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Synchronized Non-Linear Motion Trajectories of the SCANIA-2D Spectrometer at the Balder Beamline, MAX IV Laboratory

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Beamline end-stations often require components to move along non-trivial multi-dimensional trajectories in order to fulfill experimental requirements. These trajectories can often be realised through well synchronized combined motion of multiple axes with single degrees of freedom, such as linear and rotational actuators [1]. A good example of this is the SCANIA-2D (Segmented Crystal Analyzer with Image Acquisition in 2D) x-ray emission spectrometer [2] at the Balder beamline [3], MAX IV synchrotron. Here, five motorized axes are combined to precisely position the crystal assembly and area detector of a Rowland circle geometry x-ray emission spectrometer. Precise positioning is required in order to allow ground-bent (Johansson [4]) crystals to be used, thereby enabling both high efficiency and high resolution operation.

The motion of the five independent motorized axes is combined into an overall crystal assembly and detector trajectory parameterized by just two variables; Bragg angle, θ, and in-Rowland-circle shift, ΔZ. These two parameters are the primary user interface to the spectrometer, from which the constituent motorized axes positions are determined. Motion control is implemented using the IcePAP motion controller [5]. This provides independent closed-loop operation of the constituent axes, as well as synchronized motion along the trajectory defined by the θ and ΔZ. Constituent axis positions are dynamically computed by IcePAP from commanded positions in θ, greatly facilitating user operation. Trajectory configuration, scanning, and data acquisition are provided by the Tango control system orchestrated by Sardana.

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[1]: P. Sjöblom, H. Enquist, A. Freitas, J. Lidon-Simon, M. Lindberg, and S. Malki, english "Synchronized Non-linear Motion Trajectories at MAX IV Beamlines"in englishProc. ICALEPCS'23, International Conference on Accelerator and Large Experimental Physics Control Systems No. 19 (JACoW Publishing, Geneva, Switzerland, 2024) pp. 1160–1165

[2]: K. Klementiev, I. Preda, S. Carlson, K. Sigfridsson, and K. Norén, "High performance emission spectrometer at balder/max iv beamline"Journal of Physics: Conference Series 712, 012018 (2016)

[3]: K. Klementiev, K. Noren, S. Carlson, K. G. V. S. Clauss, and I. Persson, "The balder beamline at the max iv laboratory"Journal of Physics: Conference Series 712, 012023 (2016)

[4]: T. Johansson, "Über ein neuartiges, genau fokussierendes röntgenspektrometer,"Zeitschrift für Physik 82, 507–528 (1933)

[5]: N. Janvier, J. M. Clement, P. Fajardo, and G. Cuni, english"IcePAP: An Advanced Motor Controller for Scientific Applications in Large User Facilities,"in englishProc. ICALEPCS'13 (JACoW Publishing, Geneva, Switzerland) pp. 766–769.

I plan to submit also conference proceedings

Yes

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