1st TETIS Workshop

Tuesday 27 October 2020 - Thursday 29 October 2020

TEchnologies for Telescopes and Instrument control Software

Book of Abstracts

Contents

Radio / **2**

Tango Controls Software

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Tango Controls is a free open source device-oriented controls toolkit for controlling any kind of hardware or software and building SCADA (supervisory control and data acquisition) systems. Tango Controls is operating system independent and supports C++, Java and Python for all the components. It has been currently adopted as the software control framework in the main European synchrotrons and, thanks to INAF Contribution, also in Square Kilometre Array as the control software system for the whole telescope.
INAF is part of the TANGO Collaboration: an international effort to support the core developments, maintain the code and support the community.
The talk will be shown the TANGO Software Architecture, the role of INAF in the TANGO collaboration, and the INAF projects involved with the technology.

Radio / **3**

The Scaled Agile Framework (SAFe) distilled - and how it is working for SKA.

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Agile methodologies are becoming more and more popular while approaching the development of big software systems. Not only private software companies but also banks, telecommunications and transportation companies, health care, and others moved to this kind of approach to managing their business. SAFe is one of the possible frameworks for supporting this change and in particular, it is the one chosen by SKA to manage the software development process.

This presentation will give you a very high-level introduction of the Scaled Agile Framework along with some examples of its adoption in SKA.

ELT / **4**

ESPRESSO: a laboratory for ELT control technologies

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ESPRESSO is a fiber-fed, high-resolution, cross-dispersed echelle spectrograph installed at the ESO VLT-Cerro Paranal observatory. Since it is one of the latest instruments installed at VLT, it has been an ideal laboratory to explore the new technologies envisaged for the forthcoming ELT telescope.

The ESPRESSO control software is based on the VLT Control Software and uses the IC0 Field Bus extension (IC0/FB) to control devices connected to field-buses. The OPC Unified Architecture (OPC UA) protocol is used for the communication between the instrument control software, running on the instrument workstation, and the instrument control electronics. The latter is based on the Beckhoff PLCs (Programmable Logic Controllers), which replace the old VME-based Local Control Units (LCUs). The technical CCDs used for the field stabilization are based on the GigE interface. In this talk I will briefly review all the technologies described above.

ACS and ASTRI / 6

ALMA Common Software (ACS) - Introduction and status

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ACS is an open source project providing the infrastructure for the software of the
Atacama Large Millimeter Array and several other projects.
ACS provides a framework for the development of distributed systems based
on the Component/Container paradigm and a set of basic serviceslike:
• Transparent remote object invocation,• Publisher/subscriber paradigm
• System deployment/administration and object location
• Distributed error and alarm handling,
• Distributed logging,
• Configuration database,
In this presentation I will give an overview of ACS: basic concepts, history, status of collaboration and adoption, future perspectives, lessons learned.

Overview 2 / 8

A wide field survey of miliarcsecond software

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The Arcetri AO group, since its inception an undefined number of decades ago, has been developing software for high-resolution systems under a variety of frameworks and design methods. The main topics can be characterized as instrument control software, offline data analysis, laboratory software, and AO simulations. I will present an overview of past and current projects, of how our design methodology has changed over the years, and some details on the most interesting projects.

Space SW / 9

ECSS: Friend or Foe?

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ECSS, aka "European Cooperation for Space Standardization", is a consolidated (over 25 years of existence) set of standards devoted to all aspects of Space Projects from Management to Product Assurance and Engineering and even Sustainability (e.g. space debris and planetary protection). Batteries, finite element models, cables, risk management, adhesive stuff… all is there and anyone involved in a space project with ESA has to deal with them. Of course, being all-pervasive, they also cover Software, in particular SW Engineering and PA. They may look like a foe in the beginning but when understood and taken with the right attitude and set of tools they can be your friend. It may even happen that applying them also to ground based projects may not be such a lunatic idea.

Overview 2 / 10

EFISOFT : Sharing knowledges and resources on french ELT software development

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EFISOFT is a french national structure with some similarities with the TETIS initiative. The structure does include seven french laboratories, all are involved in one or several ELT instrument (HARMONI, MICADO, MAORY, MOSAIC and HIRES). More than a network, EFISOFT is supported by the cnrs/insu (inaf equivalent), thanks to convention ratified between universities. Its main goals is to structure the software development effort, to deploy shared software solution and sustain humain resources among laboratories. Training and cross-training as well as maintaining an efficient interface with ESO is also a preoccupation of EFISOFT.
I will present the structure, labs and people involved and how EFISOFT is being organised to tacle the workload on ELT instrument software realisation.
I will also spend some time to share the difficulties and successes of the newly born structure.

Overview 2 / 11

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

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We provide an overview of the software and control activities of the group, active in the last three decades in the field of telescopes and astronomical instrumentation control, in past and current projects. These works include deeply related tasks of control software, control electronics and control engineering as well as data handling activities, performance monitoring and control algorithms design, software implementation and tuning.

Space SW / 13

Development of the EUCLID's Data Processing Unit Application Software

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The EUCLID mission will capture a 3D image of the distribution of dark and baryonic matter from which the acceleration of the Universe will be measured to the percent level accuracy. Combining weak gravitational-lensing patterns from intrinsic alignments of galaxies and galaxy clustering probes, it will reveal signatures of the physical processes responsible for the expansion and the hierarchical formation of structures and galaxies in the presence of dark matter.

EUCLID is been equipped with a common wide-field view visible imager and a Near-Infrared Spectro-Photometer (NISP) for redshift measurements (resolution of 0.3 arc s px); combined data will be used to derive an estimate of redshift for the two billion galaxies.

We offer a comprehensive description of the application software (ASW) of the NISP's Data Processing Unit (DPU), including the software development choices, standards, architecture, trade-offs, as well as the continuous integration, and the configuration control toolkits. We also provide a detailed description of a DPU-ASW's peculiarity, which is the implementation of the on-board
data pre-processing that allows for high data reduction. Finally, we offer the validation campaigns of the ASW deployed in the NISP Flight model. All processes that lead to the qualification of the DPU-ASW's Flight version.

Space SW / 14

Space mission instruments Real-time control software: from requirements definition to flight version

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A brief description of the workflow followed during EUCLID NISP-ICU ASW development phases.Hardware platforms, SW development tools and future prospectives will be presented.

Radio / 15

Present, past and future of the development of the control software for the Italian radio telescopes

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DISCOS (Development of the Italian Single-dish COntrol Software) is presently founded on a small group of people - endorsed by the UTG2 of the Scientific Directorate of INAF "National Division for Radioastronomy" - aimed at delivering the control software for the Italian radio telescopes. The core of the project was born several years ago, during the construction of the Sardinia Radio Telescope. As of today it has gone through all the phases of the software life cycle, reaching the current stage of maintenance and extension. We operate and support all three antennas. Along time, many tools and high-level applications for observers have been included, as well as several related projects developed within INAF.
In this talk, we will briefly present the DISCOS project and the related activities. We will also provide feedback regarding the experience gained in recent years and we will analyze, in retrospect, the worst practices, the causes and consequences of management and design errors. We will also introduce the future plans. Finally, we will discuss some of the actions taken in order to mitigate the impact of the errors from the past that affect both the present maintenance and the future developments.

ELT / 16

Product & Quality Assurance for Space Projects

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The presentation will be organised in two main parts which are respectively an introduction covering general PA/QA topics, including a short overview of the ECSS Standards, and a specialised part addressing SW PA/QA principles, in which the ECSS related to the SW Product & Quality Assurance will be detailed.

ACS and ASTRI / 17

The ASTRI-Mini Array software engineering approach and the on-site software system

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The ASTRI (Astrofisica con Specchi a Tecnologia Replicante Italiana) Mini-Array consist of nine identical dual-mirrors Cherenkov gamma-ray telescopes that will be installed at the site of the Teide Observatory in Tenerife (Spain). The Mini-Array operation phase consists of two distinct periods: during the first three years, the Mini-Array will carry out dedicated science programs defined by the Astri Science Team, then it will also be partially open to execute observing programs proposed by the science community. In addition to the gamma-ray scientific program, the ASTRI Mini-Array will allow to perform optical intensity interferometric observations of bright stars.

The Mini-Array will be operated and monitored remotely from Control Rooms located at La Laguna in Tenerife and possibly also in Italy. Only maintenance activities will be carried out with the presence of personnel at the site. The raw data collected by the telescope array during the night will be transferred, in quasi-real-time, to the ASTRI Data Center in Italy to reduce the amount of computing power and storage needed at the site. In the ASTRI Data Center the data will be archived and processed to produce the final science data sets ready to be analysed with standard science data analysis tools.

Here we present a general overview of the ASTRI Mini-Array software engineering and architecture. Also, we will discuss more in details the architecture of Mini-Array Supervisory Control and Data Acquisition system that will manage and control all telescopes installed at the Teide Observatory.

ELT / 21

ELT Instrument control software framework –Development status and future challenges

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ESO is in the process of implementing a new instrument software framework with the aim to help instrument developers in building the control systems for future VLT and ELT instruments. The framework, that is still in a development phase, is adopting many new technologies according to the ELT development standards but reusing proved concepts from its predecessor at the VLT. This project is facing several challenges being one of the most important ones, the concurrent development of the software stack such as the Core Integration Infrastructure (CII), NGC II and the RTC toolkit, as well as the development of the first light instruments. This presentation will give an overview of the current status of the framework going through the main architectural principles, languages and technologies that ESO has adopted for its development together with the details of the software engineering process and its main components.

Overview 1 / 22

Welcome Address

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Overview 1 / **23**

Introduction

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Overview 2 / **29**

Discussion

Radio / **35**

Closing remarks

Overview 1 / **36**

The Instrumentation Control Group of Inaf-OATs: a brief overview of experiences and activities

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In this talk I'll present the Instrumentation Control Group of INAF-OATs focusing on the experiences gathered by the group in participating in several national and international projects spanning a period of several decades in the field of astronomical instrumentation. The know-how achieved covers, among others, topics related to control software, control electronics, software system engineering, software design methodologies, integration and commissioning activities. During the talk I' ll give a quick survey of the most important projects we participated in and I'll conclude the overview presenting our current and foreseen future activities.

Overview 1 / **37**

Overview of Control Software Development Activities at IAPS

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INAF IAPS research groups have a long time expertise in the production of scientific instrumentation for space missions. Thanks to ASI funding and in collaboration with the national industries leader in the space sector, IAPS, the Institute for Space Astrophysics and Planetology of INAF, often participates in the development of control electronics for space instrumentation, with direct involvements in the HW design and responsibilities for the control SW production.
Over the years, a consolidated expertise has been gained in developing real time applications for the most important space qualified processors and interfaces.
This contribution provides a brief description of some examples of the developed systems, describing the used environments and highlighting the lessons learnt about the adopted processes, trying to define what may be the potential need for future collaborations with other TETIS participants.

Overview 1 / 38

Control Software for Space Applications at OATo

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In this presentation I will outline the activities of the group at INAF-OATo working on avionics and control SW for space applications. I will present the background of the participants, our activities in the last years (mainly centered on the design of the Warm Electronics Units and on the Application SW for the Instrument control unit for the NISP instrument on board the Euclid mission), and the planned future projects.
Finally, I will give my view on some of the lessons learned from working in a very distributed project (as it was the case for Euclid and will be increasingly be the case for most large projects).

ELT / 39

The Instrument Control Software of MAORY, the MCAO module for ELT.

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We present the current status of the instrument control software of MAORY, the Multi-conjugated Adaptive Optics RelaY module for the Extremely Large Telescope.
MAORY is currently approaching the Preliminary Design Review (Apr 2021) and will serve as AO module for the first light instrument MICADO and for a future second instrument.
In particular first we give an overview of the functions under SW control and the interface with MICADO. We then focus into the preliminary architectural design of the control software, which is based on the ELT-SW framework under development at ESO, and takes into account the different operational requirements of two MAORY's main components, one dedicated to multi-conjugated and one to single-conjugated observations.

Overview 2 / 40

Control Software Development Activities at INAF OAPd

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In INAF-OAPd there is a long time experience in the development of control software for (mostly) ground-based Optical and Near Infra-Red astronomical instrumentation and telescopes. In this talk, I will give a brief overview of the past activities of the INAF-OAPd Control SW Group and will then introduce our current projects, all while trying to highlight aspects relevant to this Workshop.

Space SW / 41

Model driven SW architecture: ESA Euclid and PLATO control SW examples.

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TBW

ACS and ASTRI / 42

The ASTRI-Horn Telescope Control System

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The ASTRI-Horn Cherenkov telescope, installed at Serra La Nave on the Mount Etna (Italy), has been developed by INAF in the context of the "Astrofisica con Specchi a Tecnologia Replicante Italiana" (ASTRI) Project. It is the INAF proposed prototype for the Small Size class of Telescopes of the future Cherenkov
Telescope Array (CTA) and for the INAF Mini Array which will be installed at the Observatory of Teide in Tenerife (Spain).
ASTRI-Horn uses a dual-mirror configuration and a Cherenkov camera having a detector composed

of an array of monolithic silicon photomultiplier sensors (SiPM) coupled with a specifically designed front-end and back-end electronics. Therefore ASTRI-Horn represents a successful innovative solution for the detection of atmospheric Cherenkov light as was demonstrated by the detection of the Crab Nebula during the Science Verification phases.
The ASTRI-Horn is an end-to-end system. Great efforts were dedicated to the development of the Telescope Control System (TCS) whose task is to allow the operation and maintenance of the telescope controlling and coordinating all the functionality of the telescope subsystems.
Each Telescope subsystem (e.g. Mount, Optical Assembly, Cherenkov Camera, etc) has its own Local Control system which interacts with the hardware devices. At this lower level there are more stringent requirements regarding performance, reliability and safety, since this is where the real telescope handling logic resides as well as the telescope safety system.
The purpose of this contribution is to give a general overview of the ASTRI-Horn TCS presenting its architecture and the solutions adopted. Particular emphasis will be given to describe the camera control system including its graphical user interface designed to support both the laboratory and on site camera operation activities.

Space SW / 43

Flight Software Development at Uni Vienna with the CORDET Framework

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The Department of Astrophysics at Uni Vienna are a provider of flight software for scientific instrumentation. A description of specific challenges in the development of such SW is given and we show how some of these are mastered with the help of the CORDET framework. We explain what it covers and how to get started.