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P2.1046 Towards applications of deep learning techniques to establish surrogate models for the power exhaust in tokamaks

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see full abstract here
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One of the main challenges in the design of an economically viable fusion reactor are the highly localized thermal loads experienced by the plasma facing components, especially the targets in a divertor-based design, on which this work focuses. These thermal loads cause degradation of the target material and might severely damage the machine, resulting in longer downtime for maintenance. It is essential to predict these thermal loads for the design and operation of future fusion devices. Under attached conditions, simplified analytical models, such as the two-point model, are sufficient to determine the thermal load experienced by the divertor targets for given conditions of the upstream plasma. For scenarios with significant power dissipation there exist codes that take into account the complex physics of particle and heat transport in the plasma edge. However, since such codes are computationally very expensive and time consuming, modeling and predicting thermal loads under non-simplified operational conditions remains a challenging yet crucial task for current and future devices. In light of recent developments and successes in the field of machine learning techniques, datadriven modeling is an interesting option for the prediction of such heat loads. We present first steps towards predicting the power exhaust in tokamaks using deep learning methods (neural networks) and experimental data from the ASDEX Upgrade experiment. The work focuses on data selection and our initial approach of modeling the electron temperature in front of the divertor target given a set of accessible plasma parameters. In a first step we modeled a proxy for the electron temperature close to the target as a function of (indirect) operational parameters such as plasma current, toroidal magnetic field, heating power and radiated power. Although our first model yields subpar results the general approach seems to work.

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