

Online identification algorithm for mathematical model of RF cavity system based on FPGA

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The mathematical model of a RF system incorporates crucial characteristic parameters of the RF cavity, including cavity bandwidth, resonant frequency, and LFD factors. This mathematical model is crucial for cavity performance evaluation and optimization of control algorithms. The network analyzer is usually used for measuring the scattering parameters of the RF system and subsequently constructing mathematical models. However, its measurement steps are tedious and fail to identify the system model online. Therefore, we have developed a sweeping algorithm in the LLRF system. This sweeping algorithm simulates the operational principles of a network analyzer, which can achieve the cavity system model online identification. The sweeping algorithm has been verified on a superconducting cavity of the CAFE accelerators. The measurement result using the proposed sweeping algorithm is in accordance with those obtained via a network analyzer. Furthermore, this algorithm successfully measures the distortion curve of cavity frequency response caused by Lorentz force detuning. Finally, we discuss the influence of LFD variation on the measurement of the critical cavity parameters.

Keyword

LFD, FPGA, cavity bandwidth, resonant frequency, LLRF

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