Influence of dimensions of the transducers on guided wave mode identification in structural health monitoring of composite objects

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Ultrasonic guided wave (UGW) based condition monitoring have been widely investigated due to ability to detect, localize and characterize the damage in complex systems. However UGW possess multimodal, frequency dispersive and environmental sensitive character. Since all waves propagate with different velocities, after multiple reflections and mode conversions, the receiver captures interfered and diffused ultrasonic field. Moreover the frequency spectrum of the excited signal is usually distorted by different factors such as: acoustic properties of the material, character of dispersion and the excitation conditions. One of the major factors influencing the excitation is the geometry, dimensions and principle of operation of ultrasonic transducers. In some sense this affects the bandwidth of excited signal and the final result of mode interference. Therefore in order to be able to identify the modes of guided waves, the spatial filtering properties must be known. The aim of this work was to investigate the spatial filtering effects of macro fiber composite transducers operating on complex shape composites. The dependence between the spectrum distortion and the type of excitation as well as properties of the particular guided wave mode was investigated by the finite element simulations and the experiments on the aluminium and the glass fiber composite samples. The transient functions for different kind of modes were reconstructed and related to the dispersion character of the particular mode. The significance of the spatial filtering on identification of the guided wave modes was demonstrated also.