Development of Algorithms for the End-To-End System Simulation, Mode Analysis and Performance Optimization for a Generic and Multi-Tokamak High-frequency Magnetic Diagnostic System

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- **how to generate a simulated δB_{MEAS}?**
  - δB_{MEAS} is a time series which contains a continuum background (EM fluctuations), multiple discrete temporal and spatial components (Eigenmodes), the equilibrium magnetic field, frequency- and time-dependent noise, and accounts for the position and orientation of the sensor as mounted on the wall

- **challenges for measurement and analysis of magnetic fluctuations in fusion experiments**
  - **multiple degenerate modes** expected at nearly the same frequencies (usual case: multiple poloidal harmonics for the same toroidal harmonic)
  - **need precise ±1 determination** of toroidal and poloidal mode numbers for (active) feedback control and MHD spectroscopy (island width and location, for instance)
  - **must satisfy measurement tolerances** to define correct and wrong detection of the modes, suitable thresholds then have to be defined
  - **uneven spatial sampling needs to be used** (due to potential loss of sensors over time)
  - **blind RT analysis**: no previous knowledge of fluctuation spectra can/should be used

End-To-End System Modelling for the ITER-AI Magnetic Sensors: Frequency Spectrum With/Out Equilibrium B_0