Abstract

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Predicting acoustic emission attenuation within different small solids shapes at different source positions using a ray-tracing technique

Acoustic Emission (AE) is a term used for structure-borne elastic waves generated within, on the surface of, a solid as a result of events such as particle impingement, cracking, sliding rolling contact. The waves are normally detected using an array of surface-mounted sensors, and so structures, processes and machinery can conveniently be monitored using the array, provided that the signals at the sensors can be interpreted in terms of the generating event(s). For signal interpretation in real structures, it is generally not practicable to solve the wave equation for all possible modes of AE propagation from source to sensor, and so the current work is aimed at simulating such propagation using a ray tracing technique. As the attenuation of AE signals is affected not only by the material properties, but also by the geometry of the object and the type of surrounding media, knowledge of attenuation is essential to ensure that sensors can be placed appropriately on large complex structures. The main purpose of this work is to establish a computationally efficient way of predicting the attenuation of AE in complex structures using 3D solid modelling and a ray tracing technique to simulate surface, bulk and combined surface and bulk wave propagation in the solid. This paper is confined to some relatively simple structures with the assumption of total reflection at boundaries. Four different solid steel shapes of varying dimensions have been used and attenuation has been measured and simulated using bulk and surface ray-tracing. Adjustments have been made to the model parameters in order to fit the simulation to the measurements. Surface wave, bulk wave and combined surface and bulk wave simulations all give good agreement with the measured results and exhibit the same general differences as the block shape changes. To investigate more subtle changes in measured results, such as the effect of the environment on reflection at the boundaries, and to investigate the blending of internal and surface simulations, developments of the simulation physics and some further tests will be required.