Symbolic Regression Analysis on the EUROfusion JET-ILW Pedestal Database

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The EPED model [1] can predict the H-mode JET-ILW pedestal height and width within a relative error of about 20% when the pedestal is close to the Peeling-Ballooning (PB) boundary. However, when the pedestal is far from the PB boundary, our present understanding of the pedestal physics is still lacking [2,3]. Moreover, the extrapolation to future JET-ILW experimental scenarios and to different tokamaks is even more challenging. In addition, it should be desirable to use engineering parameters as inputs for future operative pedestal predictions. To face these issues a new multi-objective genetic programming (GP) [4,5] code has been implemented. This code is able to perform a multi-objective symbolic regression analysis [6] on the EUROfusion JET-ILW pedestal database [7] and to find new analytical regression models for the pedestal height and/or width testing different sets of input decision variables from the pedestal database. In order to avoid overfitting, the minimization of the model complexity is considered and all evolved models are tested on a validation set to measure their generalization capabilities. The GP code has been validated on simple test cases and preliminarily tested on the pedestal database deriving analytical expressions with EPED-like input quantities. The evolved models found so far, along with a final step of standard nonlinear parameter optimization, shows a good fit on the normalized pedestal pressure. To get more general results on the underlying pedestal physics, the work will test also new model selection criteria, new sets of input variables and new constraints on the model search space. The results of this work will be compared with those ones from the EPED model. The final goal of this work is to obtain regression models capable of explaining the pedestal database with, at the same time, high accuracy and low complexity, in order to get better insights on pedestal physics.

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