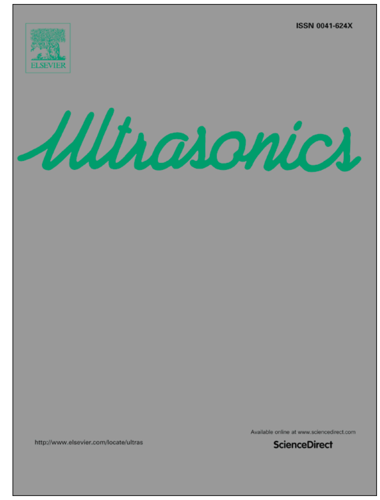
Accepted Manuscript



Extraction of Guided Wave Dispersion Curve in Isotropic and Anisotropic Materials by Matrix Pencil Method

C.Y. Chang, F.G. Yuan

PII: S0041-624X(17)30946-0
DOI: https://doi.org/10.1016/j.ultras.2018.05.003
Reference: ULTRAS 5745

To appear in: *Ultrasonics*

Received Date: 10 November 2017
Revised Date: 7 May 2018
Accepted Date: 9 May 2018

Please cite this article as: C.Y. Chang, F.G. Yuan, Extraction of Guided Wave Dispersion Curve in Isotropic and Anisotropic Materials by Matrix Pencil Method, *Ultrasonics* (2018), doi: https://doi.org/10.1016/j.ultras.2018.05.003

Extraction of Guided Wave Dispersion Curve in Isotropic and Anisotropic Materials by Matrix Pencil Method

C. Y. Chang[1,2] and F. G. Yuan[1,2]*

1 Department of Mechanical and Aerospace Engineering, North Carolina State University, Raleigh, NC 27695

2 Integrated System Health Management Laboratory ISHM, National Institute of Aerospace, 100 Exploration Way, Hampton, VA 23666

* Corresponding author. Email: yuan@ncsu.edu

ABSTRACT

Guided wave dispersion curves in isotropic and anisotropic materials are extracted automatically from measured data by Matrix Pencil (MP) method investigating through *k-t* or *x-ω* domain with a broadband signal. A piezoelectric wafer emits a broadband excitation, linear chirp signal to generate guided waves in the plate. The propagating waves are measured at discrete locations along the lines for one-dimensional laser Doppler vibrometer (1-D LDV). Measurements are first Fourier transformed into either wavenumber-time *k-t* domain or space-frequency *x-ω* domain. MP method is then employed to extract the dispersion curves explicitly associated with different wave modes. In addition, the phase and group velocity are deduced by the relations between wavenumbers and frequencies. In this research, the inspections for dispersion relations on an aluminum plate by MP method from *k-t* or *x-ω* domain are demonstrated and compared with two-dimensional Fourier transform (2-D FFT). Other experiments on a thicker aluminum plate for higher modes and a composite plate are analyzed by MP method. Extracted relations of composite plate are confirmed by three-dimensional (3-D) theoretical curves computed numerically. The results explain that the MP method not only shows more accuracy for distinguishing the dispersion curves on isotropic material, but also obtains good agreements with theoretical curves on anisotropic and laminated materials.

Keywords: dispersion curves; Matrix Pencil method (MP); chirp signal; 2-D FFT; phase velocity; group velocity