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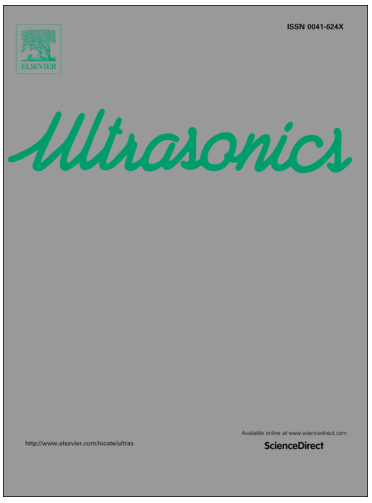

Simultaneous ultrasonic parameter estimation of a multi-layered material by the PSO-based least squares algorithm using the reflection spectrum

Xiaoyu Yang, Chengcheng Zhang, Chuanyong Wang, Anyu Sun, Bing-feng Ju, Qiang Shen

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Simultaneous ultrasonic parameter estimation of a multi-layered material by the PSO-based least squares algorithm using the reflection spectrum[1]

Xiaoyu Yang[a], *Chengcheng Zhang*[b], *Chuanyong Wang*[a], *Anyu Sun*[a,*], *Bing-feng Ju*[a], *Qiang Shen*[b]

[a] *The State Key Laboratory of Fluid Power Transmission and Control, Zhejiang University, Hangzhou, People's Republic of China*
[b] *State Key Laboratory of Advanced Technology for Materials Synthesis and Processing, Wuhan University of Technology, Wuhan, People's Republic of China*

Abstract

Advanced multi-layered materials with superior performance are required for many applications. The non-destructive characterization of multi-layer properties is a hot spot of current research. The least squares inversion method using the reflection spectrum has been developed and widely used to estimate the properties of thin single layers simultaneously. However this method has the problems of a loss in speed and simplicity, and a local optimal solution, especially in the cases of a multi-layered structure because of the increasing estimated parameters and the uncertainty influence from the parameters. Particle swarm optimization (PSO) is a robust global search algorithm similar to 'bird' foraging, which can be used to improve the performance of the least squares inversion algorithm. This paper has proposed a PSO-based least squares estimation using the ultrasonic reflection spectrum to make simultaneous measurement. The simulation and experiment, carried out on the aluminum-TC4 bi-layered material, tested and proved the capability of the new algorithm. The real measured parameters and the estimated parameters were obtained. The results have been compared to analyze the errors of the estimated parameters.

Keywords: Multi-layered material, Least squares inversion, Simultaneous

*Corresponding author
Email address: anyusun@zju.edu.cn (Anyu Sun)

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