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Minerva neural network based surrogate model for real time inference of ion temperature profiles at Wendelstein 7-X ANDREA PAVONE, JAKOB SVENSSON, ANDREAS LANGENBERG, Max Planck Inst Plasmaphysik, NOVIMIR PABLANT, Princeton Plasma Physics Laboratory, ROBERT C. WOLF, Max Planck Inst Plasmaphysik — Artificial neural networks (ANNs) can reduce the computation time required for the application of Bayesian inference on large amounts of data by several orders of magnitude, making real-time analysis possible and, at the same time, providing a reliable alternative to more conventional inversion routines. The large scale fusion experiment Wendelstein 7-X (W7-X) requires tens of diagnostics for plasma parameter measurements and is using the Minerva Bayesian modelling framework as its main inference engine, which can handle joint inference in complex systems made of several physics models. Conventional inversion routines are applied to measured data to infer the posterior distribution of the free parameters of the models implemented in the framework. We have trained ANNs on a training set made of samples from the prior distribution of the free parameters and the corresponding data calculated with the forward model, so that the trained ANNs constitute a surrogate model of the physics model. The ANNs have been then applied to 2D images measured by an X-ray spectrometer, representing the spectral emission from plasma impurities measured along a fan of lines of sight covering a major fraction of the plasma cross-section, for the inference of ion temperature profiles and then compared with the conventional inversion routines, showing that they constitute a robust and reliable alternative for real time plasma parameter inference.

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