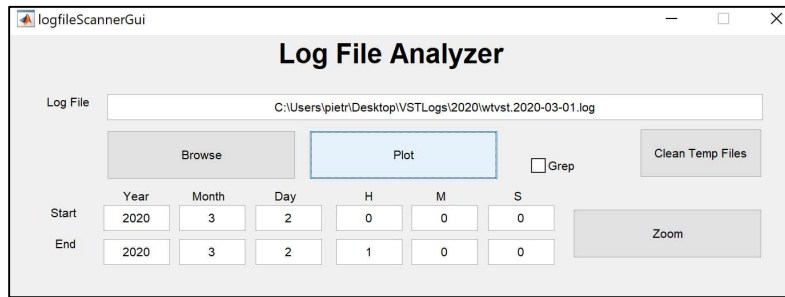
Post-instrument delivery
- Operations
- Maintenance
- System Improvements

Observatory Ctrl Software

OB Scheduler

SOXS (Son Of X-Shooter)

Led by M. Landoni
(INAF Brera)

❑ Control of the
   telescope operations
❑ Remote Scheduling

Due for:
➢ NTT-SOXS
➢ VST (TBD)

Tracking Control

Control Engineering

- ❏ Inside Telescope Control Software
- ❏ Uses Telescope Control Electronics
- ❏ System Identification
- ❏ Control Scheme
- ❏ Design and implementation of controllers
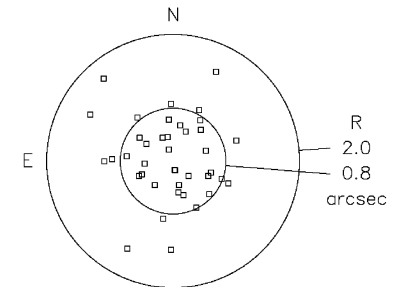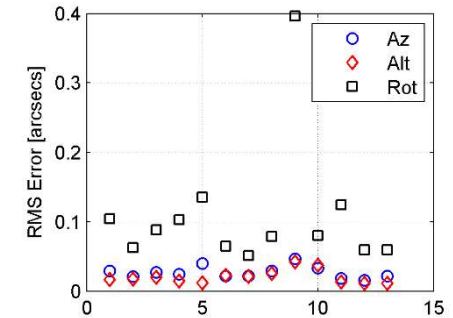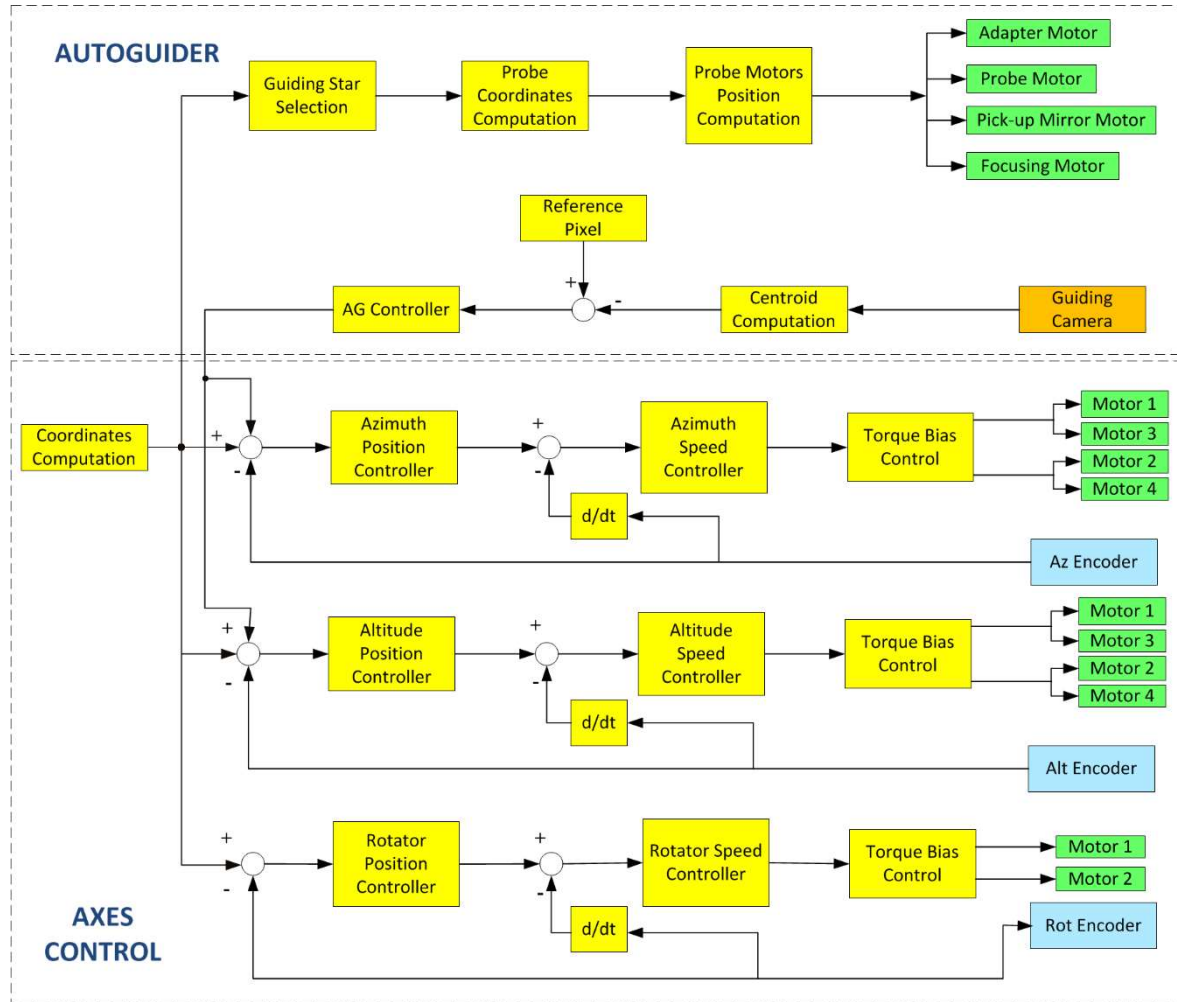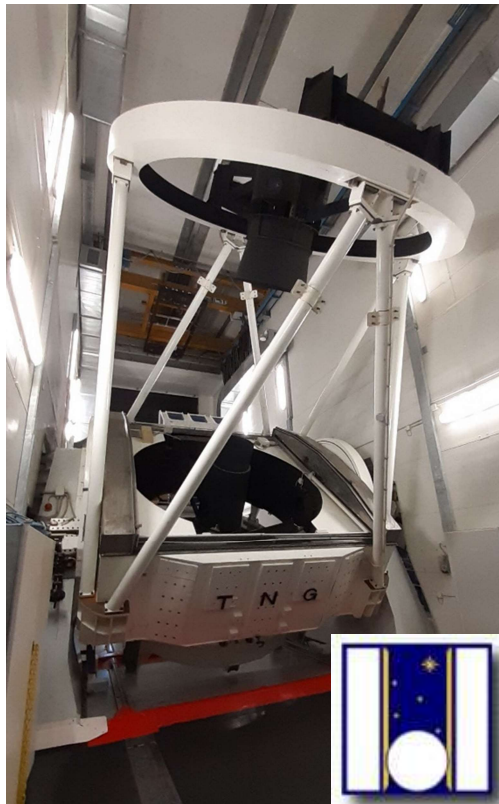- ❏ Tightest requirements for optical telescopes
- ❏ Done for major INAF optical telescopes (TNG, VST)
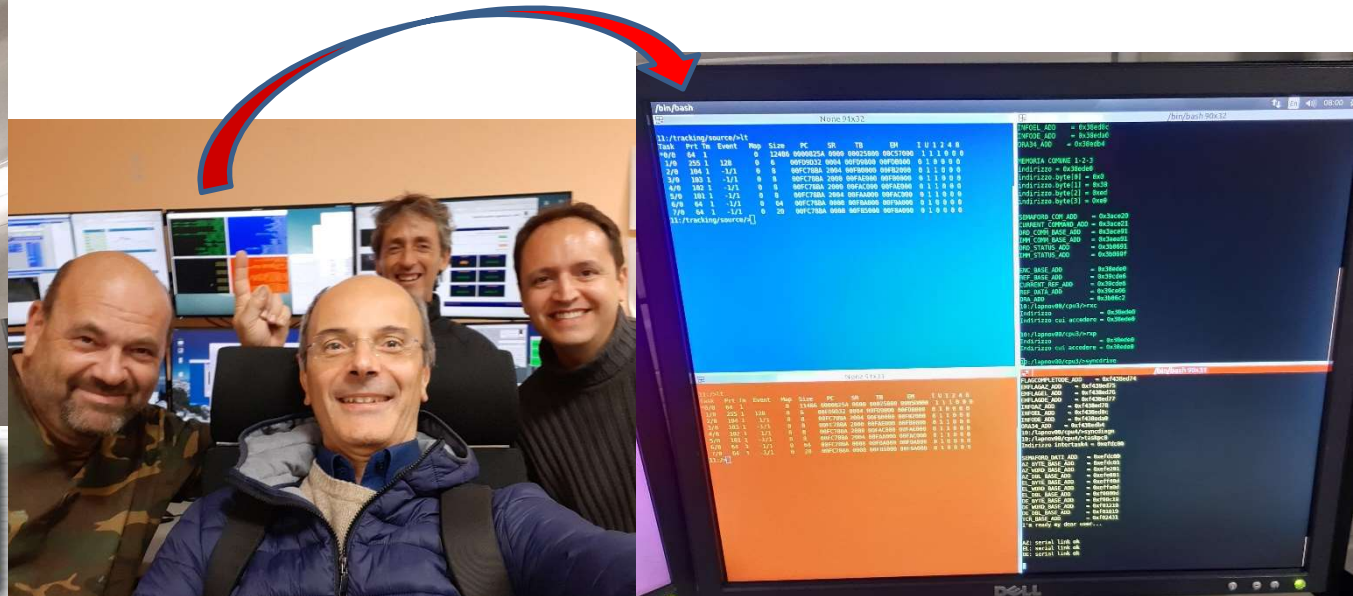- ❏ *Sets the telescope performance*
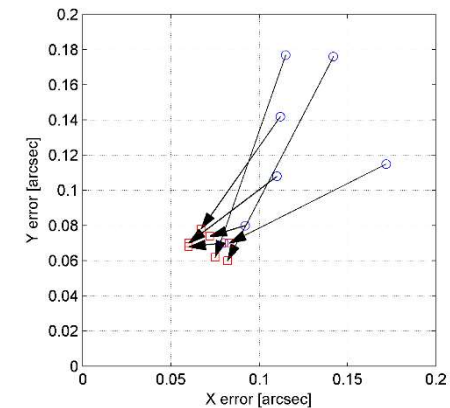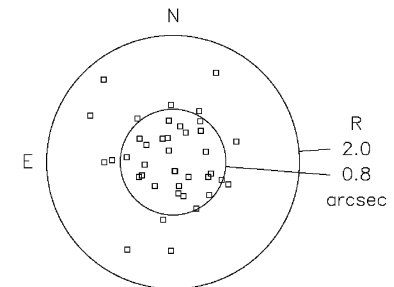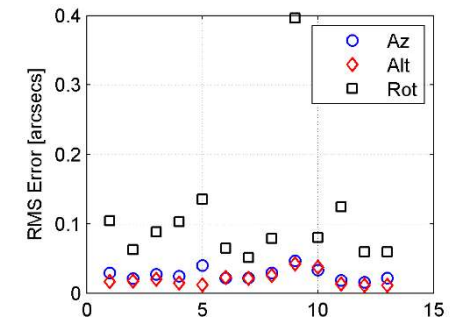
Tracking Control
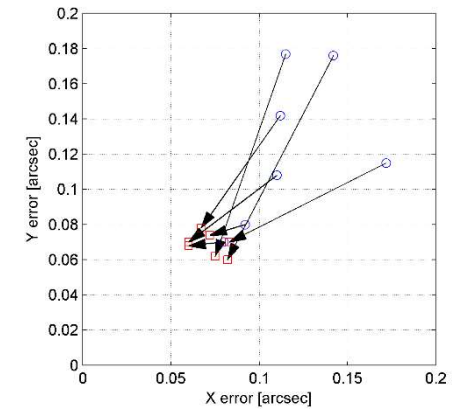
Tracking Control

- ❑ Trip back to the TNG
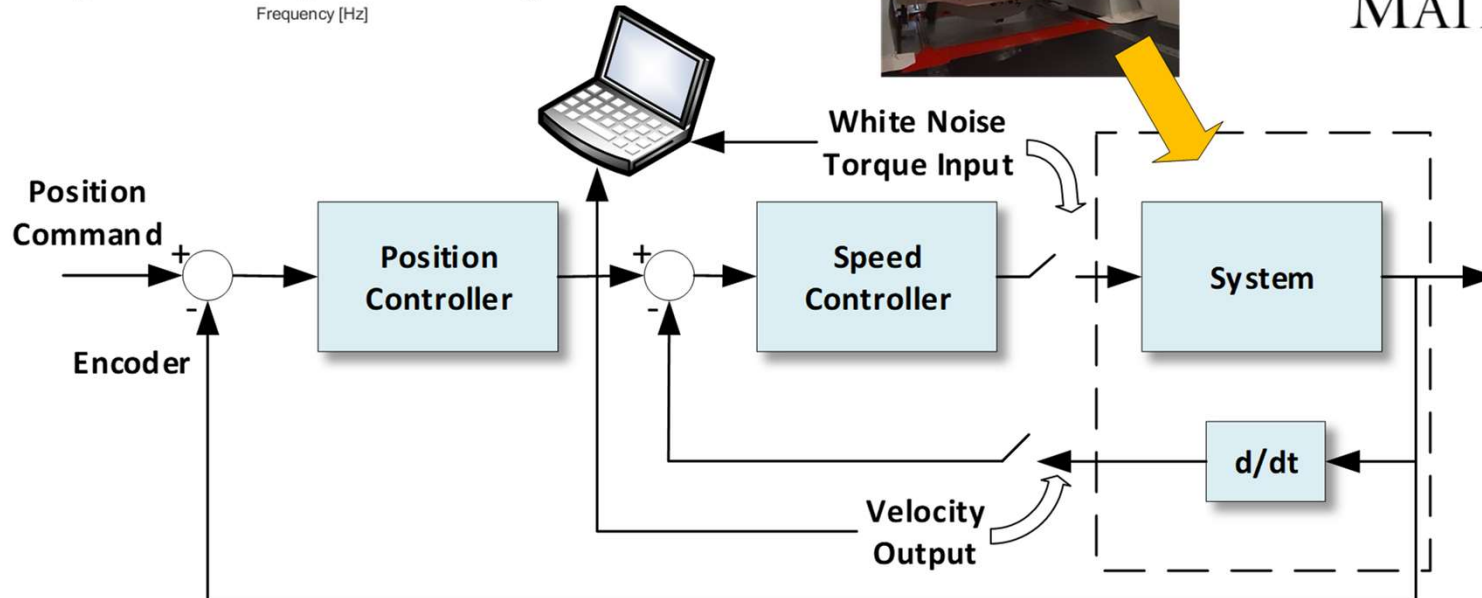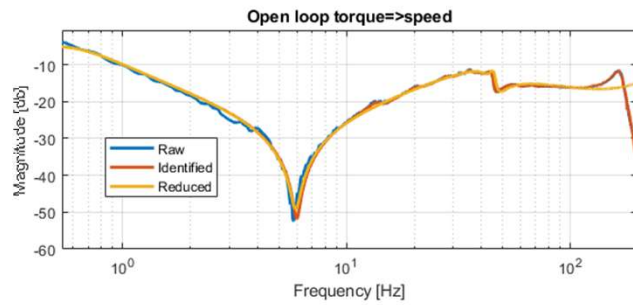- ❑ TNG Servo Control Redesign
- ❑ Azimuth Axis Completed

''After all this time''

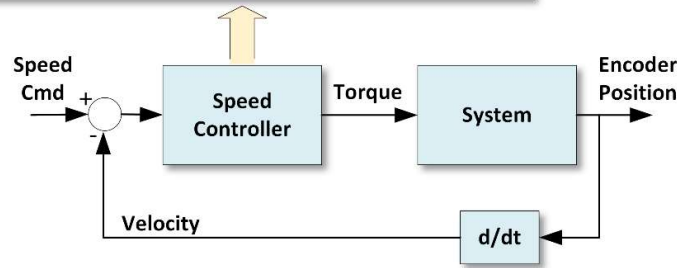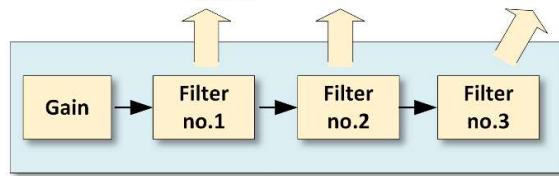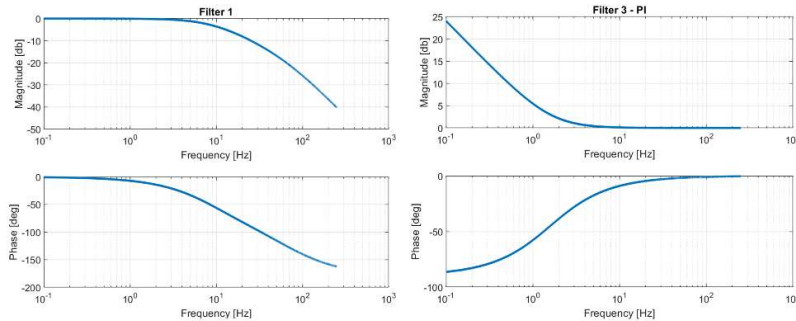Trigger for new activities in one historical application field

Telescope Control

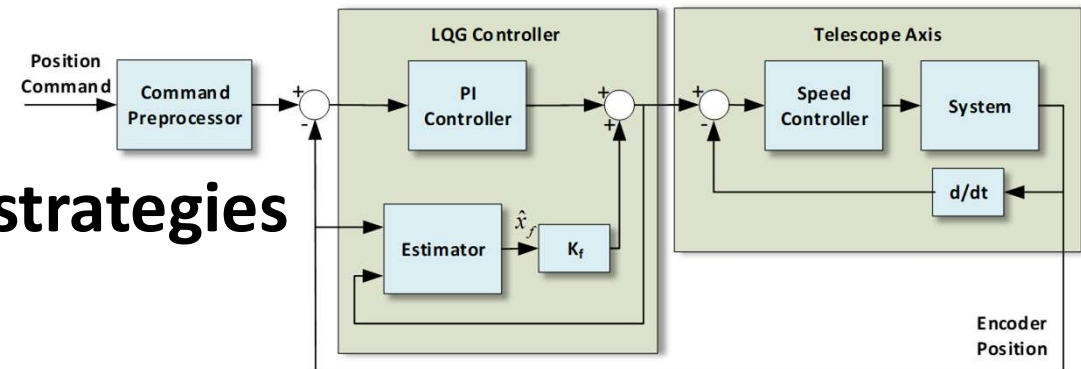## System Identification

Telescope Control

Pointing & Tracking Servo Controllers
- ❑ Design
- ❑ Implementation

Prototyping new control strategies
- ❑ Command shaper
- ❑ LQG Control

Conclusions

- Overview of some classes of applications
- Control Software
- But also control and software
- Control Electronics
- Control Engineering
- Multiwavelength 'sw' technologies (e.g. telescope control of pointing & tracking works for any optical-radio-etc. telescope or antenna)
- Possible synergies sw, sw+hw, sw+control