Deep learning-based reduced order models for Micro-Electro-Mechanical systems

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The design of reduced order models (ROMs) in mechanical vibratory systems including geometric nonlinearities, such as Micro-Electro-Mechanical systems (MEMS), poses challenges mainly because of the lack of invariance of the linear subspaces, and the highly nonlinear behavior of these systems. Conventional ROMs anchored to the assumption of modal linear superimposition might however reveal inefficient when dealing with nonlinear problems arising in computational mechanics. For this reason, we exploit POD-DL-ROMs to construct ROMs by exploiting deep learning (DL) algorithms and dimensionality reduction through POD. In this way, both the nonlinear trial manifold and the nonlinear reduced dynamics are learned in a non-intrusive way, by relying on DL algorithms trained on a set of solution snapshots. By several numerical examples, we show that this framework ensures an accurate estimation of the frequency response functions of structures within times compatible with industrial design requirements, towards the construction of digital twins of MEMS.

References

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