Feedback Coil Geometry and its Effect on Structure of the Resistive Wall Mode*

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The NMA [1] stability code has been used to study the effect of the feedback coil geometry on the performance of feedback to the resistive wall mode (RWM). In the present formulation, the plasma is assumed to obey ideal MHD with no flow. During the open loop operation, the complete dynamics of the plasma-resistive wall system can be shown to obey an ortho-normal set of open loop eigenfunctions, with the eigenvalues being their open loop growth or damping rate. Usually, only one of these eigenfunctions could be unstable and appears as the naturally growing RWM, with all others appearing as damped (resistive wall) modes. The formulation of NMA is based on this set of normal modes. The effect of feedback on stability is determined completely by a characteristic equation which depends on the feedback circuit and the properties of the normal modes. These properties are the open loop growth rate, the coupling of the coils to them, and the ability of the sensor to detect them. The mode structure during feedback operation is shown explicitly as mixing of the different open loop eigenfunctions. Thus, it is predicted that the mode structure would undergo distortion during the feedback operation. This distortion is large if the feedback coil preferentially excites the stable eigenfunctions instead of coupling mainly to the unstable RWM. Distortion can be minimized by judicious design of the feedback coil. The implication of this optimization on present and future feedback systems is presented.

[1] M.S. Chu, M.S. Chance, A.H. Glasser, M. Okabayashi, Nucl. Fusion **43**, 441 (2003).

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