Stability and resolution studies of HOMBPMs for the 1.3 GHz superconducting accelerating cavities at FLASH

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Abstract

HOMBPMs (HOM based Beam Position Monitors) are installed at the FLASH facility at DESY, Hamburg. These are aimed at aligning the beam and monitoring the beam position. Over time, the accuracy of beam position prediction is degraded. This is due to instability issues in the 1.3 GHz and 3.9 GHz superconducting cavities and associated electronics. In this paper, we demonstrate for the first time a measurement technique which is stable and can be relied upon over a period of three months with unprecedented resolution (below 4 μm horizontally and 2 μm vertically). We attribute this improvement in stability to a focused campaign on various signal processing and analysis techniques. These techniques include SVD (Singular Value Decomposition), ANN (Artificial Neural Network) and PLS (Partial Least Square). We found the best resolution and computational power using the latter method, PLS. These techniques are directly applicable to the HOMBPM system at the European XFEL that is currently under construction. However, they are in many ways generic and hence applicable to other measurement methods.