Surrogate-Based Optimization Techniques for the Validation of Plasma Transport Models

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The Validation via Iterative Training of Active Learning Surrogates (VITALS) framework [1] exploits surrogate strategies and a genetic-algorithm-based optimizer to test whether a combination of plasma parameters exists such that experimental transport measurements are reproduced by a transport model. For the first time, additional measurable quantities, such as incremental electron thermal diffusivity, temperature and density fluctuation levels, cross-phase angles, and particle diffusion and convection coefficients can be used simultaneously along with transport fluxes to study model validation. Furthermore, any combination of plasma parameters can be scanned with minimal computational cost. VITALS has been used successfully to validate the TGLF quasilinear turbulent transport model in the Alcator C-Mod and ASDEX Upgrade tokamaks [2]. First results indicate that these machine learning algorithms are suitable and adaptable as a self-consistent, fast, and comprehensive validation methodology for plasma transport codes.

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