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Toward online learning of a cavity mechanical model for improved resonance control

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The energy consumption of particle accelerators becomes an important issue nowadays. One option to address this is to employ cavities with a very high quality factor. Despite its energy saving potential, such quality factor poses a serious control problem, because the cavities become very sensitive to noise affecting their resonance frequency. A resonance controller is thus needed. There have been many attempts to design such a controller, using both model-based and model-free approaches. Yet the problem still remains an open issue. An important aspect that is apparently missing in existing solutions is a real-time adaptation to plant variations. Specifically, variations in the frequency of unwanted mechanical oscillations that perturb the cavity. In this contribution, we show the dependency of these oscillations on various operating conditions. By doing so, we motivate the adoption of a machine learning-based adaptive modeling which learns the cavity dynamics online. Such modeling is expected to improve the performance of the resonance controller by making it more robust to plant variations.

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