Array magnetics modal analysis for the DIII-D tokamak based on localised time-series modelling

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Abstract. Time-series analysis of magnetics data in tokamaks is typically done using block-based fast Fourier transform (FFT) methods. This work presents the development and deployment of a new set of algorithms for magnetic probe array analysis. The method is based on an estimation technique known as stochastic subspace identification (SSI). Compared with the standard coherence approach or the direct singular value decomposition approach, the new technique exhibits several beneficial properties. For example, the SSI method does not require that frequencies are orthogonal with respect to the timeframe used in the analysis. Frequencies are obtained directly as parameters of localised time-series models. The parameters are extracted by solving small-scale eigenvalue problems. Applications include maximum-likelihood regularised eigenmode pattern estimation, neoclassical tearing-mode detection and automatic clustering of modes, and magnetics-pattern characterisation of sawtooth pre- and postcursors, edge harmonic oscillations and fishbones.

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