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Imaging of BVID in Composites: Comparison of Advanced NDT Methodologies

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Fiber reinforced plastics (or composites) are widely used in many advanced engineering structures because of their high specific stiffness and strength. A major drawback of composites is their sensitivity to internal damage features. Especially for laminates, a small impact event often leads to barely visible impact damage (BVID) which could affect the structural integrity of the composite. Over the last decades several non-destructive testing (NDT) methods have been developed and proposed in order to detect and evaluate BVID in an efficient manner.
In this study, a comparative experimental analysis is presented of several state-of-the-art NDT methods for imaging BVID in composites (see figure 1 for several examples). The following approaches are studied in this contribution:

- **Ultrasonic C-scan** using both transmission and reflection (dynamically time-gated) signals
- **Local Defect Resonance LDR** using both out-of-plane and in-plane polarized vibrations
- Low-power **VibroThermography VT** using mono-frequency as well as wideband vibrations

These NDT techniques are applied on carbon fiber reinforced polymers which have been impacted (according to ASTM D7136) by a low-velocity drop weight at an energy of 6.3 J, resulting in BVID. A critical investigation is performed on both the opportunities and the (current) limitations of the considered NDT techniques for imaging BVID in composites. This involves an evaluation in terms of defect detectability, defect sizing and defect depth estimation.

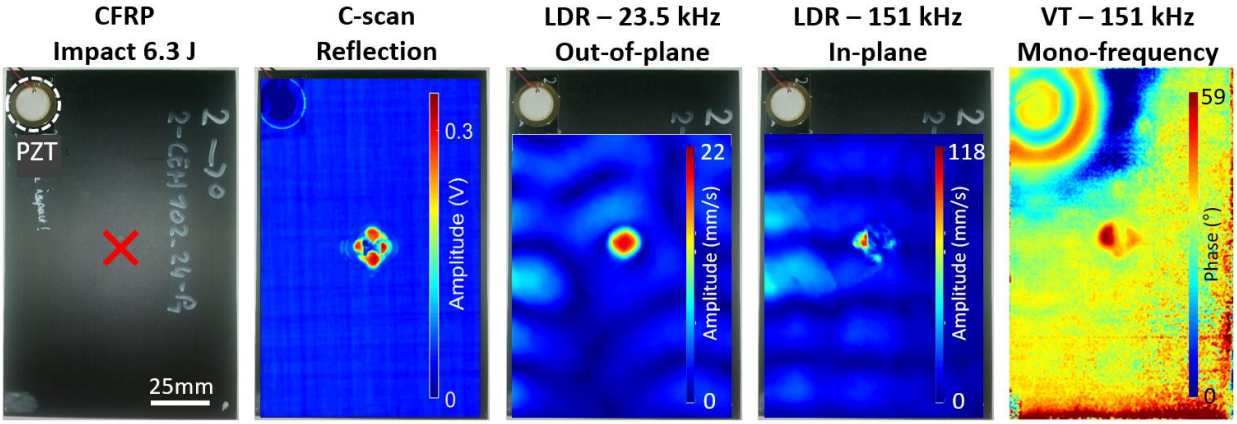

Figure 1, from left to right : Impacted CFRP, Reflection C-scan, Out-of-plane LDR at 23.5 kHz, In-plane LDR at 151 kHz and VT at 151 kHz

Keywords
Ultrasound, Local Defect Resonance LDR, Vibrothermography VT, BVID, Composites

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