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Computational simulation of cymatics with experimental analysis

P.D.S.H. Gunawardane[1], S. Harshana[1], A.P.T.D. Pathirana[2] and N.T. Medagedara[2*]

[1]*Department of Mechanical Engineering, The University of British Columbia, Vancouver, Canada*
[2]*Department of Mechanical Engineering, The Open University of Sri Lanka, Nugegoda, Sri Lanka*

Cymatics is a visual representation of sound and vibrations, on surfaces of plates, diaphragms, and membranes, in the forms of auditory-images. The surfaces that are exposed to these vibrations are sprinkled with fine particles that accumulate at nodes, to create visualizations of a specific geometry which is unique to the particular frequency. The focus of this research is to design an experimental platform, dedicated towards observing the behaviour of cymatics, through the analysis of such visualizations (Chladni patterns). This is further investigated by performing numerical modelling using finite element simulation. Aluminum (Al) plates of 2 mm thickness—having three shapes, consisting of identical surface area—were used for both experimental and finite element analysis (FEA). FEA was performed using ANSYS simulation software and patterns were derived for different vibrational frequencies. The results demonstrated that 60% of the experimental imagery conforms with the visualization generated by ANSYS software. Additionally, the lowest average frequency error and average deviation for similar images were found to be 9.2 % and 2.8 mm, respectively for the triangular shape plate, validating that the shape of the plate plays a paramount role in cymatics analysis. An image processing technique was used to determine the deviation between the images created by the experimental platform and FEA for all three shapes. 2D Image processing technique was considered on the planner dimension of the required testing images. A black colour backgrounded image represented the testing plates having a vibration feature. A white colour sand line was used to track the cymatics pattern for 2D image processing. The patterns of the simulated image obtained from from ANSYS was compared with the 2D image which was obtained from a USB camera. The results demonstrate that Chladni patterns are best represented by a triangular shaped plate.

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E-mail: tmmed@ou.ac.lk