ADVANCED NUMERICAL METHODS AND MACHINE LEARNING TECHNIQUES IN APPLIED SCIENCE

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ABSTRACT

Advanced computational methods and machine learning (ML) techniques are playing an increasingly central role in addressing complex challenges across various scientific and engineering disciplines. The Minisymposium **Advanced Numerical Methods and Machine Learning Techniques in Applied Science** will examine the mathematical and computational foundations underlying modern numerical approaches to scientific computing. The session will highlight advanced numerical algorithms, reduced-order modeling techniques, and hybrid methods that merge data-driven learning with physics-based models, focusing on how these approaches can optimize computational efficiency, enhance predictive accuracy, and extend the applicability of simulation techniques across various areas of scientific research. The objective is to demonstrate how the synergy between traditional mathematical models and ML techniques can lead to more efficient, scalable, and precise simulations, thereby addressing complex scientific challenges in real-world scenarios.

The session will encompass a variety of topics, including (but not limited to) the following areas of interest:

- **Sparse and low-rank approximations in data-driven modeling.**
- **Hybrid approaches combining multiscale mathematical models with data integration.**
- **Mathematical foundations of scientific ML in computational science and numerical simulations.**
- **ML techniques for physics-informed modeling, uncertainty quantification, and data assimilation.**
- **Advanced numerical methods for solving high-dimensional PDEs and optimization problems.**

The session will highlight how these advanced techniques are driving progress across various fields, including computational biology, environmental sciences, and industrial processes, illustrating their potential to enhance research and development.