

The uncertainty quantification of plasma equilibrium calculation on Experimental Advanced Superconducting Tokamak (EAST)

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The precision of plasma equilibrium is a pivotal issue in the field of fusion plasma physics and the operation of tokamak plasmas. During the plasma equilibrium uncertainty quantification (UQ) campaign, input parameters for the equilibrium solver are assigned default value ranges derived from EAST experimental data. These input parameters are subsequently processed by an encoder, decoder, and analyzer within a sequence-to-sequence deep learning model. The outcomes of the UQ campaign provide insights into the calculated equilibrium output uncertainty and its sensitivity analysis. Drawing from the results of this sensitivity analysis, the rankings of influence for equilibrium input parameters on the calculated safety factor q profile, plasma shape, toroidal field, plasma pressure, and 0D outputs are presented. Meanwhile, the sensitivity of the magnetic probes on the equilibrium calculation for the EAST double null configuration is analyzed. By analyzing the magnitude of uncertainties in plasma equilibrium calculations, on the one hand, the sources of error can be identified for subsequent diagnostics and physical analysis, thereby improving the accuracy and robustness of the final results. On the other hand, the sensitivity analysis of parameter influence can provide valuable insights for optimizing the plasma discharges platform.

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