# Simulation, Modelling & Experimental Validation Of 3DP Auxetic Structure For Vibration Isolation

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## Abstract

Auxetic materials, also known as metamaterials, have exotic properties like negative Poisson's ratio by virtue of their structural design rather than being a material property. Auxetic materials find their applications in fields like vibration isolation, impact energy absorption, etc. In this current study, a 2-D bow tie re-entrant structure was selected, and different possible dimensions were selected for studying the vibration isolation in the axial direction which contained the arrangement of the auxetic structures.

Using the Structural Mechanics Module in COMSOL® Multi-physics Tension & Vibration Test simulations were carried out and experimental results were compared with the simulations to study the effect of dimensions on Poisson's ratio and the effect of Poisson's ratio on the vibration isolation performance of the structures with the frequency swept from 10 Hz to 2.5 kHz in steps of 10 Hz. The response was measured in terms of the Energy vs Frequency graphs by comparing it with a standard reference sample.

As the phenomena underlying the vibration isolation using auxetic structures are very complex to be modeled mathematically, machine learning algorithms were employed to capture the effect of dimensions and Poisson's ratio of the auxetic structures on the vibration attenuation. Artificial Neural Networks in combination with Genetic Algorithms were used to identify dimensions that give targeted vibration attenuation. It is evident that ANN is very robust in its predictability and when coupled with Genetic Algorithm (GANN), it can explore the unexplored search space effectively thus helping us design new materials and structures with targeted applications.

## Figures used in the abstract

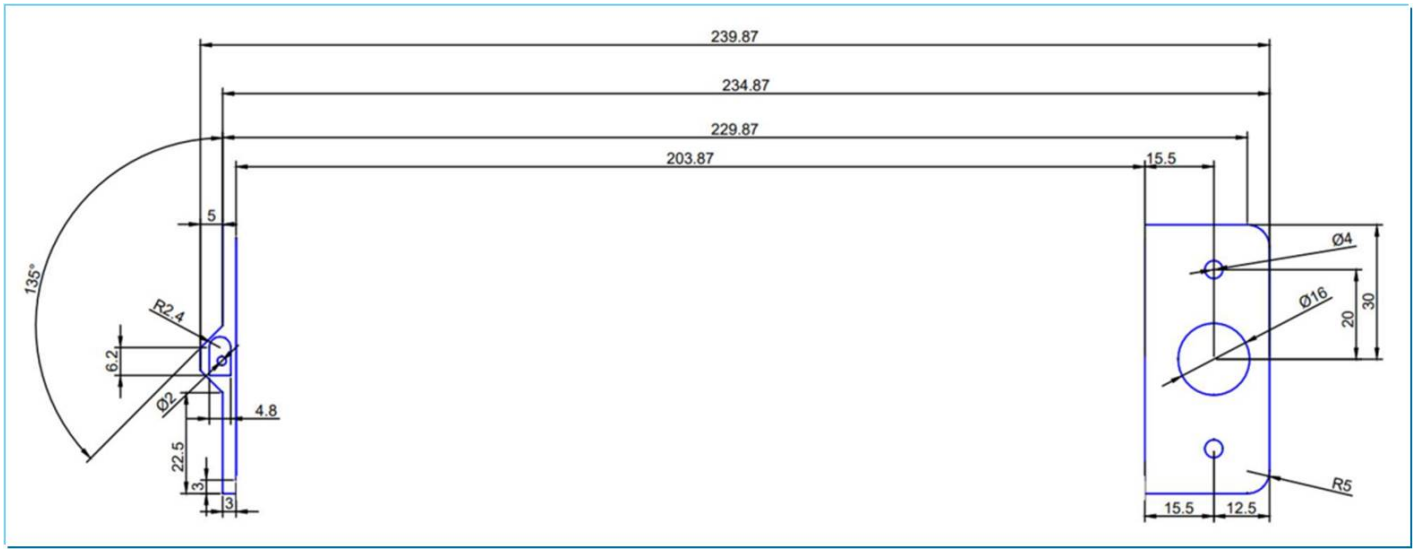


**Figure 1** : Sample Dimensions


**Figure 2** : Reference Sample

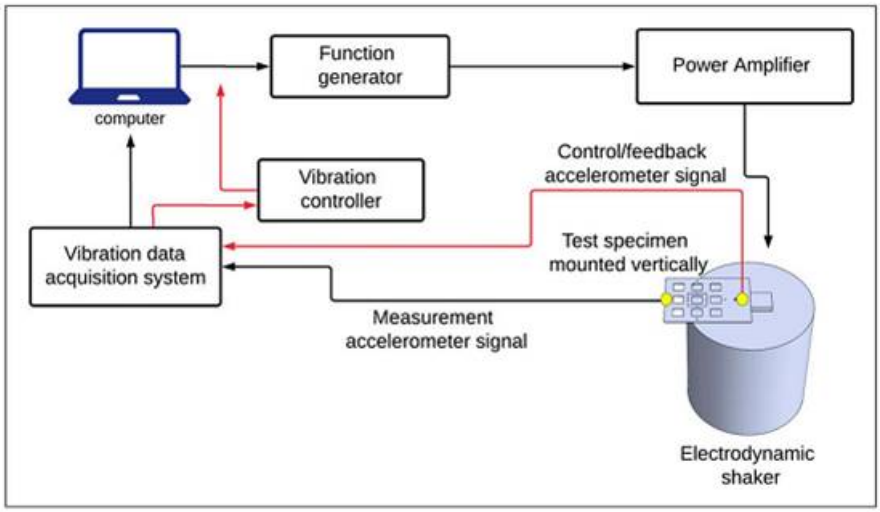


**Figure 3** : Schematic of Vibration Experiment

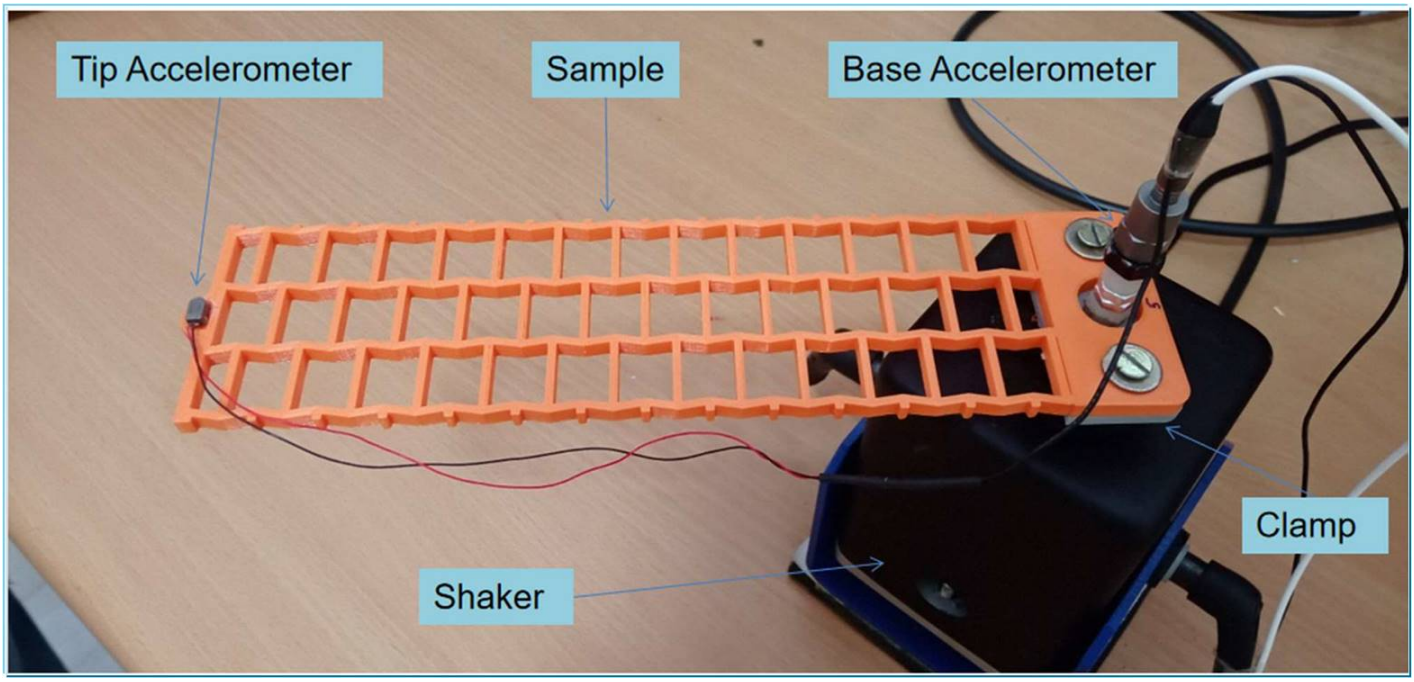


**Figure 4** : Experimental Setup