Overview and application possibilities of machine learning in aerospace engineering

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A growing number of machine learning (ML) techniques implementations in the commercial sector (speech and gesture recognition, handwriting, fraud detection, credit scoring and finance) and the industrial sector (tasks of medical and technical diagnostics, bioinformatics, forecasting tasks in the mining industry) confirms the relevance and possible application of ML in other industries.
The analysis of the problems of ML and the possibility of application in the industry: for experimental research and numerical calculations. The history of the formation of ML, the analysis of various time stages of development and the designation of problems that arose at each of these stages are highlighted. The paper paid special attention to the review of cases of the introduction of ML models in industry. The application of ML in computational aerodynamics was considered: such as mathematical modeling and the use of a model based on the physics of processes as an objective function and the processing of calculation results. For example, developing ML methods for aerodynamic shape optimization [1]. Authors propose a new optimizer based on ML techniques, such as reinforcement learning, transfer learning and deep neural networks. The proposed approach is tested for a typical aerodynamic shape optimization of missile control surfaces with computational fluid dynamics (CFD). For the considered aerodynamic shape optimization problem of missile surfaces, a remarkable reduction in the computational time has been accomplished. With its help, a significant reduction in computing time has been achieved.

[1] Yan X, Zhu J, Kuang M and Wang X 2019 *Aerospace Science and Technology* **86** 826–835