VARIOUS ASPECTS OF MACHINE LEARNING ENHANCED NUMERICAL METHODS TO SOLVE DIFFERENTIAL PROBLEMS

DAVIDE OBERTO*, MORENO PINTORE§ AND GIOANA TEORA†

* mathLab, Mathematics Area, SISSA
via Bonomea 265, I-34136, Trieste, Italy
doberto@sissa.it

§ Laboratoire Jacques-Louis Lions, Sorbonne Université, Inria,
4 place Jussieu, 75005 Paris, France
moreno.pintore@sorbonne-universite.fr

† Dipartimento di Scienze Matematiche "G. L. Lagrange" Politecnico di Torino,
Corso Duca degli Abruzzi 24, 10129 Torino, Italy
gioana.teora@polito.it

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ABSTRACT

Thanks to the recent hardware and algorithmic improvements in the field of machine learning (ML), numerous novel methods relying on ML have been proposed to solve complex engineering problems. Such tasks, usually modelled by means of partial differential equations, require efficient, accurate, and reliable numerical solvers.

The numerical solvers can generally be categorized into three main groups: solvers not relying on ML, solvers that rely exclusively on ML, and hybrid solvers that integrate classical techniques with ML algorithms. This third category, situated at the intersection of these two research domains, includes original methods that combine the advantages of the classical methods with the efficiency and nonlinearity of neural networks or other ML techniques.

A wide array of hybrid methods can be conceived. Examples include (but are not limited to) approaches to train neural networks to emulate established classical methods, for mesh generation or refinement, to stabilize neural networks by projecting them onto standard discrete function spaces, to develop efficient interpolation and quadrature schemes, and to approximate discrete function spaces or physical quantities involved in existing numerical techniques.

This minisymposium is intended to explore such novel hybrid approaches and encourage collaboration in this emerging research area. Contribution related to ML enhanced numerical methods are welcome. Submissions may address various aspects of these techniques, including theoretical foundations, implementation strategies, physical modeling, or performance analysis.