Development of Surrogate Models for Divertor Power Load Prediction Based on Machine Learning Techniques

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One of the main challenges in the design of an economically viable fusion reactor are the 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 prolonged downtime for maintenance. It is essential to predict these thermal loads for the safe design and operation of future fusion devices.

Under attached conditions, simplified analytical models 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, data-driven modeling is an interesting option for the prediction of such heat loads.

We present machine learning based approaches at predicting the power exhaust in tokamaks using experimental data from the ASDEX Upgrade experiment.