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Machine Learning Algorithms for Learning Nonlinear Terms of Reduced Mechanical Models in Explicit Structural Dynamics

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Modeling and simulations are a pillar in the development of complex technical systems. However, for time-critical applications a conduction of high-fidelity simulations is not always feasible. To mitigate this computational bottleneck model order reduction (MOR) can be applied. For nonlinear models, linear MOR approaches are only practicable to a limited extend. Nonlinear approaches, on the contrary, often require deep interventions in the used simulation code. If access is not possible, non-intrusive nonlinear model order reduction can be the key to success.
The goal of this work is to implement two different non-intrusive approaches using linear model order reduction along with machine learning algorithms. They both rely on the idea to learn the dynamics in the reduced space. In the first approach, a linear ODE is supplemented with the nonlinear inner forces discovered by the algorithms. In contrast, the second one aims to learn the sequence of the reduced dynamics of a system directly.
By applying these methods to problems arising from the field of structural dynamics, accurate surrogate models are received. They can speed up the simulation time significantly, while still providing high-quality state approximations.

Primary author: Mr KNEIFL, Jonas (Institute of Engineering and Computational Mechanics)

Co-author: Prof. FEHR, Jörg

Presenter: Mr KNEIFL, Jonas (Institute of Engineering and Computational Mechanics)

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