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Bayesian Techniques for Design Optimization of Magnetic Diagnostics and Validation on the WEST tokamak

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Next-generation fusion devices such as DEMO present significant challenges in diagnostic system design due to spatial and cost constraints. Previous work has demonstrated the successful application of Bayesian experimental design to DEMO, optimizing both the placement and orientation of magnetic coils to reduce sensor quantity while maintaining diagnostic accuracy.

In this study, we extend the application of Bayesian methods to the magnetic diagnostic system of WEST, focusing on optimizing the quantity of pick-up coils using mutual information as the criterion for sensor selection. The approach systematically identifies sensor configurations that maximize information gain while minimizing measurement uncertainty in key plasma parameters, including plasma current centroid, total current, and X-point position.

Preliminary results indicate that a reduction in the number of pick-up coils is feasible without compromising diagnostic accuracy, underscoring the effectiveness of Bayesian design in guiding optimal sensor configurations. This work provides a rigorous framework for sensor optimization under engineering and economic constraints, offering insights for diagnostic design in future fusion devices.

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