# Parameter Identification and Investigating the Effect of Higher-order Inertia in a Gradient Elasticity Model of Metamaterials in Dynamic Loading

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**Abstract**

In metamaterials with a complex microstructure, the role of higher-gradient terms in the mechanical response is not negligible. Here, our goal is to identify the parameters of a homogenized model for a type of metamaterials known as pantographic structures. For the description of the pantographic structure, we employ a 2D non-linear second-gradient model which considers the complex structure as a homogenized plate [1]. The parameters of the model are identified for the corresponding structure through an automatized optimization algorithm [2]. We validate the identified parameters for the dynamic regime by comparing displacement plots with experiments [3].
Experimental results are obtained by applying forced oscillations to pantographic specimens made by 3D-printing technology. Qualitative and quantitative analyses for different frequency ranges show a good agreement far away from the eigenfrequencies while discrepancies are present close to the eigenfrequencies. To investigate the effect of microinertia, we include higher-order inertia in the model. As a result, the computations moved favorably toward predicting the mechanical behavior close to the eigenfrequencies. However, the experimental characterization of higher-order inertial terms that exist in theories is not yet understood, therefore there is no clear methodology for determining their values up to now. Further studies in this direction are encouraged.

**References**

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