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The Impact of Simple Layering and Layer Rotation Design on the Natural Vibration Performance of Grid Beetle Elytron Plates

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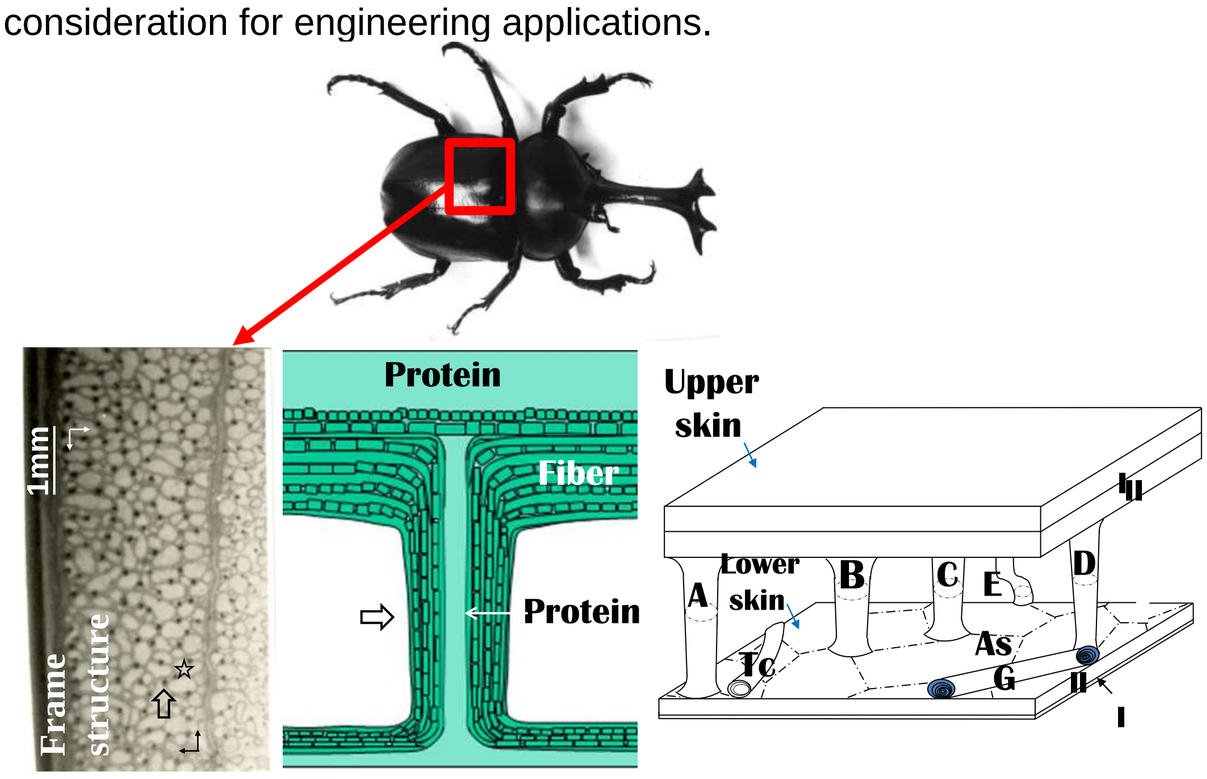
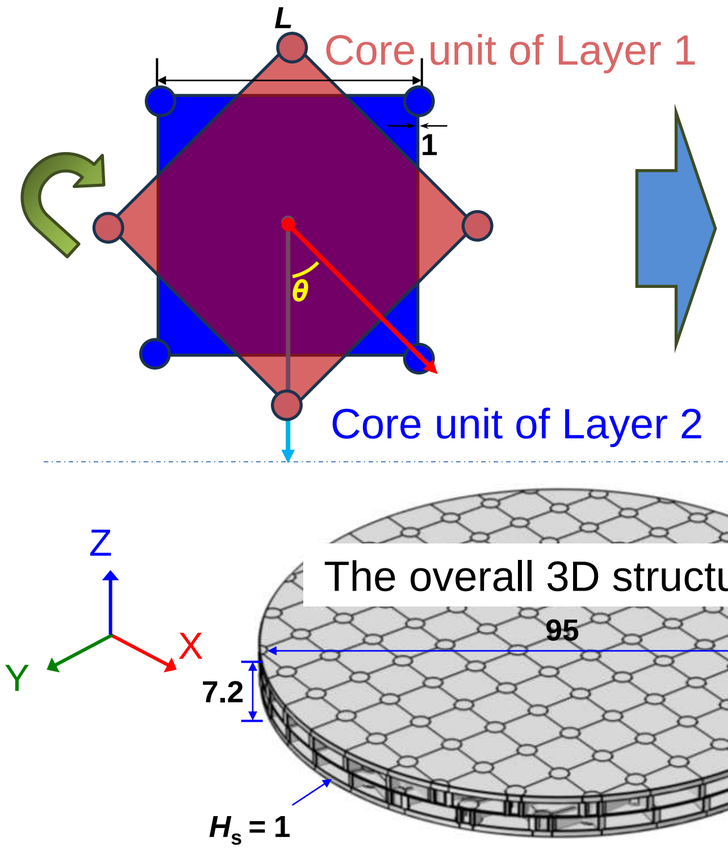
INTRODUCTION & AIM

Inspired by the forewing structure of *Trypoxylus dichotomus*, GBEPs have been developed, exhibiting superior mechanical properties over traditional grid plates. This research investigates the effect of layer rotation on the natural vibrational frequencies of GBEPs, a crucial consideration for engineering applications.



NOVEL STRUCTURAL DESIGN

The whole structure contains two skins, one middle plate and two GBEP cores.

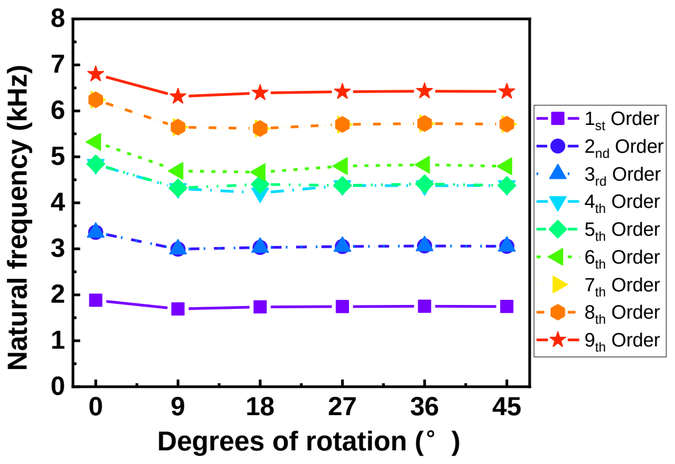


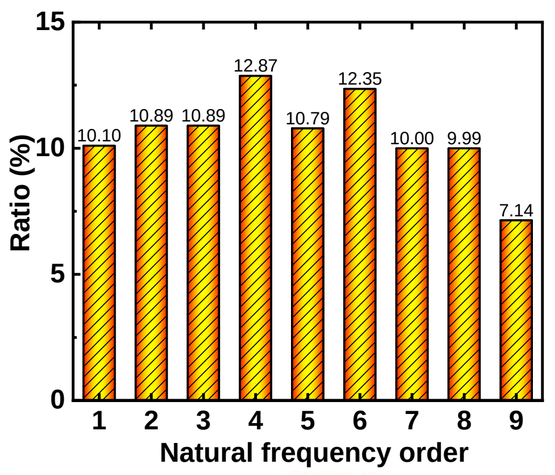
METHOD

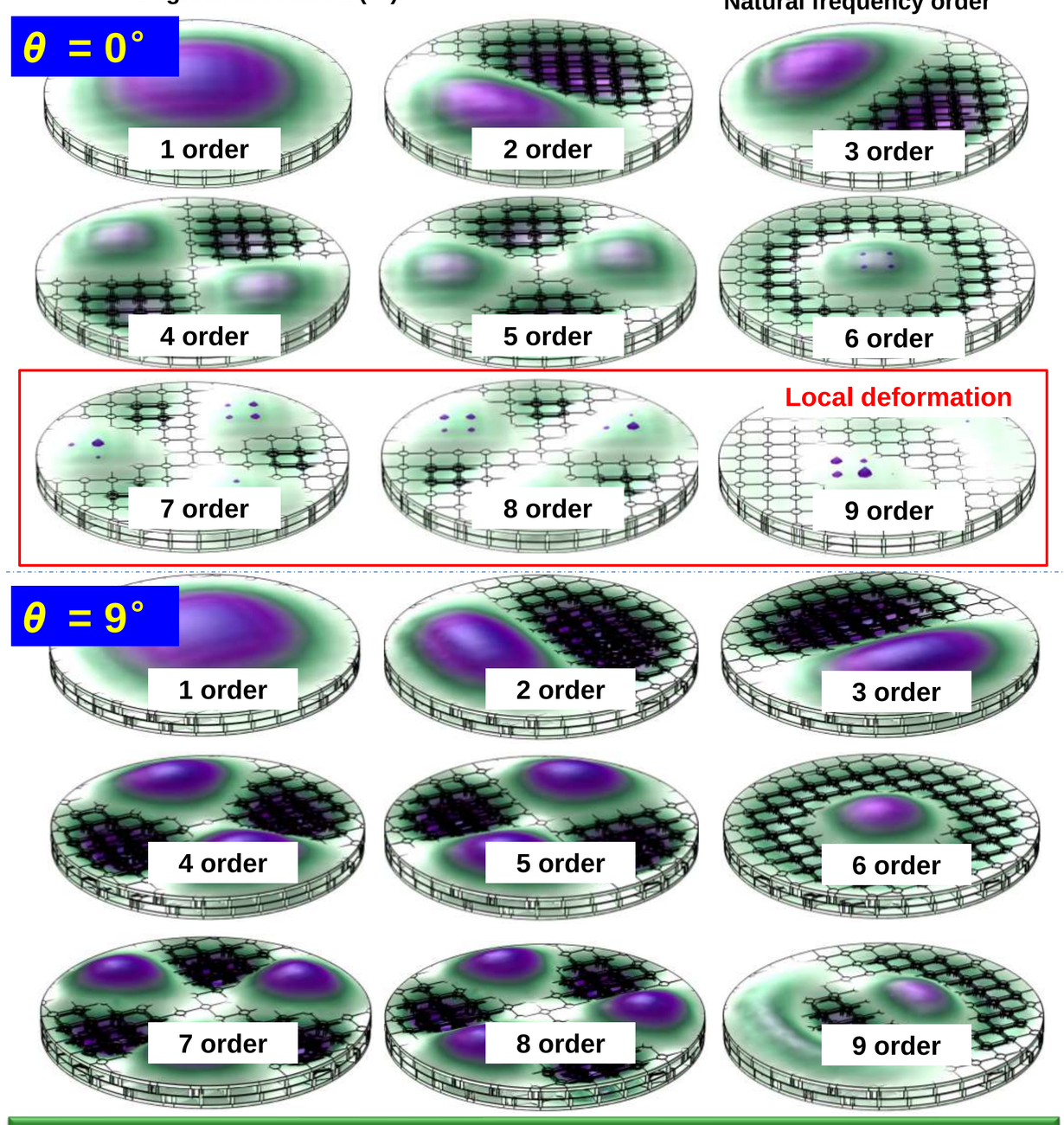
The study utilizes COMSOL Multiphysics and the ARPACK solver to analyze the vibrational response of GBEPs. Two identical plates were layered and rotated at angles from 0 to 45 degrees, in 9-degree increments, to examine changes in the first 9 natural frequency modes under various rotational configurations.

RESULTS & DISCUSSION

Rotational adjustments significantly enhanced the clarity of vibrational modes, with dual-layered GBEPs showing more defined first 9 natural vibration modes compared to non-rotated structures. Rotation induced up to a 12.87% shift in natural frequencies, demonstrating the efficacy of this method in modulating vibrational characteristics.







CONCLUSION

This investigation highlights the capacity of simple structural modifications in biomimetic designs to achieve desired vibrational performances. Adjusting the orientation of layers in GBEPs allows for flexible vibrational properties, paving the way for their versatile application in different engineering contexts. The study leverages biomimetic principles to offer a novel approach for precise vibrational tuning in material design.