

Machine learning in numerical simulations: results, challenges, and open problems

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Abstract: Machine learning (especially deep learning) has achieved tremendous success in many cognitive tasks, like image classification and text mining.

Modern machine learning can be considered as a collection of algorithms and software packages that are able to solve complex function interpolation tasks. For “numerical people” an obvious question is if these technologies can be efficiently used to solve computational modeling tasks and create faster solvers. This has been already tried, and neural networks have gained a bad reputation in numerical simulations due to the fact that they produce non-robust approximations, and the accuracy is difficult to control. One of the promising ways is to use tensor methods for multivariate function approximations: it has been recently shown that tensor decomposition can be viewed as a special type of neural networks, but can be computed using fast and stable algorithms. I will highlight recent results in this area.

Finally, I will talk about open problems in the attempts that try to bridge the gap between data science and computational science.