

Abstract Submitted
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Exact prediction of linear stability of Multi-Region relaxed MHD energy principle ARUNAV KUMAR¹, JOSHUA DOAK, ZHISONG QU, ANU, STUART HUDSON², PPPL, ROBERT DEWAR, MATTHEW HOLE, ANU — A variational principle based on a generalization of Taylor’s relaxation, referred as Multi-Region relaxed Magnetohydrodynamics (MRxMHD), was developed to incorporate both an ideal and resistive MHD equilibrium problem. With a well posed manner, suitable numerical solutions of MRxMHD are constructed using the Stepped Pressure Equilibrium Code (SPEC) [1]. In principle, SPEC could also establish to describe the MRxMHD stability, that of, a plasma equilibrium. A novel theoretical second variation of energy functional so-called Hessian is the guideline, which could predict MHD linear instabilities as a by-product of SPEC equilibrium calculation. We demonstrate a newly implemented Hessian algorithm in SPEC which can predict linear MRxMHD stability. Negative eigenvalues of Hessian predict an instability. Validation of SPEC will be shown for both toroidal and cylindrical geometries, and the numerical results are thoroughly verified against ideal and resistive MHD stability theories. This will open a new pathway to study MHD instabilities in three-dimensional (3D) stellarator geometry.

1. Hudson *et.al* Phys. Plasma, **19**:112502, 2012.

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