PROCEEDINGS OF SPIE

Software and Cyberinfrastructure for Astronomy VIII

Jorge Ibsen Gianluca Chiozzi Editors

16–21 June 2024 Yokohama, Japan

Sponsored by SPIE

Cosponsored by NAOJ—National Astronomical Observatory of Japan (Japan) NICT—National Institute of Information and Communications Technology (Japan) JNTO—Japan National Tourism Organization (Japan) City of Yokohama (Japan)

Cooperating Organization Optronics Co., Ltd. (Japan)

Published by SPIE

Volume 13101

Part One of Two Parts

Proceedings of SPIE 0277-786X, V. 13101

SPIE is an international society advancing an interdisciplinary approach to the science and application of light.

The papers in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. Additional papers and presentation recordings may be available online in the SPIE Digital Library at SPIEDigitalLibrary.org.

The papers reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from these proceedings: Author(s), "Title of Paper," in Software and Cyberinfrastructure for Astronomy VIII, edited by Jorge Ibsen, Gianluca Chiozzi, Proc. of SPIE 13101, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X ISSN: 1996-756X (electronic)

ISBN: 9781510675254 ISBN: 9781510675261 (electronic)

Published by **SPIE** P.O. Box 10, Bellingham, Washington 98227-0010 USA Telephone +1 360 676 3290 (Pacific Time) SPIE.org Copyright © 2024 Society of Photo-Optical Instrumentation Engineers (SPIE).

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by SPIE subject to payment of fees. To obtain permission to use and share articles in this volume, visit Copyright Clearance Center at copyright.com. Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher.

Printed in the United States of America by Curran Associates, Inc., under license from SPIE.

Publication of record for individual papers is online in the SPIE Digital Library.



Paper Numbering: A unique citation identifier (CID) number is assigned to each article in the Proceedings of SPIE at the time of publication. Utilization of CIDs allows articles to be fully citable as soon as they are published online, and connects the same identifier to all online and print versions of the publication. SPIE uses a seven-digit CID article numbering system structured as follows:

• The first five digits correspond to the SPIE volume number.

• The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B ... 0Z, followed by 10-1Z, 20-2Z, etc. The CID Number appears on each page of the manuscript.

Contents

xiii Conference Committee

Part One

SESSION 1	PROJECT OVERVIEWS AND PROGRESS
13101 02	Software life cycles in astronomy: 40 years of computing at CFHT [13101-1]
13101 03	SKA telescope control system design and status [13101-2]
13101 04	Status of the European Solar Telescope control system [13101-3]
13101 05	Status of the ELT control software development [13101-4]
13101 06	Reconstruction of the computer, software, and data systems of Leighton Chajnantor Telescope [13101-5]
SESSION 2	OBSERVATORY/TELESCOPE CONTROL I
13101 07	Software infrastructure for the highly-distributed semi-autonomous Dragonfly spectral line mapper [13101-6]
13101 08	USNO's unified telescope control software [13101-7]
13101 09	Control/monitoring system: lessons from APEX remote operations, comparison to Paranal, and perspective towards ELT [13101-8]
13101 0A	SKAO observation execution tool: designing for concurrent, responsive observations [13101-9]
13101 OB	Sofware framework for controlling any linear or rotation axis and any sensor of a telescope [13101-10]
13101 OC	The METIS instrument control system [13101-147]
SESSION 3	SOFTWARE TESTING/QUALITY

13101 0D Advanced log analysis for operations at Paranal Observatory [13101-77]

- 13101 OE Enhancing SKA software testing through data mining strategies [13101-13]
- 13101 OF Open-source simulation tools for verifying NASA Pandora SmallSat's scientific performance [13101-14]
- 13101 0G A unit testing approach to developing an industrial real time distributed control system for the New Robotic Telescope [13101-15]
- 13101 OH Methodology for the integration of the array control and data acquisition system with array elements of the Cherenkov Telescope Array Observatory [13101-16]

SESSION 4 INSTRUMENTATION CONTROL

- 13101 01 Advancements in astronomical instrumentation: a new control software framework for ELT and VLT instruments at ESO [13101-17]
- 13101 0J VERTECS: A COTS-based payload interface board to enable next generation astronomical imaging payloads [13101-18]
- 13101 0K The design of WFST camera control system [13101-19]
- 13101 OL The fibre target alignment process of the 4MOST instrument [13101-20]
- 13101 0M ANDES, the high resolution spectrograph for the ELT: the software ecosystem [13101-21]

SESSION 5 AI AND ML APPLIED TO CONTROL

13101 ON	Pointing model meets deep learning: a retrospective study on a MeerKAT+ telescope applying deep learning methods for blind pointing corrections [13101-22]
13101 OP	Integrating deep neural networks with COSMIC for real-time control [13101-24]
13101 0Q	Deep learning solutions to telescope pointing and guiding [13101-25]
13101 OR	Machine learning-driven approaches for precision antenna alignment [13101-26]

SESSION 6 DATA MANAGEMENT, PROCESSING AND PIPELINES I

- 13101 0S Specreduce: An AstroPy-coordinated toolbox for spectroscopic data reduction [13101-27]
- 13101 0T Advancements in streamlining time-domain and multimessenger astronomy follow-up infrastructure at Keck Observatory [13101-28]

13101 OV Simons Observatory: observatory scheduler and automated data processing	13101-	-30]
--	--------	------

13101 OW	Implementation plans for the data reduction pipeline for METIS at the ELT [].	13101-31]	
----------	---	-----------	--

SESSION 7 AI AND ML

13101 OX	Redesign of astrophysical codes for exascale computing: the SPACE experience [13101-32]
13101 OY	Astronomical PSF characterization using grammar evolution and symbolic regression [13101-33]
13101 OZ	The survey of surveys: machine learning for stellar parametrization [13101-35]

13101 10 Unanticipated fault diagnosis of large telescopes based on IGWO-iForest [13101-36]

SESSION 8 CLOUD TECHNOLOGIES/ADOPTION

13101 12	Efficient use of commercial cloud for astronomical data archive and data analysis [13101-38]
13101 13	Moving forward to a cloud hybrid infrastructure for La Silla Paranal Observatory [13101-39]
13101 14	Securing the software supply chain for containers: practices and challenges in a cloud-native landscape for a global observatory [13101-40]
13101 15	Embracing Industry 4.0 paradigms for digital transformation at the Gran Telescopio Canarias [13101-41]

SESSION 9 OBSERVATORY/TELESCOPE CONTROL II

13101 16	ELT tracking local supervisors design and development status []	13101-42]
----------	---	-----------

- 13101 18 Replacing DDS with Apache Kafka as middleware technology for the Rubin Observatory control system [13101-44]
- 13101 19 Design, implementation, and deployment of SKAO's AlarmHandler, the software system to automatically handle Tango controls attribute alarms in the SKA control system of SKA Low and SKA Mid [13101-45]
- 13101 1A The WALOP software [13101-46]

13101 1C	Architecture and implementation of a 25000 FPS radio camera on the long wavelength array [13101-48]
13101 1D	The first release of the Cherenkov Telescope Array Observatory array control and data acquisition software [13101-49]
13101 1F	HERMES (HOP Enabled Rapid Message Exchange Service): an application and interface that facilitates sharing structured data between science teams over Kafka for time-domain astronomy [13101-51]
SESSION 11	CYBERINFRASTRUCTURE
13101 1G	A modern DevOps and serverless architecture for the New Robotic Telescope software infrastructure [13101-52]
13101 1H	HPC and GPU accelerated imaging toward the SKA era [13101-53]

13101 11 Innovations and impact of the CANFAR science platform [13101-54]

SESSION 12 DATA ENGINEERING

13101 1K	An asynchronous web application to visualise large sky surveys [13101-57]
13101 1L	Log detector: enhancing efficiency through automated issue detection and reporting at ALMA [13101-58]
13101 1M	Sasquatch: Rubin Observatory metrics and telemetry service [13101-59]
13101 1N	The database quest for the Square Kilometre Array [13101-60]
13101 10	The Gaia AVU–GSR solver: CPU+GPU parallel solutions for linear systems solving and covariances calculation toward exascale systems [13101-61]
SESSION 13	DATA MANAGEMENT, PROCESSING AND PIPELINES III
13101 1P	The United States extremely large telescope (US-ELTP) NOIRLab program platform: user services, data management, and science platform for ELT science [13101-62]
13101 1Q	Development of a data reduction pipeline for the Aspera SmallSat mission [13101-63]

13101 1R Concept verification of the JASMINE astrometric plate analysis [13101-64]

13101 15 Updates on the transients handler of the Cherenkov Telescope Array Observatory [13101-65]

SESSION 14 PROJECT MANAGEMENT/SOFTWARE ENGINEERING

	13101 1U	SKAO software development management: an update [13101-67]
	13101 1V	Tackling software management challenges on the GMT project [13101-68]
	13101 1W	Lessons learned and challenges in maintaining the ViaLactea knowledge base [13101-69]
	13101 1X	Development of the observatory software for the SKAO [13101-70]
	13101 1Y	Software development and integration of an adaptive-optics testbed using the Giant Magellan Telescope software frameworks [13101-71]
	13101 1Z	Engineering maintainable software in a research software landscape: the new LOFAR2.0 proposal tool [13101-72]
-		POSTER SESSION: SOFTWARE AND CYBERINFRASTRUCTURE FOR ASTRONOMY
	13101 20	Extensible pipeline development powered by PyCPL and PyEsorex [13101-73]
	13101 21	Optimizing thermal control of the MMTO primary mirror [13101-74]
	13101 22	Tracing component wear signatures in ASTRI-Horn historical monitoring time-series [13101-75]
	Part Two	
	13101 23	The blue multiunit spectroscopic explorer (BlueMUSE) on the VLT: end-to-end simulator BlueSi [13101-78]
	13101 24	Rsimu: design of the component simulation framework for RACS2 [13101-79]
	13101 25	Data reduction pipeline for the METIS integral field spectrograph [13101-80]
	13101 26	Using a random forest for antenna bandpass fault detection in the low-frequency Square Kilometre Array [13101-81]
	13101 27	The software version control procedure for the array control and data acquisition software of the Cherenkov Telescope Array Observatory [13101-82]
	13101 28	MORFEO: instrument control software continuous integration and software quality assurance [13101-83]

13101 29	The science alert	generation sys	stem of the Cher	enkov Telescope A	Array Observatory	[13101-84]
10101 27	The selence aleri	generation sys		cline releacope r	andy obscrivelory	

- 13101 2A H2RG controller and data acquisition for GTC-EMIR+ [13101-85]
- 13101 28 **Rubin's hybrid on premises-cloud data access center** [13101-86]
- 13101 2C Building a vibration anomaly detection system for VLTI UT runs [13101-87]
- 13101 2D Data archive and data management software at the Large Millimeter Telescope [13101-88]
- 13101 2E Bringing FORS into the ELT era: implementation of the control software [13101-89]
- 13101 2F Automated scheduler for the SOXS instrument: design and performance [13101-90]
- 13101 2G The SOXS instrument control software approaching the PAE [13101-91]
- 13101 2HThe resource manager and central control systems for the Cherenkov Telescope Array
Observatory [13101-93]
- 13101 21 Efforts to improve software maintainability at ASTRON [13101-94]
- 13101 2J A deep neural network to restore pulsar dynamic spectra corrupted by radio frequency interference [13101-95]
- 13101 2K MAVIS: designing the interface between instrument control software and SRTC [13101-96]
- 13101 2L Upgrade of VLT-FORS control system: details on its final design and construction phase [13101-97]
- 13101 2M Addressing obsolescence: migrating Grantecan's primary system to a new real-time solution [13101-98]
- 13101 2P Investigation into the use of machine learning to detect memory leaks during continuous integration testing of observatory control software [13101-100]
- Automation of the full functional tests by execution of the regression verification of the main functionalities of the boot software (BSW) of the PLATO payload [13101-101]
- 13101 28 Management of LOFAR 2.0 station states and transitions through the TANGO-controls framework [13101-103]
- 13101 2T Building the largest mock astrometric catalogue of the Milky Way centre in the near infrared for the end-to-end simulation of the JASMINE satellite [13101-104]
- 13101 20 Autonomous interactive agents for global telescope network orchestration [13101-105]
- 13101 2V **TCSpy: Multitelescope array control software for 7-Dimensional Telescope (7DT)** [13101-106]

- 13101 2W The intelligent observatory: software for robotic operation, monitoring, and safeguarding [13101-108]
- 13101 2X
 The ERIS pipeline [13101-109]
- 13101 2Y
 AI detection of S/N<1 sources in infrared images: a deep learning algorithm developed for the AZT24 facility at Campo Imperatore Observatory [13101-110]</td>
- 13101 27 SKA base classes: a case study of reusability of code in a large-scale telescope control system [13101-111]
- 13101 31 The PLC control system development from ASTRI-Horn to ASTRI Mini-Array [13101-113]
- 13101 32The comprehensive monitoring, logging, and alarm system for the Cherenkov Telescope Array
Observatory [13101-114]
- 13101 33 The instrument control software of the LOCNES near infrared solar telescope [13101-115]
- 13101 34 FAST: a software suite for automatic weather and optical turbulence forecast on ground-based telescope sites [13101-116]
- 13101 35 The Gaia AVU-GSR pipeline: a verification pipeline for the global astrometric sphere reconstruction and its future developments [13101-117]
- 13101 36 ASTRI Mini-Array on-site information and communication technology infrastructure [13101-118]
- 13101 38 The implementation of the Ariel FGS application software [13101-120]

POSTER SESSION: SOFTWARE AND CYBERINFRASTRUCTURE FOR ASTRONOMY

- 13101 38 A reliable and automated orchestrator for the computing system of the ASTRI project [13101-56]
- 13101 3C CCAT: FYST prime-cam readout software: a framework for massively scalable KID arrays [13101-122]
- 13101 3D The electronics and control of mechanisms and house-keeping for the FRIDA instrument: current status and achievements [13101-123]
- 13101 3E Datasink: an efficient open-source system for reliable transfers of observatory data and jobs [13101-125]
- 13101 3F A modern GUI for the control and tuning of the Gemini Observatory M2 tip/tilt/focus mechanism [13101-128]
- 13101 3G Converting Rubin Observatory's data butler to a client/server architecture [13101-129]
- 13101 3H **HEART: automated build and test infrastructure for real-time controller development** [13101-130]

13101 31	Correcting non-common path aberrations with deep learning and ERIS on VLT [13101-131]
13101 3J	Programming methodologies of NSF's DKIST facility management system [13101-132]
13101 3L	MAVIS: The preliminary data reduction pipeline [13101-135]
13101 3M	Iterative development of a python-driven software for detector control replacement at Gemini Observatory [13101-136]
13101 3N	Bright star subtraction pipeline for LSST: phase one report [13101-137]
13101 30	Integration of machine learning and other software solutions to enhance SALT's observational efficiency [13101-138]
13101 3P	Use of a finite state machine approach for sequence control in the GREGOR infrared spectrograph (GRIS) [13101-140]
13101 3Q	Python and pipelines: Python interfaces for ESO's CPL and HDRL data reduction libraries [13101-141]
13101 3R	Taurus integration to ELT control software [13101-142]
13101 3T	Description of MORFEO SRTC physical design and prototyping activities [13101-144]
13101 3U	METIS AOCS at the beginning of MAIT [13101-145]
13101 3V	METIS RTC as a computationally heavy system [13101-146]
13101 3W	The MICADO first light imager for the ELT: PLC-based software design for cryogenic control [13101-148]
13101 3X	MORFEO at ELT: recent updates in the real-time computer design [13101-149]
13101 3Y	DAO4MATTO: the real-time control implementation for the MATTO test bench [13101-150]
13101 3Z	The Simons Observatory: a minimum-cost matching algorithm for pairing measured resonances with designed detectors [13101-151]
13101 41	VSTPOL: upgrading the VST instrument control software for the new wide-field polarimetric mode [13101-153]
13101 43	ASPIS prototype for causal chains of space weather phenomena [13101-155]
13101 44	Active optics control and its integration with the adaptive optics in the European Solar Telescope (EST) [13101-156]
13101 45	Software infrastructure for the visible tunable filter [13101-158]

- 13101 46 Roboscheduler: coordinating 50,000 observations over the five years of SDSS-V [13101-159]
- 13101 47
 The ScopeSim ecosystem [13101-160]
- 13101 48 Building a control system with cloud native technologies: leveraging kubernetes and tangocontrols for CI/CD practices in SKA Observatory software [13101-161]
- 13101 49 Optimization of multiobject observations with GMT-MANIFEST: a case for the G-CLEF exposure time calculator [13101-162]
- 13101 4A Keck planet finder tip/tilt control [13101-163]
- 13101 4B Anomaly detection for the Roman Space Telescope wide field instrument's science data processing pipeline [13101-164]
- 13101 4D The Simons Observatory: deployment of the observatory control system and supporting infrastructure [13101-166]
- 13101 4E The evolution and roadmap of the Taranta project [13101-167]
- 13101 4G Modernising discovery, access, and interoperability for the Trieste solar radio system heritage archive [13101-169]
- 13101 4H SMA-X: versatile information sharing in and around telescopes, and beyond [13101-170]
- 13101 41 Leverage collaborative design techniques to develop a unified interface for the SKA central signal processor [13101-171]
- 13101 4J Enhancing feature development and user satisfaction in SKA: a beta testing approach within the Cream team [13101-172]
- 13101 4K Git with the program: migrating to Git for software revision control at DKIST [13101-173]
- 13101 4N Deep learning in the SKA era: patterns in the SNR population with unsupervised ML methods [13101-176]
- 13101 4S Final integration and commissioning of the GHOST instrument control software [13101-185]