

Preface: AAI-MLPS 2021 Combining Artificial Intelligence and Machine Learning with Physical Sciences

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This volume contains the contributed papers selected of the AAI 2021 spring symposium on “Combining Artificial Intelligence and Machine Learning with Physics Sciences.” The symposium was held on 22 to 24 March 2021 in a virtual form because of the Covid-19 outbreak.

This symposium aimed to present the current state of the art and identify opportunities and gaps in AI/ML-based physics modeling and analysis. With recent advances in scientific data acquisition and high-performance computing, Artificial Intelligence (AI) and Machine Learning (ML) have received significant attention from the applied mathematics and physics science community. From successes reported by industry, academia, and the research community at large, we observe that AI and ML hold great potential for leveraging scientific domain knowledge to support new scientific discoveries and enhance the development of physical models for complex natural and engineered systems.

The accepted papers were presented over 3 days with two invited talks each day. The symposium was broadcast live and camera-ready presentations were posted on the symposium YouTube channel (link). More than 100 participants contributed to intense discussion during presentation. Presenting topics include 1) state-of-art learning frameworks that can seamlessly synthesize models, governing equations and data, 2) architectural and algorithmic improvements for scalable physics-informed learning, 3) stability and error analysis for physics-informed learning, 4) software development facilitating the inclusion of physics domain knowledge in learning, and 5) discovery of physically interpretable laws from data. Applications included fluid mechanics, quantum mechanics, material sciences, and chemistry, and provided recent efforts in incorporating domain knowledge into machine learning.

As editors of the proceedings we are grateful to everyone who contributed to the symposium. We would like to thank the invited speakers:

- Surya Ganguli, Stanford University
- Ben Adcock, Simon Fraser University
- Animashree Anandkumar, Caltech/NVIDIA
- Nathan Kutz, University of Washington
- Jan S. Hesthaven, EPFL

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- Marta D’Elia, Sandia National Laboratories
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