NUMERICAL MODELLING OF ULTRASONIC WAVE PROPAGATION IN CARBON FIBRE MATERIAL

Mastan Raja Papanaboina[1], Dr. Elena Jasiūnienė[2,3], Dr. Egidijus Zukauskas[2]

[1]Kaunas University of Technology, Studentų 56, Kaunas, Lithuania, mastan.papanaboina@ktu.edu
[2]Prof. K. Baršauskas Ultrasound Research Institute, Kaunas University of Technology, K. Barsausko St. 59, LT-51423 Kaunas, Lithuania
[3]Department of Electronics Engineering, Kaunas University of Technology, Studentu St. 48, LT-51367 Kaunas, Lithuania.

The composite materials which have superior qualities such as high strength and light weight. There are different types of composite material combinations such as carbon fibre, glass fibre and many other kind of materials. Where high strength and light weight is required the composite materials are playing key role in the area of aeronautics and other engineering fields [1]. The carbon fiber sandwich materials are very stiff and have low bending properties. The attachment of two carbon fiber skins to the honeycomb core make carbon fibre honeycomb panel.

The 2D model of carbon fibre reinforced plate with delamination type defects was prepared using abaqus explicit finite element software. The thickness of the modelled plate was 1 mm. Investigations were carried-out using 5MHz frequency bulk ultrasonic waves in pulse-echo mode.

The ultrasonic waves excitation zone was placed on top of the plate at different positions-above defect free and defective zones. Ultrasonic waves reflected at different position where detected and investigation of ultrasonic waves interaction with defects was carried-out.

The delamination type defects between the composite layer have been created artificially and the ultrasonic scan results are obtained in CIVA simulation software which uses phased array transducer at a frequency of 3.5MHz and 5MHz. The transducer uses 128 elements. The longitudinal wave modes have been modelled. The sensitivity zone is enabled concerns defects and the depth direction of sensitivity zone is along local normal. The defect depth and size have been obtained.

The results conclude that the finite element software analysis used for testing with 5MHz gives better results compared to 3.5MHz for both with defect and without defect of carbon fibre material. The finite element software is used to see the wave interaction with the defect. Further the same was analyzed using CIVA software to identify the position and depth of the defects.

[1] **Seth S Kessler**, **S Mark Spearing**, **Constantinos Soutis,** Damage detection in composite materials using Lamb wave methods, 5 April 2002, Seth S Kessler et al 2002 Smart Mater. Struct. 11 269

[2] **Mastan Raja Papanaboina**, **Naga Manikanta Kommanaboina**, **Hari Prasanna Manimaran**, **Dr. elena Jasiuniene**, Inspection of the Honeycomb sandwich panel using Phased arrays, Proceedings of 22nd International Scientific Conference, Transport Means 2018.