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Design and commissioning of position control for the high-dynamic cryogenic sample stage of the SAPOTI nanoprobe at the CARNAÚBA beamline (SIRIUS)

Monday 22 September 2025 16:45 (15 minutes)

SAPOTI is the second cryogenic nanoprobe station recently installed and under commissioning at the CARNAÚBA*beamline at SIRIUS, designed for multi-analytical X-ray techniques, including 2D and 3D ptychographic imaging. A high-dynamic mechatronic system** aimed to provide sample positioning at single-nanometer resolution was developed using a decoupled architecture, force actuators, high-speed and high-accuracy metrology and a dynamic filter for reaction forces. This paper presents the design and implementation of XYZ positioning controller, the fly-scan operation for imaging and results from initial technical commissioning. First, the sample stage mechatronic architecture is overviewed. Next, control strategy based on feedback and trajectory feedforward is detailed, followed by the system identification procedure and design of controllers using loop-shaping and model inversion techniques. Implementation in a real-time digital controller, along with fly-scan trajectories and triggering scheme for detectors are discussed. Finally, in-situ performance in stability, trajectory tracking and imaging reconstruction are demonstrated with experimental results.

Footnotes

*Tolentino, H.C.N., et al. "CARNAUBA: The coherent X-ray nanoprobe for the Brazilian Synchrotron Sirius/LNLS" , J. Phys.: Conf. Ser. 2017**R. R. Geraldes et al. The Sample Positioning Stage for the SAPOTI Nanoprobe at the CARNAUBA beamline at Sirius/LNLS. In Proc. 37th ASPE Annual Meeting, 2022

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