VRIJE UNIVERSITEIT BRUSSEL

The faculty of Engineering of the Vrije Universiteit Brussel invites you to attend the public defence leading to the degree of

DOCTOR OF ENGINEERING SCIENCES

of **Sidney Goossens**

The public defence will take place on **Tuesday, 8th June 2021 at 4pm.**

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BARELY VISIBLE IMPACT DAMAGE DETECTION IN AEROSPACE-GRADE CARBON FIBRE REINFORCED POLYMER COMPONENTS WITH OPTICAL FIBRE SENSORS

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Abstract of the PhD research

Optical fibre-based sensors have shown great potential for damage detection in composite aircraft components, but demonstrations of this technology have been mostly limited to laboratory experiments carried out in ideal environmental conditions. In my PhD research, I take this technology to the next level and deal with different practicalities that need to be considered when working in actual aerospace-grade environments.

First, I have investigated the embedding of optical fibre sensors within the layers of a composite panel. On top of that, I have also developed a method for mounting optical fibre sensors onto the surface of aerospace-grade composite components in a robust manner. I have verified that this type of sensor and its installation method remain unaffected by harsh in-flight conditions. While considering on-ground conditions, I have derived thresholds and radii that must be respected when attempting to detect damage. In addition, I have investigated how specialty optical fibre sensors can improve the detection of complex ultrasonic waves which are often used to support the damage inspection of large composite components.

Second, I have demonstrated that the above-mentioned in-flight compatible installation method and the practical damage detection methodology are also compatible with installation in damage-prone regions of more complex components. More specifically, I have verified the previous findings on larger and realistic component geometries, including the feet of two omega-stiffeners, a 3 m long C-shaped floor beam and two window frames.

Third and finally, I have developed a figure of merit that quantifies the health of a full-scale composite component based on the signals of a network of optical fibre sensors. This so-called global damage index allows an end user to easily assess the health condition of the inspected component and to keep track of how this health status evolves throughout the lifetime of the component.

The achievements of my PhD research have demonstrated the potential and practical considerations of using the optical fibre sensing technology at increased technology readiness level for applications in the aerospace industry. By doing so, I hope to have contributed to enabling safer, more cost-efficient, sustainable and eco-friendlier aviation.