Developing a machine learning framework for rapid surrogate optimisation of hairpin windings of traction motors

Combining hairpin windings with direct oil jet cooling is a popular approach to increase the power density of new traction motors. It has been shown that the formation of the oil layer is dependent on the jet parameters and winding geometry. Recent studies have highlighted the need for high-fidelity computational fluid dynamics (CFD) simulations to determine the optimal system parameters, however this approach has shown to be computationally expensive. Data-driven machine learning (ML)-based surrogate models for CFD simulations can play an important role in reducing computational cost associated with the design optimisation. In this proposed project, the hairpin winding geometry and the oil injector parameters will be co-optimised using coupled CFD and ML. First, the 3-D CFD setup of the system will be validated against experimental data. Then, an evolutionary optimisation technique will be used to find the best ML hyperparameters based on an initial dataset obtained from a small number of CFD simulations. Subsequently, an evolutionary algorithm will be employed to locate the design optimum on the ML surrogate surface. The proposed framework will offer the advantage of being a more hands-off approach that can be readily utilised by researchers and engineers who do not have extensive ML expertise.

For more information, please contact:
Mohammad Tayarani
m.tayaraninajaran@herts.ac.uk