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# Nanoscale precision multi-axis motion control for the CBXFEL project

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The Cavity-Based Free Electron Laser (CBXFEL) project is proposing to produce a recirculating X-ray cavity and deploy it to the SLAC LCLS (Linac Coherent Light Source) Hard X-ray (HXR) undulator line. The shape of the cavity is defined by four diamond crystals which must be positioned with nanometer-level accuracy in four Degrees-Of-Freedom (DOF). Additionally, several electron and X-ray beam diagnostic components need to be precisely positioned to achieve, monitor, and maintain the cavity alignment. These functions are accomplished by a total of sixty-nine motion axes, eight of which are actuated by lead-screw stages operated by stepper motors, thirty-seven by Ultra High Vacuum (UHV) SmarAct piezo stages, and twenty-four by custom designed flexure stages actuated by UHV piezo linear actuators. The flexure stages are driven by UHV piezo actuators and real-time position feedback is provided by capacitive sensors and optical interferometers. A motion control system based on the CK3M PMAC architecture was developed to drive the different motion stages. This paper describes the main requirements to be met, how the technologies were integrated into the accelerator control system, and the main lessons learned.

## Footnotes

## Funding Agency

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