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Advanced Plasma Diagnostic Analysis using Neural Networks

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Machine learning techniques, specifically neural networks (NN), are used with sufficient internal complexity to develop an empirically weighted relationship between a set of filtered X-ray emission measurements and the electron temperature (Te) profile for a specific class of discharges on NSTX. The NN response matrix is used to calculate the Te profile directly from the filtered X-ray diode measurements which extends the electron temperature time response from the 60Hz Thomson Scattering profile measurements to fast timescales (>10kHz) and greatly expands the applicability of Te profile information to fast plasma phenomena, such as ELM dynamics. This process can be improved by providing additional information which helps the neural network refine the relationship between Te and the corresponding X-ray emission. NN supplement limited measurements of a particular quantity using related measurements with higher time or spatial resolution. For example, the radiated power (Prad) determined using resistive foil bolometers is related to similar measurements using AXUV diode arrays through a complex and slowly time-evolving quantum efficiency curve in the VUV spectral region. Results from a NN trained using Alcator C-Mod resistive foil bolometry and AXUV diodes are presented, working towards hybrid Prad measurements with the quantitative accuracy of resistive foil bolometers and with the enhanced temporal and spatial resolution of the unfiltered AXUV diode arrays.

Eligible for student paper award?

No

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