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ADVANCING COMPUTATIONAL MECHANICS WITH SYMBOLIC REGRESSION

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MINISYMPOSIUM

Symbolic Regression, a dynamic approach rooted in machine learning and symbolic computation, has garnered significant attention within the realm of computational mechanics. It enables data-driven modeling that is inherently interpretable, i.e., producing symbolic representations (equations) that best describe a dataset. Because computational mechanics is built around symbolic expressions the equations produced by symbolic regression are readily incorporated into a variety of preexisting workflows, including analytical derivations used in computational applications. This minisymposium seeks to illuminate the latest breakthroughs and applications of symbolic regression techniques in advancing the simulation, analysis, and optimization of complex mechanical systems. By harnessing the potential of symbolic regression, researchers are discovering novel avenues to enhance accuracy, model interpretability, and computational efficiency in the domain of computational mechanics.

This minisymposium will explore a comprehensive array of topics that include, but are not limited to:

1. E*quation Discovery and System Identification*: Symbolic regression techniques enable the discovery of governing equations from experimental or simulated data, facilitating the identification of system dynamics and behaviors without a priori assumptions.
2. *Physics-Informed Machine Learning*: Integrating domain-specific physical insights into symbolic regression yields hybrid models that combine data-driven learning with established physical laws to enable identification of the physical significance of individual model components while also ensuring greater interpretability, model generalization and robustness.
3. *Uncertainty Quantification and Sensitivity Analysis*: Symbolic regression streamlines the quantification of uncertainties and sensitivities within computational mechanics models, providing a deeper understanding of system behavior through traceable uncertainty propagation.
4. *Optimization and Design*: The application of symbolic regression in optimization scenarios empowers researchers to efficiently explore design spaces, identify optimal configurations, and unveil design principles governing complex mechanical systems.
5. I*nterpretable AI in Mechanics*: The symbolic nature of regression results in interpretable models, enhancing the transparency and trustworthiness of AI-driven decisions in computational mechanics applications.