6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11-15 June 2018, Glasgow, UK

# Analysis of cracks in functionally graded magnetoelectroelastic solids under impact loadings

**M. Wünsche[1,2], J. Sladek[1], V. Sladek[1] and Ch. Zhang[2]**

[1] Institute of Construction and Architecture, Slovak Academy of Sciences, 84503 Bratislava, Slovakia, E-mail: wuensche@bauwesen.uni-siegen.de, jan.sladek@savba.sk, vladimir.sladek@savba.sk

[2] School of Science and Technology, Chair of Structural Mechanics, University of Siegen, D-57068 Siegen, Germany, E-mail: zhang@bauwesen.uni-siegen.de

**Keywords**: *functionally graded magnetoelectroelastic materials, time-domain BEM, dynamic intensity factors, impact loading*

Magnetoelectroelastic composites consisting of piezoelectric and piezomagnetic phases with an additional magnetoelectric coupling effect offer advanced possibilities for broadband sensing, actuating devices and many other smart structures. In recent years composites with a continuously change of the material properties are getting increasing attention in modern engineering applications. Such functionally graded composite materials (FGMs) can be designed to satisfy the most beneficial mechanical, electric and magnetic properties. An important advantage over conventional laminates is that interfaces and stress discontinuities are avoided. Piezoelectric and piezomagnetic composites are very brittle and have a low fracture toughness. Since they are often applied under time-dependent loading, the dynamic crack analysis is of special importance.

In this paper, transient dynamic crack analysis in two-dimensional, functionally graded magnetoelectroelastic composites is presented. A boundary-domain integral formulation [1] is developed for this purpose, since fundamental solutions for magnetoelectroelastic FGMs are not available. The spatial collocation method and the convolution quadrature for temporal discretization are used. The Laplace transformed fundamental solutions for homogeneous magnetoelectroelastic materials are applied. The radial integration method is adopted to compute the resulting domain integrals. An explicit time-stepping scheme is obtained to compute the unknown boundary data [2]. Numerical examples will be presented to show the influences of the material gradation and the transient dynamic loadings on the intensity factors and the scattered wave fields.

## REFERENCES

[1] Gao X.W., The radial integration method for evaluation of domain integrals with boundary-only discretization. *Engineering Analysis with Boundary Elements*, Vol. **26**, pp. 905–916, 2002.

[2] Wünsche M., Sáez A., García-Sánchez F., Zhang Ch., Transient dynamic crack analysis in linear magnetoelectroelastic solids by a hypersingular time-domain BEM. *European Journal of Mechanics - A/Solids*, Vol. **32**, pp. 118–130, 2012.