Contribution ID: **19** Type: **Poster**

Empowering SRF Cavity by Data-Driven Resonance Control based on Dynamic Mode Decomposition

Effective resonance control of superconducting radio frequency (SRF) cavities is critical for large machines like LCLS-II, as failure to achieve proper control can result in increased RF power consumption, higher cryogenic heat loads, and increased costs. To address this challenge, we have developed a machine learning (ML) model based on the dynamic mode decomposition method (DMD) to represent the forced cavity dynamics. Using this model, we designed a model predictive controller (MPC) and demonstrated through simulation that the MPC can effectively stabilize the amplitude and phase of SRF cavities using only a frequency actuator, even in the presence of multiple mechanical modes. The lightweight and explicit ML model make the controller suitable for direct implementation on field-programmable gate arrays (FPGA), unlocking the full potential of SRF linacs like LCLS-II, enabling higher beam power and energy, and also serving as an advanced motion controller for various applications, such as photon beamlines and storage rings.

Primary author: Dr WANG, Faya (SLAC)

Presenter: Dr WANG, Faya (SLAC)

Session Classification: Poster