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Vibration suppression of composite panel with variable angle tow design and inerter-based nonlinear energy sink

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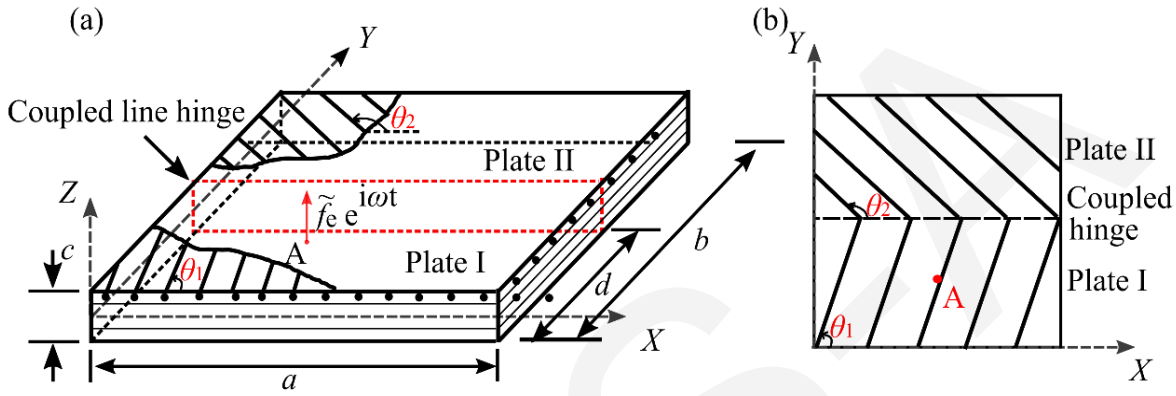
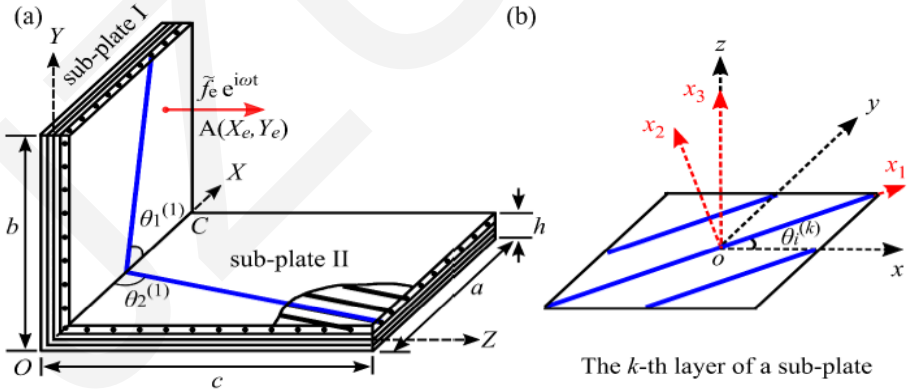
Research of composite structure vibration

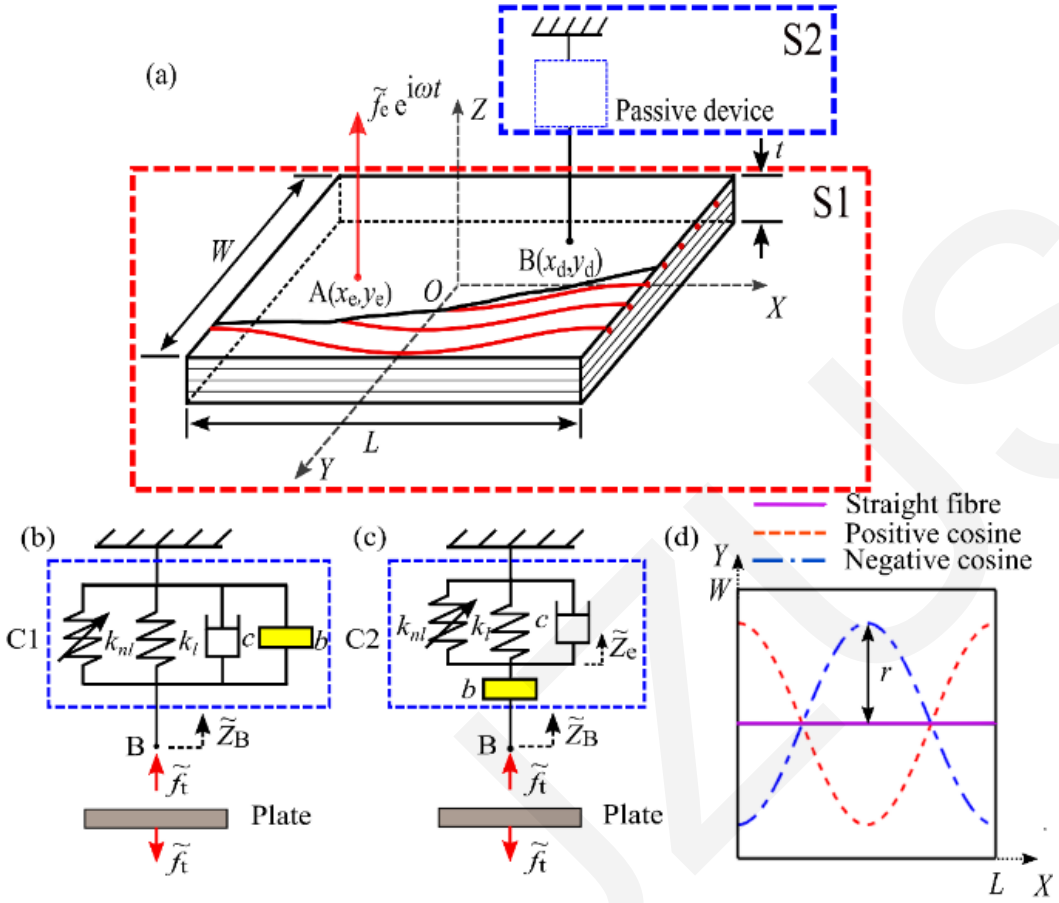


Energy transfer and vibration suppression of laminated composite plates coupled with a line hinge (C. Zhou, J. Yang, Y. Zhu, C. Zhu, Mechanics of Advanced Materials and Structures, pp. 1-19, 2023)



Vibration transmission and energy flow analysis of L-shaped laminated composite structure based on a substructure method (C. D. Zhu, J. Yang, C. Rudd, Thin-Walled Structures, vol. 169, pp. 108375, 2021)

Schematic diagram



Fibre shape function:

$$f(x) = y = \mathrm{r} * cos\left(\frac{2\pi x}{L}\right)$$

Fibre orientation:

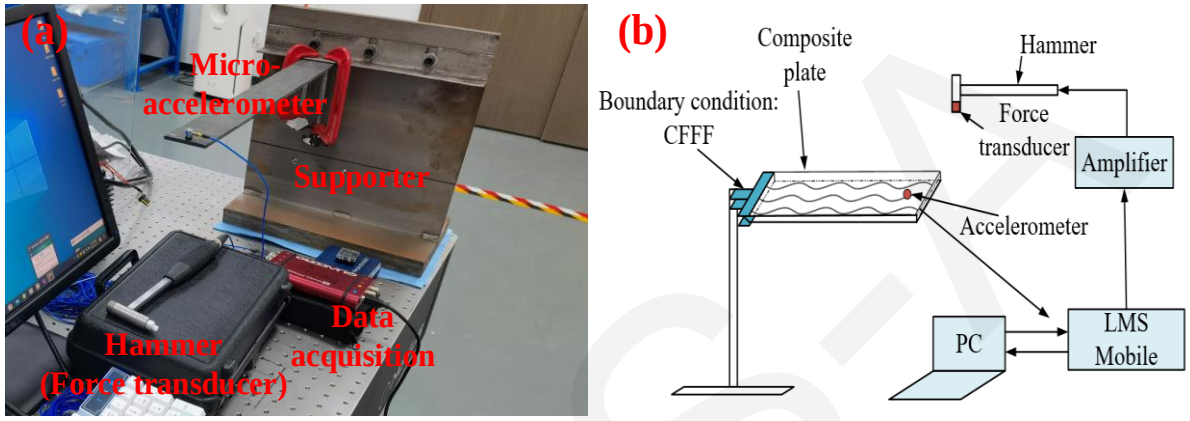
$$\theta(x) = tan^{-1}\left[\frac{2\pi r}{L} sin\left(\frac{2\pi x}{L}\right)\right]$$

M1:[+ + + +]

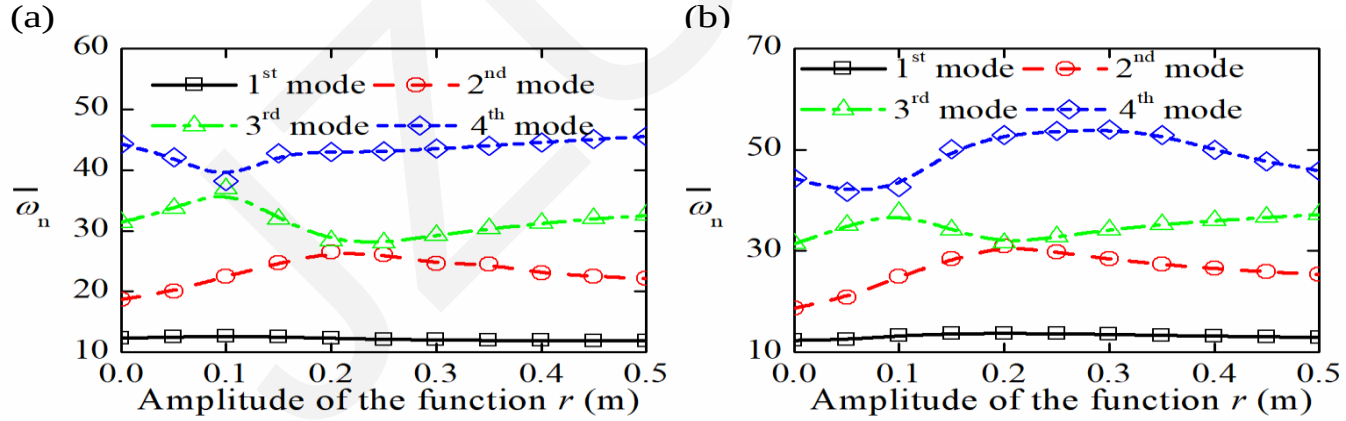
M2:[+ - + -]

VAT composite plate with an inerter-based passive NES device attached

Experimental verification and free vibration

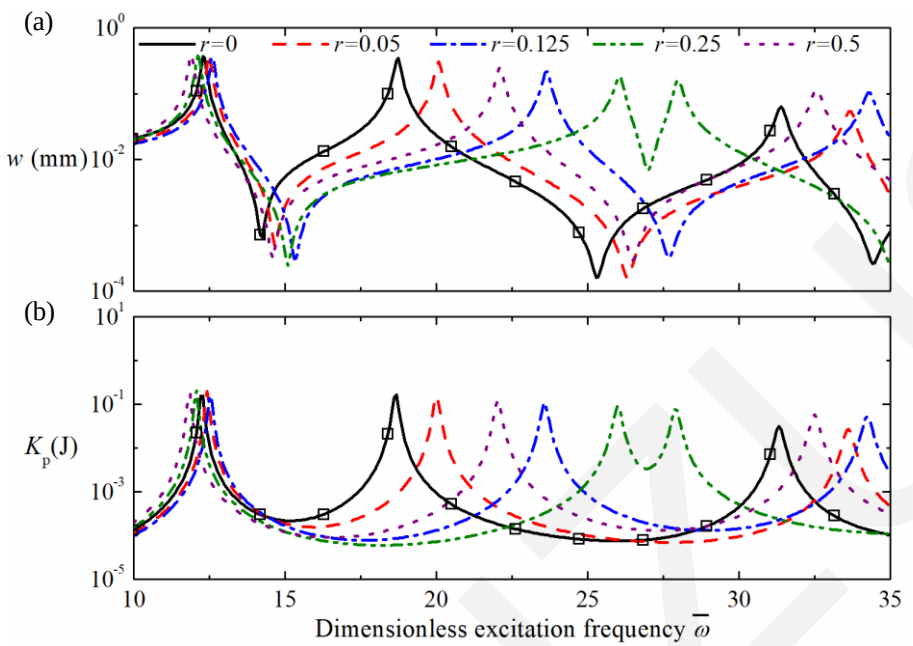


Installation of vibration test equipment: (a) experimental setup and (b) schematic setup

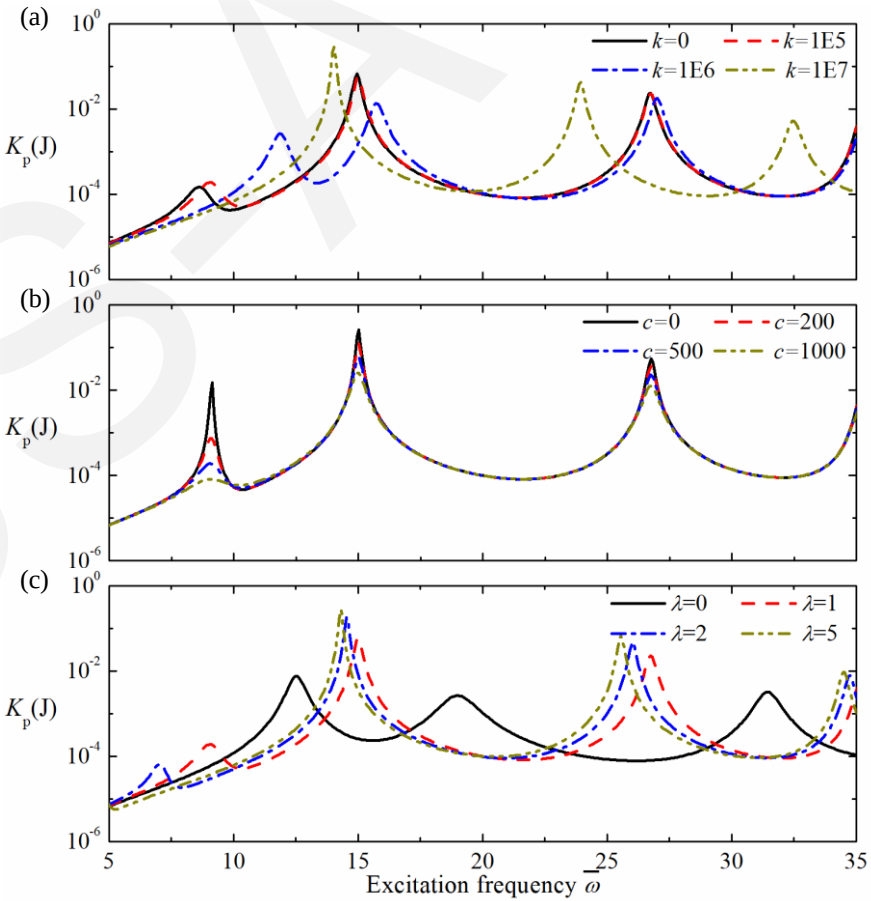


Effect of fiber function on the natural frequencies of the square VAT laminated composite plates with configuration

Displacement and kinetic energy response



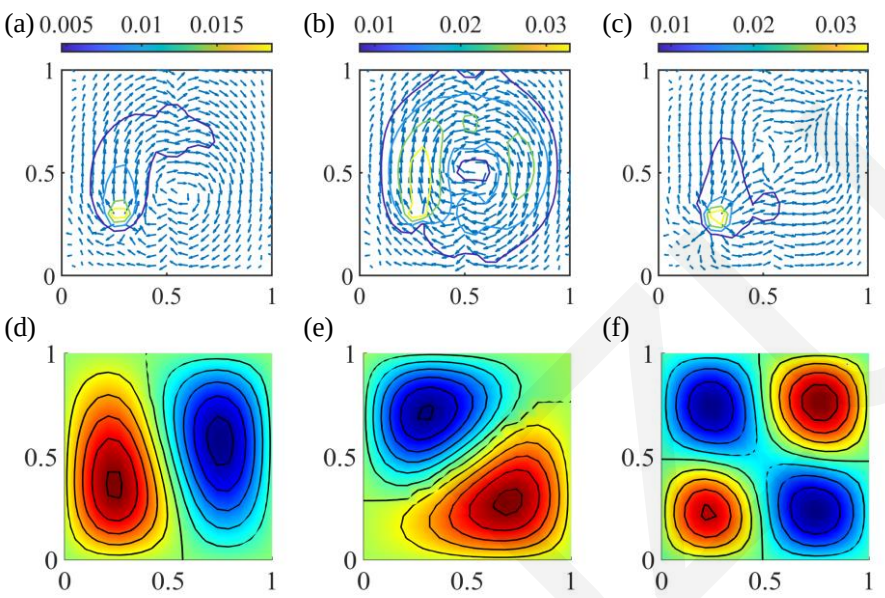
Effect of the fiber function on the w and K_p of VAT plate under M2 configuration



Effect of passive device on the K_p of VAT plate under M1 configuration

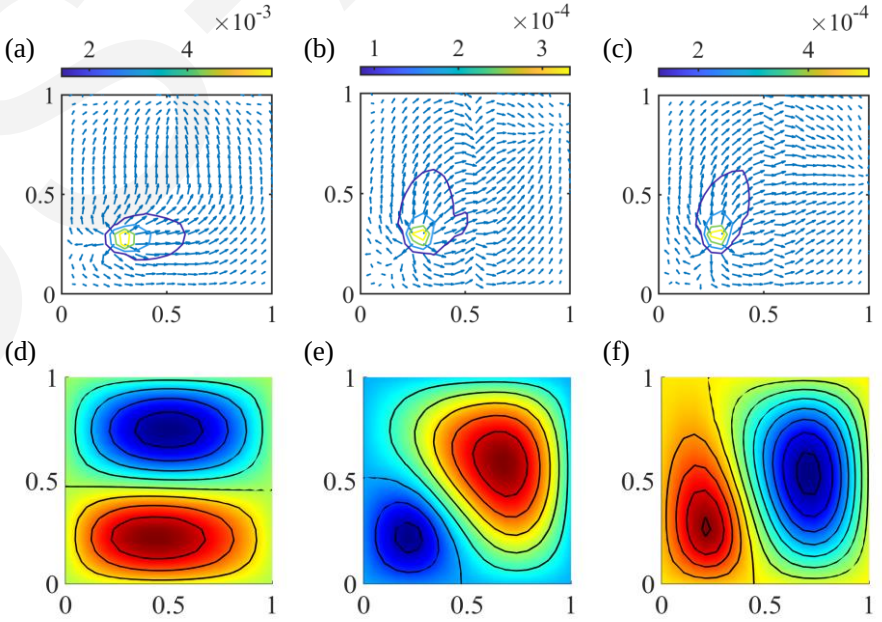
Energy transmission paths and mode shapes within square VAT composite plates

Effect of the different excitation frequencies



$\bar{\omega} = 29.71$ $\bar{\omega} = 32.87$ $\bar{\omega} = 53.68$

Effect of the different fibre schemes



$r = 0.05$ m $r = 0.25$ m $r = 0.5$ m

Conclusions

- Substructuring-based power flow method developed
- Effects of fiber path function on free vibration examined
- Influence of the fiber path function and passive device on the forced responses examined
- Dominant energy transmission paths can be tailored designed using fiber shape function and passive device.