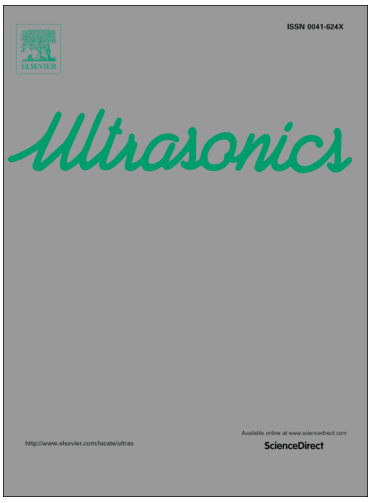


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# Cut-off frequencies of circumferential horizontal shear waves in various functionally graded cylinder shells

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**Abstract**

In this study, cut-off frequencies of the circumferential SH waves in functionally graded piezoelectric-piezomagnetic material (FGPPM) cylinder shells with traction free, electrical and magnetic open boundary conditions are investigated analytically. The Wentzel-Kramers-Brillouin (WKB) method is employed for solving differential equations with variable coefficients for general cases. For comparison, Bessel functions and Kummer functions are used for solving cut-off frequency problems in homogenous and ideal FGPPM cylinder shells. It is shown that the WKB solution for the cut-off frequencies has good precise. The set of cut-off frequencies is a series of approximate arithmetic progressions, for which the difference is a function of the density and the effective elastic parameter. The relationship between the difference and the gradient coefficient is described. These results provide theoretical guidance for the non-destructive evaluation of curved shells based on the cut-off frequencies.

**Keywords:** functionally graded piezoelectric-piezomagnetic material; cylinder shear; SH wave; cut-off frequency; Wentzel-Kramers-Brillouin method