

The aim of research will be detailed investigation of phenomenon of conversion of acoustic wave (AW) from air to elastic wave (EW) in thin-walled solids. Acoustic wave (axial pressure wave) propagates through the air and finally is transformed to elastic wave at interface of air/solid. Elastic wave in the form of shear and axial elastic waves are then reflected in the thin-walled structure and are converted to complex elastic waves: shear polarised in horizontal direction (Shear Horizontal, SH) and Lamb wave modes: symmetric (S) and anti-symmetric (A). As result complex elastic waves propagate in the solid specimen.

In the frame of project sample in the form of panels (flat and curved) with isotropic (metallic) and anisotropic (fibre reinforced polymer composites) properties will be investigated. Material with isotropic properties means that material properties does not depends on direction (for example metallic materials). In the anisotropic materials like composite, material properties strictly depends on direction.

Experimental part will be related to excitation of acoustic wave (AW) using acoustic sources (ultrasound transmitters). Angular characteristics (acoustic pressure distribution) for ultrasound transmitters will be measured in chamber based on ultrasound receiver with known characteristics or by microphones (with ultrasound bandwidth). Excitation of elastic waves will be also performed in contact way using piezoelectric transducer for the comparison of the contact and non-contact method of the wave excitation.

Experimental research will be also based on non-contact full wavefield measurements of elastic wave (EW) propagation in solid sample using Scanning Laser Doppler Vibrometry (SLDV). This equipment works like a laser radar and allows measuring the vibrations of objects.

Numerical research will include modelling of acoustic wave (AW) propagation in air, elastic wave (EW) propagation in the solid specimen and conversion of acoustic wave to elastic wave at interface air/solid. The AW modelling will be based on very effective pseudo-spectral method (PSM) of solution of acoustic wave equation. The EW modelling will be performed in spectral element method (SEM) in time domain with parallel computation ability based on graphic processor units (GPUs). This is very efficient method (reduced time consumption) useful for elastic wave propagation modelling in solids.

In the frame of project specimens in referential state and with discontinuities will be investigated. Model of discontinuities will be developed in SEM model of solid. The aim of this will be to investigate the interaction of non-contact excited elastic waves with discontinuities. This could be utilised in the future for damage detection and structural assessment. In the frame of the project the possibility of control desired elastic wave modes generation, control of its amplitudes ratio, directivity will be investigated.

New fundamental knowledge about phenomenon of conversion of acoustic wave to elastic wave at air/solid interface will be obtained. Moreover, efficient method of modelling of AW and EW will be developed. This method will be useful in the planning of experimental research. This knowledge will give information how to make the process of non-contact elastic wave generation efficient.