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12.19 Layered low-pass magnetic sensor compensations for real-time mode identification in tokamaks

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Sensors that measure small 3D magnetic fields in tokamaks are susceptible to both DC and AC vacuum field pickup that must be compensated out. In this paper, we present a novel sensor compensation algorithm that uses a layered low-pass filtering technique to efficiently remove the vacuum field pickup generated by both axisymmetric and non-axisymmetric coils. Given that a single technique is used to compensate the pickup from all coil systems and that the low-pass filtering is conducted in the time domain, the layered low-pass algorithm is uniquely suited for real-time processing. The algorithm was first deployed on the National Spherical Torus Experiment Upgrade (NSTX-U) during the 2016 commissioning campaign where it was successfully used to perform both offline and real-time locked mode identification. The offline version of the algorithm has since been tested on the DIII-D tokamak where high-spectral-content training shots are shown to improve the compensation of poloidal-field-coil-induced pickup. The cross-device portability of the algorithm demonstrates that it can broadly address the challenge of real-time magnetic sensor compensations in tokamaks. This work is supported by DoE contracts DE-AC02-09CH11466 and DE-FC02-04ER54698.

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