Validation of the Resonalyser method: an inverse method for material identification

T. Lauwagie[1], H. Sol[2], G. Roebben[3], W. Heylen[1] and Y. Shi[2]
[1] Katholieke Universiteit Leuven (KUL)
Department of Mechanical Engineering (PMA),
Celestijnenlaan 300b, 3001 Heverlee, Belgium
email: Tom.Lauwagie@mech.kuleuven.ac.be

[2] Vrije Universiteit Brussel (VUB)
Department Mechanics of Materials and Constructions (MEMC)
Pleinlaan 2, 1050 Brussels, Belgium
email: hugos@vub.ac.be

[3] Katholieke Universiteit Leuven (KUL)
Department of Metallurgy and Materials Engineering (MTM)
Kasteelpark Arenberg 44, 3001 Heverlee, Belgium
email: Gert.Roebben@mtm.kuleuven.ac.be

Abstract

The Resonalyser method uses resonance frequencies measured on rectangular plate specimens to identify orthotropic material properties. An inverse technique is used to update the material properties in a numerical model of the test plate. The obtained material properties of steel and aluminum test plates are validated with the results of standard impulse excitation tests and standard tensile tests. Impulse excitation tests (IET) were performed on beam specimens cut in different material directions of the plates. IET uses in-plane and torsional vibration modes to identify the Young's moduli, shear moduli and Poisson's ratios in the orthotropic material axes and off-axis directions. It was found that the obtained results were situated well within the error intervals of the tensile test results and that the results from IET were in good agreement with the Resonalyser results. The error bounds of the Resonalyser tests have the same small magnitude as impulse testing. Both methods based on vibration measurements are accurate and produce repeatable results.