A NON-INTRUSIVE MODEL REDUCTION METHOD IN ROLLER FORMING

J. Sandoval, D. Baroli, C. Idzik, K. Veroy-Grepl, F. Piscaglia , and A. Kramer, J.Lohmar and G.Hirt

ABSTRACT

Around 95% of all steel products are rolled at least once in the production process. Therefore, even small optimizations of the already highly optimized rolling process are promising. Today, for further optimization mostly local effects like the shear have to improve. As a result, it is necessary to either use exhaustive and complex models (such as finite element simulations) that require large scale computational effort, or apply fast heuristic models, which provide results within seconds at the price of significantly reduced accuracy.

For this reason, the use of non-intrusive model order reduction (MOR) methods [1,2] for metal forming has recently generated considerable interest; ROMS provide the possibility to construct low dimensional yet high-fidelity approximate models, thus providing highly accurate predictions at low computational cost.

In this work we propose a novel method that uses an initial Full Order Model (FOM) that is simulated on Abaqus to obtain the displacement field, from which the so-called snapshot matrix is then constructed. Afterwards, a Proper Orthogonal Decomposition (POD) is implemented to obtain a Reduced Order Model (ROM) based on the truncation of the less representative modes, resulting in much lower dimensions. The reconstruction of the reduced solution for an untrained parameter is obtained by the Gaussian Process Regression [3]. Finally, to overcome the curse of dimensionality of Gaussian Process Regression-POD, we adopt an offline sampling strategy based on bayesian optimization.

REFERENCES

[1] Ghnatios, C., Cueto, E., Falco, A. et al. Spurious-free interpolations for non-intrusive PGD-based parametric solutions: Application to composites forming processes. Int J Mater Form 14, 83–95 (2021).

[2] O. Friderikos, Marc Olive, Emmanuel Baranger, Dimitris Sagris, Constantine David. A Non-Intrusive Space-Time Interpolation from Compact Stiefel Manifolds of Parametrized Rigid-Viscoplastic FEM Problems. 2020. ⟨hal-02880322⟩

[3] Data-driven reduced order modeling for time-dependent problems Mengwu Guo, Jan S. Hesthaven, Comput. Methods Appl. Mech. Engrg., 2018.