# PROCEEDINGS OF SPIE

# Software and Cyberinfrastructure for Astronomy VII

Jorge Ibsen Gianluca Chiozzi Editors

17-21 July 2022 Montréal, Québec, Canada

Sponsored and Published by SPIE

Volume 12189

Part One of Two Parts

Proceedings of SPIE 0277-786X, V. 12189

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

Software and Cyberinfrastructure for Astronomy VII, edited by Jorge Ibsen, Gianluca Chiozzi, Proc. of SPIE Vol. 12189, 121892T · © 2022 SPIE 0277-786X · doi: 10.1117/12.2659734 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 VII, edited by Jorge Ibsen, Gianluca Chiozzi, Proc. of SPIE 12189, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

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

ISBN: 9781510653597 ISBN: 9781510653603 (electronic)

Published by **SPIE** P.O. Box 10, Bellingham, Washington 98227-0010 USA Telephone +1 360 676 3290 (Pacific Time) SPIE.org Copyright © 2022 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

xi Conference Committee

### Part One

SESSION 1	PROJECT MANAGEMENT/WEB TECHNOLOGIES
12189 01	Inspecting and adapting via problem-solving workshops: the SKA experience [12189-1]
12189 02	Managing an agile build phase while keeping the client informed with your progress [12189-2]
SESSION 2	SOFTWARE ENGINEERING
12189 03	CI-CD practices at SKA [12189-4]
12189 04	A middleware to confine obsolescence [12189-5]
12189 05	Experience of utilising CI/CD practices in the development of software for a modern astronomical observatory [12189-6]
SESSION 3	CYBERINFRASTRUCTURE
12189 06	The Sloan Digital Sky Survey cyberinfrastructure [12189-7]
12189 07	Unifying the deployment of ALMA's end user applications at its regional centers using a distributed infrastructure [12189-9]
SESSION 4	OBSERVATORY AND TELESCOPE CONTROL I
12189 08	Creating a highly flexible and autonomous stratospheric observatory: the essential elements of the European Stratospheric Balloon Observatory payload control software [12189-10]
12189 09	A graph database solution for tracking the deployment and layout of a large radio interferometer [12189-11]
12189 0A	Dynamic scheduling for SOXS instrument: environment, algorithms and development [12189-12]

12189 OB A metaheuristic approach for INO340 telescope flexible scheduling [12189-13]

12189 OC Software architecture and development plan for a 4m fully autonomous observatory (New Robotic Telescope) [12189-14]

#### SESSION 5 OBSERVATORY AND TELESCOPE CONTROL II

- 12189 0D The Software Architecture and development approach for the ASTRI Mini-Array gamma-ray air-Cherenkov experiment at the Observatorio del Teide [12189-15]
- 12189 OE EtherCAT as an alternative of the next generation real-time control system for telescopes [12189-16]
- 12189 OF New electronic brains for Halfmann telescopes [12189-17]
- 12189 0G **The ELT Sequencer** [12189-18]
- 12189 0H Simonyi Survey Telescope M1M3 control system [12189-19]

#### SESSION 6 DATA SCIENCE/ENGINEERING AND HPC

- 12189 01 Real-time inversion of solar spectropolarimetric data at high spatial and temporal resolution: HPC and GPU implementations [12189-22]
- 12189 0J Towards a data analytics platform for technical data in Paranal observatory [12189-23]
- 12189 0K Image quality evaluation and fast masking with deep neural networks [12189-105]
- 12189 OL The quality check system architecture for Son-Of-X-Shooter SOXS [12189-8]

#### SESSION 7 DATA MANAGEMENT, PROCESSING AND PIPELINES I

- 12189 0M Faro: a framework for measuring the scientific performance of petascale Rubin Observatory data products [12189-24]
- 12189 0N The Array Data Acquisition System software architecture of the ASTRI Mini-Array project [12189-25]
- 12189 OP The data processing, simulation, and archive systems of the ASTRI Mini-Array project [12189-27]
- 12189 0Q High-volume spectral data processing pipeline at the Dominion Radio Astrophysical Observatory [12189-28]

#### SESSION 8 OBSERVATORY AND TELESCOPE CONTROL III

12189 OR	Software architecture of the Intelligent Observatory Local Control Unit [12189-29]
12189 OS	Challenges of containerization and robotization the telescope control system for large robotic telescope [12189-30]
12189 OT	Modernizing observation planning for accessible, science-ready data [12189-32]
12189 OU	A high-performance data acquisition on COTS hardware for astronomical instrumentation [12189-34]
SESSION 9	INSTRUMENTATION CONTROL
12189 OV	MOONS fibre positioner control and path planning software [12189-35]
12189 OW	How Taranta provides tools to build user interfaces for TANGO devices in the SKA integration environment without writing a line of code [12189-3]
12189 OX	MAVIS instrument control software: toward the preliminary design [12189-37]
12189 OY	The control software of the BEaTriX x-ray beam calibration facility: problems and solutions [12189-38]
12189 OZ	Development of the spectrograph control software package for SDSS-V Local Volume Mapper instrument [12189-68]
SESSION 10	DATA MANAGEMENT PROCESSING PIPELINES II

#### SESSION 10 DATA MANAGEMENT, PROCESSING, PIPELINES II

- 12189 10 The sky at one terabit per second: architecture and implementation of the Argus Array Hierarchical Data Processing System [12189-39]
- 12189 11 The Vera C. Rubin Observatory Data Butler and pipeline execution system [12189-40]
- 12189 12 The BlueMUSE data reduction pipeline: lessons learned from MUSE and first design choices [12189-41]
- 12189 13 The spectroscopic pipeline design for the ELT METIS [12189-42]
- 12189 14 Automatic spectroscopic data reduction using BANZAI [12189-43]

#### SESSION 11 PROJECT OVERVIEWS AND PROGRESS

12189 15	Design, development, and testing of flight software for EIRSAT-1: a university-class CubeSat enabling astronomical research [12189-44]
12189 16	Development of the Program Execution System Architecture (PESA) for MSE [12189-45]

#### Part Two

12189 17	Latest developments for the Giant Magellan Telescope (GMT) control system [12189-46]
12189 18	TMT observatory software construction update [12189-47]
12189 19	The ELT high level coordination and control [12189-48]

12189 1A Software design for CSP.LMC in SKA [12189-49]

#### POSTER SESSION: CYBERINFRASTRUCTURE

- 12189 1B Containerizing the telemetry data pipeline for MMTO subsystems [12189-50]
- 12189 1C Assembling and integration of the ALMA hardware in the loop simulation environment [12189-52]
- 12189 1D ASTRI Mini-Array on-site Information and Communication Technology infrastructure [12189-53]
- 12189 1E The monitoring, logging, and alarm system of the ASTRI mini-array gamma-ray air-Cherenkov experiment at the Observatorio del Teide [12189-54]
- 12189 1F Extending the life of MegaCam: redesign of the data link [12189-55]

#### POSTER SESSION: DATA MANAGEMENT, PROCESSING AND PIPELINES

- 12189 1G The Gamma-Flash real-time data pipeline for ground observation of terrestrial gamma-ray flashes [12189-56]
- 12189 1H The ToITEC camera: the citilali data reduction pipeline engine [12189-57]
- 12189 11 The Son-Of-X-Shooter (SOXS) data-reduction pipeline [12189-58]
- 12189 1J The on-ground data reduction and calibration pipeline for SO/PHI-HRT [12189-59]

12189 1L Final pipeline design of the MICADO spectroscopic mode [12189-61]

12189 1M Liger at Keck Observatory: design of the data reduction system and software interfaces [12189-62]

#### POSTER SESSION: DATA

12189 10	Monitoring the performance of the SKA CICD infrastructure [12189-63]
12189 1P	Using Elasticsearch for archiving with TANGO-controls framework [12189-64]
12189 1Q	Development of a high-speed identification model for infrared-ring structures using deep learning [12189-65]
12189 1R	The Stereo Event Builder software system of the ASTRI Mini-Array project [12189-66]
12189 15	EFTE-Rocks, a framework to discriminate fast optical transient phenomena from orbital debris [12189-67]
12189 IT	Data processing pipeline for photo plates digital archives with deep neural networks [12189-104]
12189 1U	A general purpose image restoration method with deep neural network and active learning [12189-106]
	POSTER SESSION: INSTRUMENTATION CONTROL
12189 1V	MORFEO (formerly known as MAORY) instrument control software: toward a consolidated design [12189-36]
12189 1W	Scientific camera driver and application software based on ASCOM [12189-69]

- 12189 1X Design of a remote control system for a camera system based on EPICS and web technology [12189-70]
- 12189 1Y Design and development of the IGRINS-2 control software as a facility instrument of the Gemini observatory [12189-71]
- 12189 12 Design and development of the Supervisor software component for the ASTRI Mini-Array Cherenkov Camera [12189-72]
- 12189 20 Improvements to SHINS, the SHARK-NIR instrument software, during the AIT phase [12189-73]
- 12189 21 Synchronized observations with multiple detectors in GRIS: a demonstrator of an instrument for the European Solar Telescope (EST) [12189-74]

12189 22	HEART: Gemini Infrared Multi-Object Spectrograph (GIRMOS) Real-time Controller using Herzberg Extensible Adaptive Real-time Toolkit (HEART) [12189-75]
12189 24	Array data acquisition system interface for online distribution of acquired data in the ASTRI Mini-Array project [12189-77]
12189 25	Real-time exposure control and instrument operation with the NEID spectrograph GUI [12189-78]
12189 26	HEART: Herzberg Extensible Adaptive Real-time Toolkit (HEART): internal structure: blocks, pipes, and composition of a new RTC [12189-79]
12189 27	A flexible automation solution for the Gemini North Adaptive Optics facility [12189-80]
12189 28	CUBES and its software ecosystem: instrument simulation, control, and data processing [12189-81]
12189 29	Employing ELT software technologies for the upgrade of the FORS instrument at ESO VLT [12189-82]
12189 2C	Status of the Automated Data Extraction, Processing, and Tracking System (ADEPTS) for CHARIS/SCExAO [12189-85]

#### POSTER SESSION: OBSERVATORY/TELESCOPE CONTROL

- 12189 2D LVMECP: SDSS-V Local Volume Mapper Enclosure Control Package [12189-86]
- 12189 2E LVMAGP: SDSS-V local volume mapper acquisition and guiding package [12189-87]
- 12189 2F INO340 telescope interlock, safety, and alarm management systems [12189-88]
- 12189 2G HARMONI at ELT: an evolvable software architecture for the instrument pointing model [12189-89]
- The online observation quality system software architecture for the ASTRI Mini-Array project 12189 2H [12189-90]
- 12189 21 The telescope control system for the ASTRI Mini-Array of imaging atmospheric Cherenkov telescopes [12189-91]
- 12189 2J CCAT-prime: observatory control software for FYST [12189-92]
- 12189 2K ZeroMQ-based control system for optical telescope [12189-93]
- 12189 2L pytelpoint: an open-source package for modeling and assessing telescope pointing performance [12189-95]

#### POSTER SESSION: SOFTWARE ENGINEERING

12189 2M SciDevOps: accelerating scientific software delivery under a continuous integration model [12189-97]

#### POSTER SESSION: SOFTWARE QUALITY AND TESTING

12189 2N An exposure time calculator for the Maunakea Spectroscopic Explorer [12189-98]

#### POSTER SESSION: UI/WEB TECHNOLOGIES

- 12189 2P Designing the MICADO observation preparation software for a distributed architecture [12189-102]
- 12189 2Q Rapid and painless development of python INDI drivers to elegant and responsive web GUIs [12189-103]

#### **POSTER SESSION**

- 12189 2R 2dFdr Pipeline As a Web Service (PAWS): on demand reduction of archival 2dF-AAOmega observations [12189-107]
- 12189 2S Data central's data aggregation service [12189-108]

## **Conference Committee**

#### Symposium Chairs

René Doyon, Université de Montréal (Canada) Shouleh Nikzad, Jet Propulsion Laboratory (United States)

#### Symposium Co-chairs

Sarah Kendrew, European Space Agency (United States) Satoshi Miyazaki, National Astronomical Observatory of Japan (Japan)

#### **Conference** Chairs

Jorge Ibsen, European Southern Observatory appointed to Atacama Large MIllimiter/Submillimiter Array (Chile) Gianluca Chiozzi, European Southern Observatory (Germany)

#### Conference Programme Committee

Alan Bridger, UK Astronomy Technology Centre (United Kingdom)
Tom Donaldson, Space Telescope Science Institute (United States)
Frossie Economou, Large Synoptic Survey Telescope (United States)
Kim Gillies, Thirty Meter Telescope Observatory Corporation (United States)
Juan C. Guzman, Commonwealth Scientific and Industrial Research Organisation (Australia)
José M. Filgueira, GMTO Corporation (United States)
George Kosugi, Subaru Telescope, NAOJ (Japan)
Shui Hung Kwok, W. M. Keck Observatory (United States)
Nuria P. F. Lorente, Australian Astronomical Optics, Macquarie University (Australia)