**Predicting flow fields around airfoils and geometry optimization using a graph neural network**

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In this study we apply Machine Learning methods to the problem of the flow over airfoils which geometry is to be optimized using Graph Neural Network (GNN) and combined optimization methods (Bayesian optimization and gradient based methods).

In work of Viquerat et al. [1] was shown that GNN can approximate stationary solutions of the Navier-Stokes equations with higher accuracy than previously used CNN and provide a significant reduction in time required to obtain a solution (about 2-3 orders) in comparison with the direct calculation by CFD solver at the cost of a small error rates. Due to these advantages, it was proposed to use GNN as a flow approximator in the algorithm of aerodynamical shape optimization, where it is necessary to obtain a large number of solutions in order to find optimal geometry parameters. After training the model, we utilized it in conjunction with different optimization algorithms, such as Bayesian optimization [2] and gradient-based methods (e.g., BSFG). This approach can be implemented in various applied tasks, for example, maximization of lift/drag force ratio for airfoils.

References:

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