Angular location of the impact on composite structure using single rosette

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An external impact can cause an internal damage in the composite structure with no visible damage areas on the external surfaces. The hidden damage can be a source of further mechanical deterioration of this structural element. Additional NDT (*Non-destructive Testing*) techniques can be applied for the interior inspection of the structural element in impact locations in order to check whether the damage was induced after impact.

The first goal of the study is to show numerical simulation related to spectrum of reflected light connected with a selection of appropriate FBG sensors which will be used in an impact detection problem. The proper selection of sensors' grating length is based on maximum reflectivity characteristic and minimum side lobe power leakage. The simulated reflectance of the FBG sensors with the different lengths and the modulations of the refractive index were described, analyzed and discussed within coupled–mode theory assumptions. The Grating length and the refractive index profile are the critical parameters contributing to performance of the FBG sensors.

The second goal is to show a method which determines a travelling direction of a perturbed wave as seen by Fiber Bragg Grating (FBG) rosette. The travelling wave is caused by an impact. A line between the impact point and the rosette is estimated using the concept of principal direction associated with the principal strain. The principal strains are calculated using standard rosette analysis based on infinitesimal strain theory. Using two rosettes the method can be used to estimate the impact location which is the intersection point of two lines corresponding to principal direction of each rosette. During the experiment the composite plate (500 mm x 500 mm x 5 mm) with one rosette bonded to plate was investigated.

The main advantage of the proposed impact detection procedure is that the rosette works in passive mode and does not require information about wave propagation velocity but for accurate localization profile of wave velocity should be a circle. Proposed solution can be applied in many thin-walled structures such as aircraft fuselage, ships, oil rigs or storage vessels.