附件1

资助领域

In recent years, the combination of numerical methods and learning-based approaches has gained an ever-increasing interest as a research field within Numerical Mathematics and Scientific Computing. The suggested topic “Intelligent Numerical Mathematics” (iNum) will foster the development of the two emerging fields of learning-based numerics and numerically efficient learning methods. Here, both fields are viewed as research topics within Numerical Mathematics and Scientific Computing. This viewpoint is supported by a fast-growing number of publications and presentations at conferences across Applied Mathematics and Computational Science and Engineering (CSE).

By using learning-based numerics, the range of tractable problems as well as the efficiency and robustness of numerical methods can be tremendously enhanced, for example by

* learning of numerical parameters such as relaxation parameters, adaptivity criteria or regularisation weights,
* learned components in model reduction or multi-scale methods,
* generation of good initial guesses or preconditioners for iterative solvers,
* decisions between different options such as parallelisation strategies or different types of solvers for (non-)linear systems of equations,
* load balancing based on learned performance models.

Here, challenges are expected in terms of stability requirements, convergence or, more general, quality guarantees. In the field of numerically efficient learning methods, new or improved numerical algorithms are used to tune state-of-the-art learning methods. Increased computational efficiency and parallel scalability as well as numerical robustness of modern learning algorithms can be expected as scientific output. For example, improvements in the training phase are expected by

* enhanced optimisation methods,
* sparsification, regularisation and error control,
* parallel numerical methods with improved scalability and reduced communication.

Learning methods challenge the traditional numerical approaches in many of the aforementioned aspects and pose new questions for research in Numerical Mathematics and Scientific Computing.