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Locating Nonlinearities in Mechanical Systems: A Dynamic Network Approach

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Abstract: Accurately modelling nonlinearities is becoming increasingly important in the many high-tech sectors of mechanics, in particular in the context of model-based control design. During the nonlinear modelling process, a key step is the determination of the physical locations of the nonlinearities. The present work aims at developing a data-driven approach to nonlinearity location based on analysing nonparametric frequency response functions (FRFs). To achieve this objective, measurement locations in mechanical systems are interpreted as an arrangement of nodes in a dynamic network, and linearisation techniques are applied to the FRFs constructed from node to node. Illustrative results obtained on a numerical three-degree-of-freedom mechanical system demonstrate the effectiveness of the proposed approach.

Keywords: Mechanical systems; nonlinearity; experimental data; dynamic networks; linearisation; nonlinear data-driven modelling; nonlinear system identification.