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センサー信号雑音が３次元CCS法によるLHD磁場逆解析に及ぼす影響

Influence of the sensor signal noise on the reconstructed field in the LHD using the 3-D CCS method

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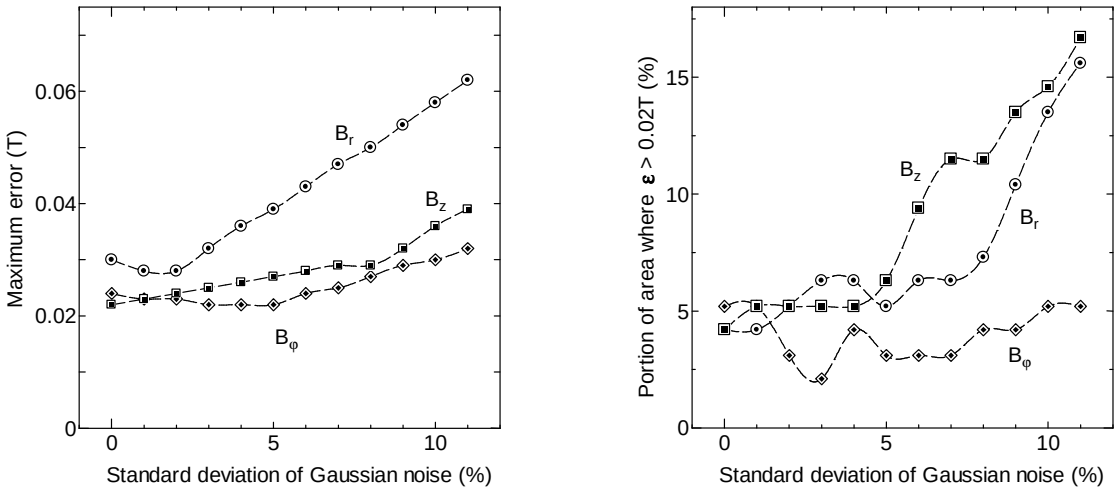
Introduction: The three-dimensional (3-D) Cauchy condition surface (CCS) method code, 'CCS3D', is now under development to reconstruct the 3-D magnetic field profile outside a non-axisymmetric fusion plasma using only magnetic sensor signals [1]. The present report deals with the influence of the sensor signal noise on the reconstruction for the LHD.

Method: Noises were numerically generated using normal (Gaussian) random numbers and added to all magnetic field and flux loop signals. A noise-added signal $\tilde{b}_j$ is given by $\tilde{b}_j = b_j(1+\sigma \cdot G)$ with the original signal b_j, where G denotes a unit Gaussian random number, while σ the standard deviation of the Gaussian noise.

Results: The reference field distribution was given beforehand using the 3-D MHD equilibrium code HINT2 [2]. The term 'error' in this report means the deviation of the reconstructed field from the HINT2-based reference field. Figure 1(a) shows the change in the maximum errors of reconstructed B_r, B_φ and B_z as a function of σ, while figure 1(b) indicates the variation in the portion of the area where the error is larger than 0.02T. Both error tendencies were investigated for the region $1.0 < \rho < 1.1$ in the minor radius (ρ) space, i.e. very near the last closed magnetic surface. It is understood from these results that the reconstructed field profile is not very sensitive to the noise in the sensor signals since the CCS method is made in a least square sense.



(a) Variation in the maximum errors (b) Portion of area where $\varepsilon > 0.02$T (%)

Figure 1. Influence of the sensor signal noise

Conclusion: If we assume that the total signal error caused by the signal fluctuation is no more than a few percent, it would not adversely influence the reconstructed field.

References:

[1] Itagaki, M., Maeda, T., Ishimaru, T., Okubo, G., Watanabe, K. et al.. 2011 *Plasma Phys. Control. Fusion* **53** 105007
[2] Suzuki, Y., Nakajima, N., Watanabe, K., Nakamura, Y., Hayashi, T. 2006 *Nucl. Fusion* **46** L19