



«HW & SW strumentale (Monitoring e control)» @ Inaf-OATs: field of expertise and activities

Paolo Di Marcantonio on behalf of

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Roberto Cirami, Igor Coretti, Samuele Galeotta, Alessandro Marassi,
Antonio Sulich, Daniele Tavagnacco, Andrea Zacchei

Macro areas

Main area of expertise in the field:

- control (software and electronics) of telescopes, radiotelescopes, focal plane astronomical instruments and astronomical facilities
- software frameworks
- software methodologies (UML, MDA, UX/UI and requirements analysis)
- FPGA/GPU, RTOS, GUIs



Macro areas

Additional areas enabled by expertise gather in participating to international projects (see talks in other forum session's – science data segment, SysEng and PM):

- software management
- software system engineering
- data flow

Control software and electronics

- observational strategies
- high-level software
 - GUIs and HMIs design and development
 - coordination
 - algorithms (quick look, guiding, stabilization etc.)
- Low-level software
 - interoperability (OPC-UA, GigE etc.)
 - real-time systems
 - PLC (Beckhoff, Siemens) code development
- control electronics
- electrical distribution
- safety



FLAMES/GIRAFFE
control software
(1999-2002)



Xshooter control software
(2003 - 2008)

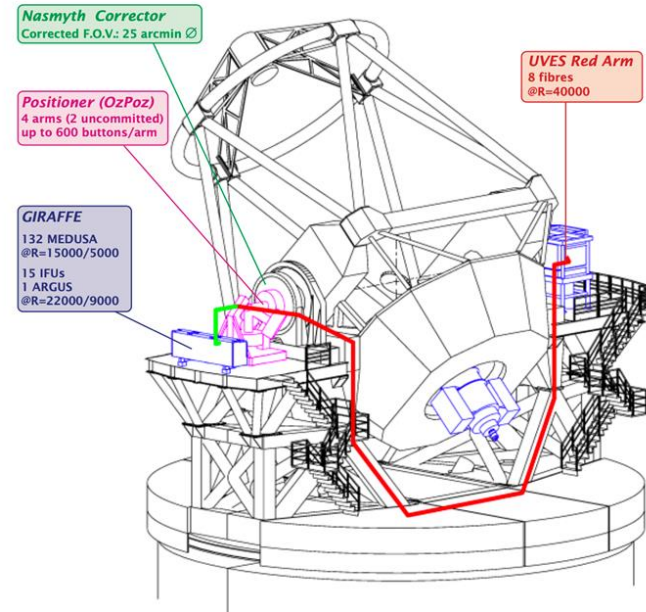


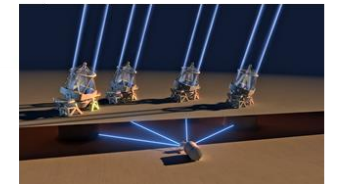
Figure 1. Scheme of FLAMES on Kueyen: all FLAMES components are indicated



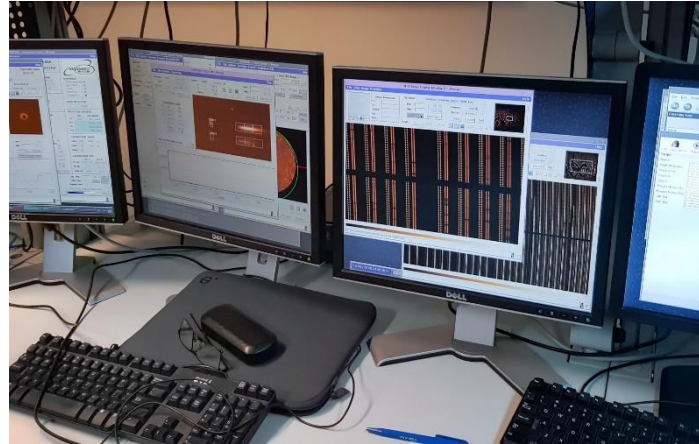
UVES control software
(1992-1999)



ESPRESSO software
(2011-2017)



Control software



FCS Devmgr Prototype (on algenib.oats.inaf.it)

File FCS Devices

States: **Operational** Idle

Device	State	Offset [uu]	Unit	Buttons
entr	Operational	0.00	[uu]	Setup gui
entr	Standstill	0 [enc]	0.0	
lmsk	Operational	0.00	[uu]	Setup gui
lmsk	Standstill	0 [enc]	0.0	
ldck	Operational	0.00	[uu]	Setup gui
ldck	Standstill	0 [enc]	0.0	
mxuh	Operational	0.00	[uu]	Setup gui
mxuh	Standstill	0 [enc]	0.0	
mxuv	Operational	0.00	[uu]	Setup gui
mxuv	Standstill	0 [enc]	0.0	
hel1	Operational	0 %	ON	Setup
hel1	Off	0.0	secs	
arl1	Operational	0 %	ON	Setup
arl1	Off	0.0	secs	
nel1	Operational	0 %	ON	Setup
nel1	Off	0.0	secs	

Time Type Command Parameters/Reply

SETUP STOP

HARPSN-AG TCCD engineering Field stabilization Stabilization status Algorithm

Status: **GUIDING OK**

Detector: Real camera Exp. status: video
Exp. time [s] [0.2]: 1.0 Set Radius mask [arcsec] [0]: 3 Set

Fiber Mode (Manual): X: 220 Y: 208
X: 220 Y: 208 Auto Manual/Click Defaults Set

Telescope offset Move [pix]:

Corrections Barycenter: X: 216.39 Y: 208.42 Corrections Apply

Live Image Integrated Image

Mean [arcsec] X: -0.000147 Y: -0.000087 Std. Dev. [arcsec] X: 0.15943 Y: 0.202769

ESPRESSO -- TCCD Operations -- @wespr

File Std. Options Stabil. param Overlays Misc. Help

Cursor information VALUE:

Field stabil. status **ON** Pupil stabil. status **OFF**

Painting Field Stabil. Pupil Stabil.

Field stabilization

Detector: F84 Real CCD
State: ONLINE Exposure
Exp. time: 0.10 Filter: F82D10
Flux corr.: 2 1 Set Reset

Fiber finding: Manual Auto
Mask radius: 2.073 (*) Set
Corrections: Skip Apply
Amount: (pix)

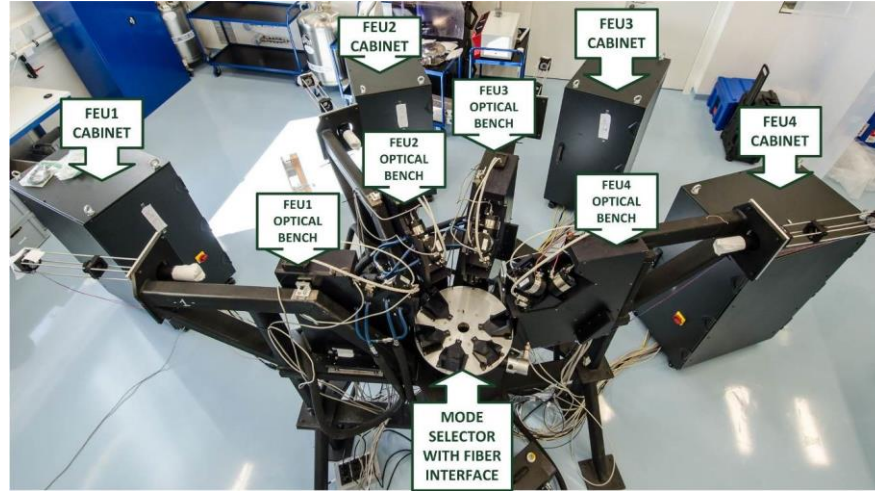
Deviations
Baryc. Fiber ref. Mean Std. dev.
X 110.6 112.0 -0.01 0.09
Y 111.4 111.1 0.00 0.07

Plot units: arcsec pixel Legend: Errors (fiber pos. - barycenter) x y Piezo corr.: x y

Control electronics



- ALARM SYSTEMS SIREN
- NETWORK SWITCH
- SHUTTERS CONTROLLER
(LEFT TO RIGHT: HR, UHR, MR)
- SHUTTERS POWER SUPPLIES
- BECKHOFF MAINTENANCE
CONTROL PANEL
- ALARM ANUNCIATORS
- ESO CABINET THERMAL
CONTROL UNIT
- BECKHOFF PLC 2 SUBRACK
(SPECTROGRAPH FUNCTIONS)
- BECKHOFF PLC 1 SUBRACK
(FEU FUNCTIONS)



People & Expertise

Control Software



Paolo Di Marcantonio



Roberto Cirami



Giorgio Calderone



Sara Bertocco (fraction)

Electronics / hardware



Igor Coretti

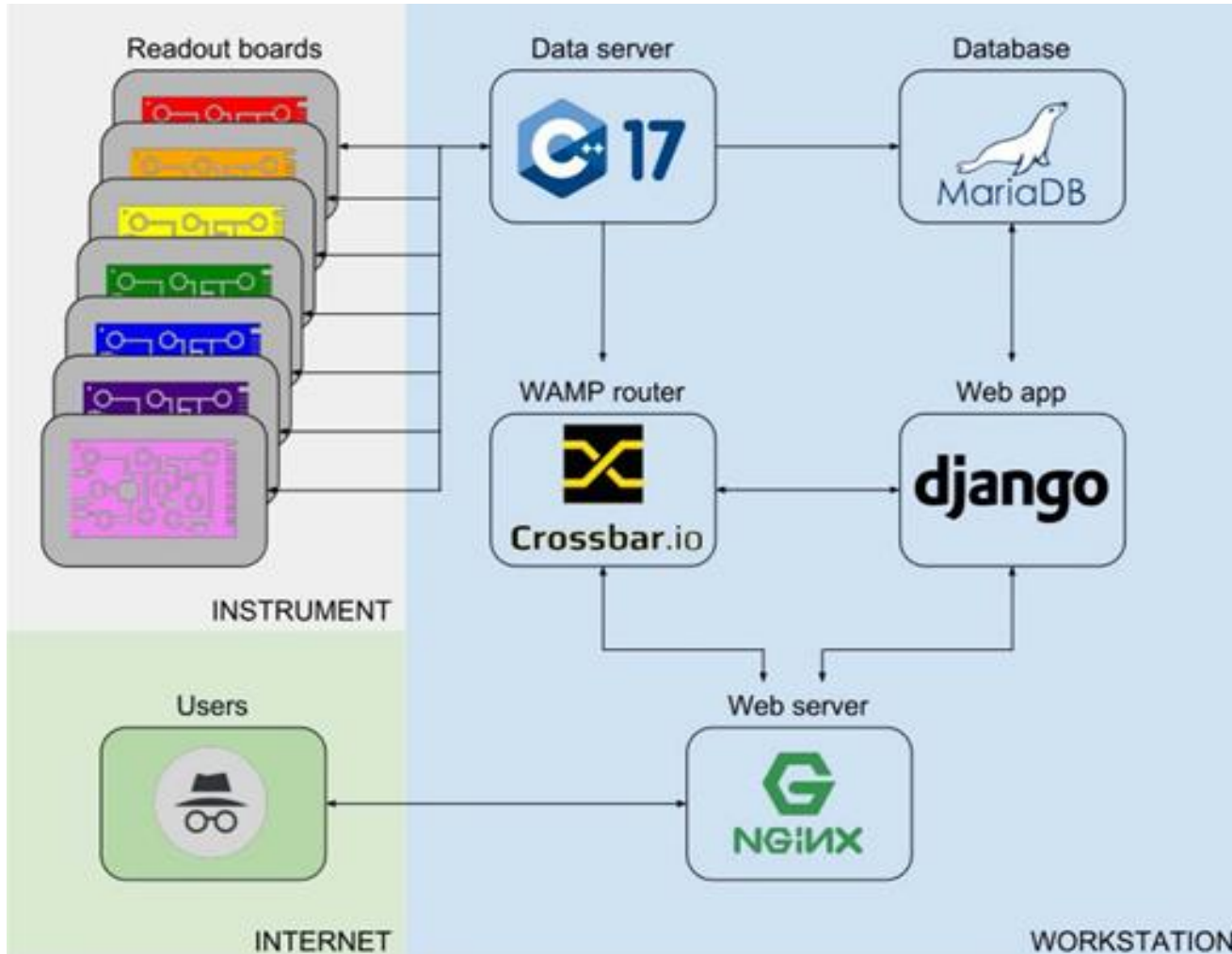


Veronica Baldini



Antonio Sulich

Telescopes



Daniele Tavagnacco



Samuele Galeotta



Andrea Zacchei

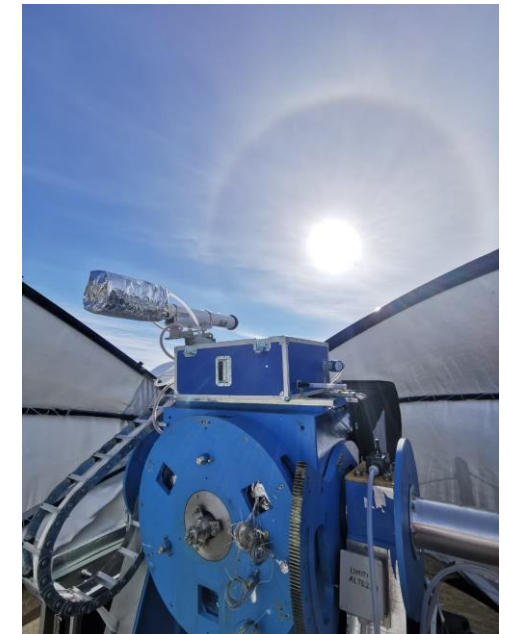
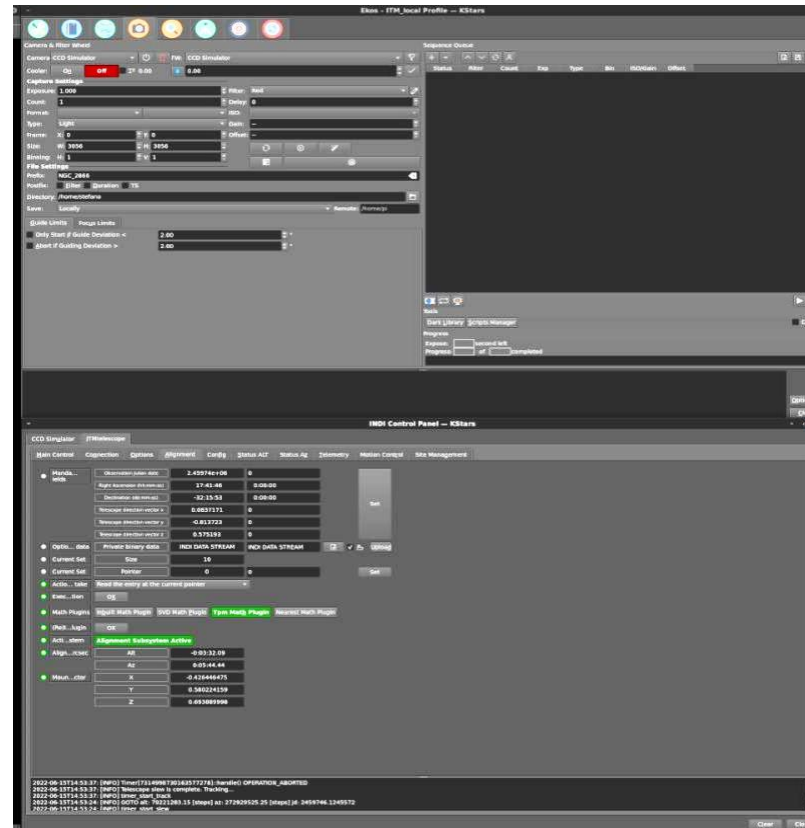
LSPE-STRIP

Survey TeneRife Polarimeter instrument is part of the *Large Scale Polarization Explorer* telescope devoted to the observation of the Cosmic Microwave Background (CMB).

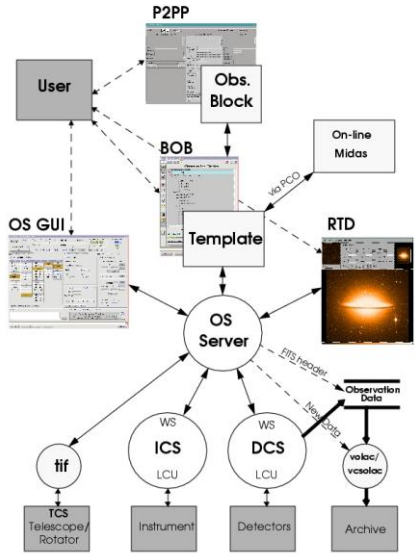
Telescopes

Antarctic telescope (ITM) opt-IR

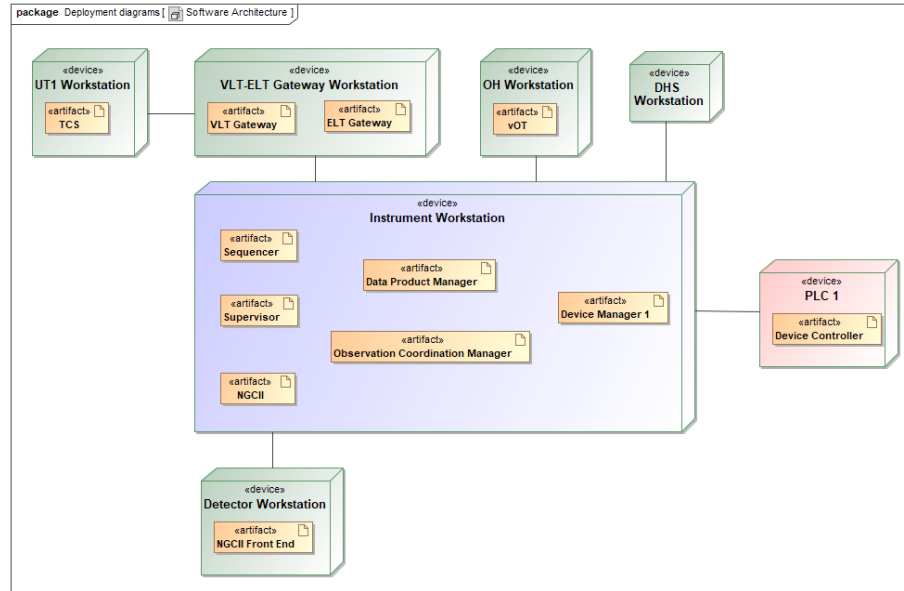
- Telescope @ DomeC managed by OAVdA (Aosta Valley)
- Design and installation of telescope control HW/SW:
 - PLC EVCO
 - phyMOTION (motor controllers)
 - INDI (open source software to control astronomical equipment)
- Control software and pointing model
 - Kstars
 - INDI-Ekos (Kstars plug-in)



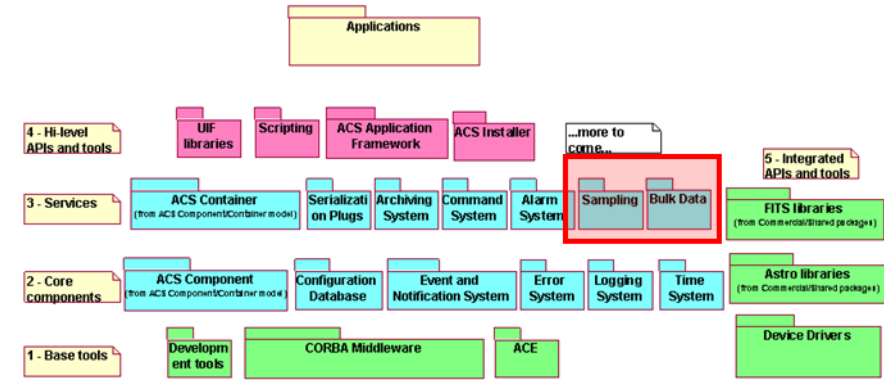
Frameworks - middleware



VLT framework



ELT IFW Framework



ACS Framework



Tango Framework

User eXperience/UI - SKA



Valentina Alberti

➤ Understand context of use

- Semi-structured interviews
- Affinity diagrams
- Story mapping

➤ Specify user requirements

- User roles and personas
- User-level use cases

➤ UI design solutions

- Visualization techniques
- Usability aspects
- Sketches and storyboards

➤ Evaluate against requirements

Mockup

Subarray overview (Taranto bar) | 17:30:00 TAI / 18:30:00 Local

Subarray 1 State: ● Health: ●

Subarray 1: IDLE → CONFIGURING → READY → SCANNING

Target: Name: NGC1068

Scan: ID: 1, Type: Science A, Progress: [Progress bar]

Frequency setup: Freq band: 1, Freq min: 0.35e9, Freq max: 1.05e9

Baselines: Active baselines: 2, Baselines health: ✓

Referen frame: ICRS, ra: 19:49:40.774, Pointing: ✓, Tracking: ✓

Processing: Type: Correlation, Block ID: pb-myp01-20200325-00001, Workflow: realtime v0.10, Buffer storage: ✓

Assigned resources: Dishes: 3,4, VCC: 12, FCP: 14, SDP: 01-23-45-67-89-AB

Component	HealthState	adminMode	OpsState	Simulator	ObsState	ObsMode
TMC	●	ONLINE	●	False	SCANNING	IMAGING
CSP	●	ONLINE	●	False	SCANNING	IMAGING
CBF	●	ONLINE	●	False	SCANNING	MAGING
SDP	●	ONLINE	●	False	SCANNING	IMAGING

Dishes:

No.	DishMode	State band 1	Pointing state	Power state	DS control state
03	Operate	Operate_FULLL	Track	Full	Remote
04	Operate	Operate_FULLL	Track	Full	Remote

FSP:

ID	healthState	adminMode	State	Function	obsState	Subarray	Unused resources
1	●	ONLINE	ON	CORR	SCANNING	1	--
4	●	ONLINE	ON	CORR	SCANNING	1	--

Selecting FSP would show this table instead of the dishes one. Only the FSPs used by the subarray will be shown

Power graph: Y-axis -30 to -50, X-axis 0.0 to 1.2. Phase graph: Y-axis -3 to 3, X-axis 0.0 to 1.2.

FPGA/GPU, RTOS, GUIs



Alessandro Marassi

Embedded Systems Software Design

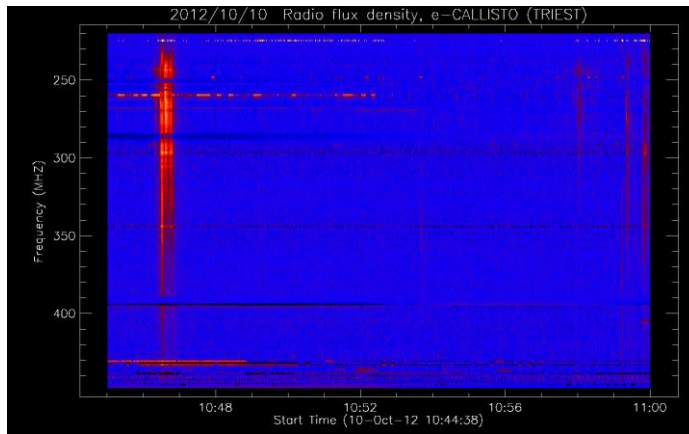
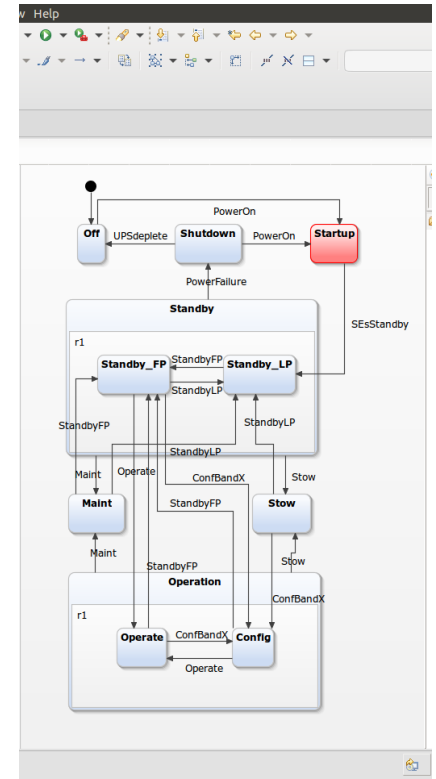
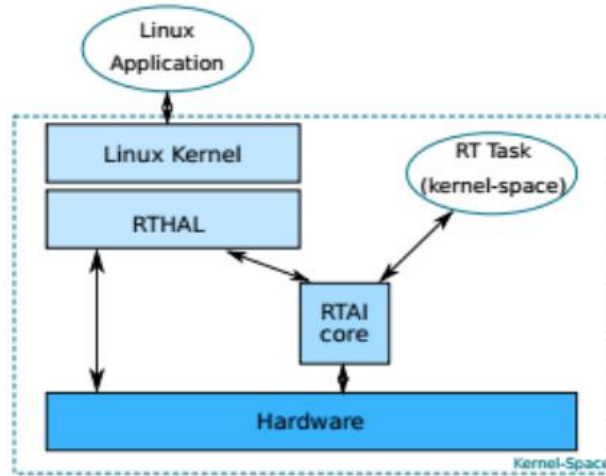
- RTOS
- CPU/FPGA/GPU Programming

Pattern Recognition

- Machine/Deep Learning

TANGO controls and GUI design/development

Radiotelescope control software



A screenshot of the SKA DSHLMC Engineering Interfaces software. It shows a 'Dish Element View' with a menu bar (Logs, Alarms, Archive, States/Modes/Health, Monitor, Control, Configuration). A central window titled 'Alarms <aken>' displays a table of alarm events.

Time	Alarm	Status	Acc	Message	Acknowledge Selected
Mon Sep 19 10:25:50 2005	sr/pscds1.2/feut	NORMAL	NOT_ACK		
Mon Sep 19 10:25:50 2005	sr/pscds1.2/foff	ALARM	ACK	messaggio di prova	Acknowledge edge
Mon Sep 19 10:25:50 2005	sr/pscds1.3/feut	NORMAL	NOT_ACK		
Mon Sep 19 10:25:50 2005	sr/pscds1.3/foff	ALARM	ACK	messaggio di prova	
Mon Sep 19 10:25:50 2005	sr/pscds1.4/feut	NORMAL	NOT_ACK		
Mon Sep 19 10:25:50 2005	sr/pscds1.4/foff	ALARM	NOT_ACK	messaggio di prova	
Mon Sep 19 10:25:50 2005	sr/pscds1.5/feut	NORMAL	NOT_ACK		
Mon Sep 19 10:25:50 2005	sr/pscds1.5/foff	ALARM	NOT_ACK	messaggio di prova	
Mon Sep 19 10:25:50 2005	sr/pscds1.6/feut	NORMAL	NOT_ACK		
Mon Sep 19 10:25:50 2005	sr/pscds1.6/foff	ALARM	NOT_ACK	messaggio di prova	
Mon Sep 19 10:25:51 2005	sr/pscds1.1/foff	ALARM	NOT_ACK	messaggio di prova	
Mon Sep 19 10:25:51 2005	sr/pscds1.5/foff	ALARM	NOT_ACK	messaggio di prova	

INAF Collaborations

- most of the projects we are involved in are projects with large international and national collaborations
- within these projects, INAF-OATs collaborates with many INAF institutes
- moreover the Instrument Control Group is part of TETIS Coordination Unit within the INAF UTG1 OptNIR Division

