Instrumentation and Controls Autumn ’21 Meeting

Thursday 27 May 2021 - Friday 28 May 2021

Zoom

Book of Abstracts

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Advanced Instrumentation Technology Centre at ANU

David Brodrick[1]

[1] *ANU*

Corresponding Author(s): david.brodrick@anu.edu.au

The Advanced Instrumentation Technology Centre (AITC), at ANU's Mount Stromlo Observatory, is a largely self-funding body, receiving contracts to develop optical and infrared instrumentation for some of the world's largest telescopes. We also host the Australian Space Test Facility and are a node of the Australian Astronomical Optics (AAO) consortium, operating and providing instrumentation for Australia's premier telescopes.

This presentation provides a brief introduction to the AITC, some of our current projects and the control systems used to realise them.

Open Discussion Session / **11**

Architecture and maintenance of accelerator control system

Nikolai Lobanov[1] ; Peter Linardakis[2] ; Daniel Tempra[1] ; Stephen Battison[1]

[1] *ANU*

[2] *Australian National University*

Corresponding Author(s): daniel.tempra@anu.edu.au, stephen.battison@anu.edu.au, peter.linardakis@anu.edu.au, nikolai.lobanov@anu.edu.au

Under current University re-structure, we have limited resources allocated for upgrades and regular maintenance of the HIAF control system. We will structure this talk as an open discussion session dedicated to the current status and future development of HIAF control system and potentially engaging some collaborators from the delegation to form an advisory/workforce group to address those issues.

Afternoon Session / **7**

Automatically generated engineering GUIs

Author(s): Andraz Pozar[1]

Co-author(s): Rosemary Waghorn [1] ; Zai Wang [1]

[1] *Australian Synchrotron*

Corresponding Author(s): zai.wang@synchrotron.org.au, andrazp@ansto.gov.au, rosemarywaghorn@synchrotron.org.au

At the Australian Synchrotron we will use a combination of tools to capture the operational area controls system structure and from it generate engineering GUIs for that area at a click of a button.

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CSBS - Control System Breakdown Structure

Author(s): Rosemary Waghorn[1]

Co-author(s): Andraz Pozar [1]

[1] *Australian Synchrotron*

Corresponding Author(s): andrazp@ansto.gov.au, rosemarywaghorn@synchrotron.org.au

At the Australian Synchrotron we use a tool to allow entry of the operational area controls system structure which includes both the assembly and control hierarchies. This tool also includes auto generate of component (devices, controllers, hosts, IOCs) names, and API endpoints that can be used by other applications.

Morning Session / 8

Computer Control Operation and Future Upgrade Plan in STAR Accelerator Facility at ANSTO

JIAN WANG[1] ; David Button[1] ; Nikolas PANERAS[1] ; Matthew REES[1] ; Andrew DOWNES[1]

[1] *CAS ANSTO*

Corresponding Author(s): jian.wang@ansto.gov.au

STAR is a 2MV tandetron accelerator that can perform both IBA and AMS analyses. It has three ion sources which include two duoplasmatron sources for hydrogen and helium, and a solid target sputter source used primarily for ionising carbon samples for AMS. The STAR accelerator currently has 3 beamlines, a multi-elemental surface analysis beamline (SIBA1), a high-resolution depth profiling and irradiation beamline (SIBA2), and a 14C beamline (AMS).
This presentation will firstly introduce the current computer control system, and look at its history and developments. These include partial modification of the original C14-OS package in Windows NT, and upgrade from Windows NT to Windows XP.
Due to the age of the system, and the base hardware, operation and maintenance of the control system has become problematic. Consideration for a future upgrade of the STAR computer control system are in there early stage. This presentation will also explore two possible upgrading and replacement options.

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Developing a High Voltage Generator controller for the 2MV Tandetron accelerator

Nikolas Paneras[None] ; Yasser Yasser Mafi Nejad[None]

Corresponding Author(s): mafinejy@ansto.gov.au, nep@ansto.gov.au

The aim of this project is to develop a controller to run the High Voltage Generator (HVG) for the 2MV Tandetron accelerator (Small Tandem Accelerator for Research (STAR)) at ANSTO.

The HVG is a solid state voltage multiplier used instead of a belt or pellet chain to generate the high potential for the accelerator terminal.

The current HVG controller PCB is damaged and is running in a static, fixed frequency mode. The current controller is constructed of obsolete components that have no direct replacements. The repair of this PCB in not a feasible option.

The new control hardware is based on a NI cRIO-9035 PLC using a NI9401 (Ultra-fast digital output), NI9403 (Digital Input/Output) and a NI9205 (Analogue Input). We are using LabVIEW 2019 for the software development environment.

This PLC consists of a FPGA and a Real Time unit within an ARM based processor. The accelerator controller is in charge of tracking the resonant frequency of the accelerator. This is achieved within the FPGA section by implementing a phase-locked loop (PLL). The output stage IGBTs are controlled also by the FPGA using PWM in real parallel execution. Moreover, the interlock system will be developed in Real Time controller.

The implemented wideband PLL will maximise power delivery efficiency to the HVG. The PLL free-running VCO is able to tune from 35 kHz to 47 kHz (25%) with a lock in range of 40.7 to 41.3 kHz. This enables the controller to precisely track the drift in the resonant frequency of the HVG.

The controller can also precisely vary the width of the pulse (PWM) from 1% to 99% (operational range from 5 – 30 %) with the resolution of 1% at the entire frequency band. This will enable the accelerator to run at different voltages terminals.

Experimental results shows that our new HVG control system not only runs the accelerator efficiently and safely, but also provides remote monitoring and upgradability.

Afternoon Session / **17**

Docker for Beamline Controls

Stephen Mudie[1]

[1] *ANSTO*

Corresponding Author(s): stephenm@ansto.gov.au

The SAXS/WAXS beamline at the Australian Synchrotron has been successfully using docker containers to run epics IOCs, including Galil motor controllers and GigE video cameras, since 2016. This system has proved extremely reliable, easy to maintain, and self documenting. The current system uses Docker Swarm for High Availability/Redundancy, and where possible reuses docker images for multiple IOCs, with configuration injected at run time. This talk will give an introduction to Docker and present an overview of the implementation of Docker on the Australian Synchrotron SAXS/WAXS beamline.

Morning Session / **4**

Fast ORM Measurement for Australian Synchrotron

Simin Chen[1] ; Eugene Tan[2]

[1] *ANSTO*

[2] *Australian Synchrotron*

Corresponding Author(s): eugene.tan@synchrotron.org.au, simin.chen@synchrotron.org.au

The fast ORM measurement system would be capable of reducing the measurement time of the storage ring's corrector to position response matrix from 15 minutes down to around 1 minute.

The fast ORM measurement system is designed to generate sinusoidal excitation of the electron beam with or without FOFB correction data for fast response measurements. It is also equipped with a white noise generator for closed loop gain analysis. With a much larger FPGA, the FOFB correction data can be encoded as UDP packets and sent to IOCs for archiving and offline analysis.

Morning Session / **15**

Float64 Motor Record

Nader Afshar[1] ; Mark Clift[1] ; Ben Baldwinson[1] ; Ross Hogan[1] ; Danny Wong[1] ; Alan NG[1]

[1] *Australian Synchrotron - ANSTO*

Corresponding Author(s): nadera@ansto.gov.au, rossh@ansto.gov.au, baldwinb@ansto.gov.au, wongd@ansto.gov.au, nga@ansto.gov.au, mark.clift@synchrotron.org.au

In the Australian Synchrotron, we have standardised our motion controls based on Omron's PowerBrickLV(r), an advanced and versatile controller platform.

In order to utilise the advanced features of these controllers while maintaining the complexity that comes with the versatile and multi-purposed controller, DLS developers team led the community by setting up a software stack with modules in the controller firmware up to the motor record.

In the Controls Systems team, we took on the task of advancing the DLS software stack and Motor Record to meet our new requirements for PPMAC namely: supporting fractional readbacks in engineering units from controller, improved performance of the driver, additional protection functions at the controller level and streamlined routines e.g. homing routines, without backward compatibility requirements.

Now we are testing our beta version of the software stack, with an improved Motor Record, driver and IOC templates.

Morning Session / **13**

Interfacing to Xilinx Alveo Accelerator Cards using caproto and pyOpenCL

Author(s): Euan Troup[1]

Co-author(s): Andrew Bolin [2]

[1] *CSIRO Astronomy and Space*

[2] *CSIRO Astronomy and Space Science*

Corresponding Author(s): andrew.bolin@csiro.au, euan.troup@csiro.au

Xilinx Alveo FPGA processing cards are used for DSP in beamformers for both CSIRO Parkes telescope CryoPAF and SKA-Low Telescope Correlator and Beamformer projects. The telescope control systems use EPICS and TANGO respectively. We have used pyOpenCL to create a control-system-independent layer to the beamformer firmware in the Alveo card then used caproto to create a Python IOC for interface to the Parkes control system. This talk will describe these systems with details of the caproto Python script

Morning Session / **12**

MEX Crystal Spectrometer

Danny Wong[None]

Corresponding Author(s): wongd@ansto.gov.au

The Crystal Spectrometer is one of the first equipment arrived onsite for ANSTO's BR-IGHT program.
- Where it came from?
- What changes were made?
- How it is currently implemented?
- Engineering GUI
- video of Spectrometer in Action
- What's next?

Afternoon Session / **14**

Machine Vision Applications

Matthew Rees[1]

[1] *ANSTO*

Corresponding Author(s): matthew.rees@ansto.gov.au

At the Centre for Accelerator Science (CAS) in ANSTO Lucas Heights, we have recently been evaluating solutions incorporating the use of Machine Vision as a tool for improving our systems and operations.
This talk will provide a brief introduction to Machine Vision and its applications in general industry. We will discuss how Machine Vision has been used previously here at CAS and explore its future potential.

Open Discussion Session / **18**

Open Discussion

General open discussion

Afternoon Session / **6**

Physics Instrumentation Engineers of Australia - Let's Collaborate More!

David Brodrick[1]

[1] *ANU*

Corresponding Author(s): david.brodrick@anu.edu.au

Having been engaged in the development of radio telescopes, neutron facilities, and optical and infrared astronomy facilities, I can't help observe that many of the engineering building blocks are precisely the same. At the same time I see that, in practice, so few of the instrumentation engineers

in Australia have the opportunity to share experiences with, or learn lessons from counterparts at other Australian physics facilities.

The ANU Research School of Astronomy and Astrophysics have recently allocated strategic funding to support better collaboration and communication with our instrumentation counterparts supporting other realms of science in Australia.

The intent of this talk is to provide a background to the initiative while leaving time for discussion on ways in which better engagement may enrich us all.

Afternoon Session / **19**

Science NET

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Script based GUI builder for instrument control and data treatment

Norman Xiong[1]

[1] *ANSTO*

Corresponding Author(s): nxi@ansto.gov.au

A new feature has been added to the Gumtree software that allows users to create their own graphical user interfaces for controlling the neutron scattering instruments and treating data. Users without any GUI design experience can write simple Python scripts in this software environment, and the system will automatically generate the GUI accordingly. These scripts can be used for a mixed of purposes such as driving devices, collecting neutrons, treating the data, and plotting them.