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ONLINE MONITORING OF COMPOSITE OVERWRAPPED PRESSURE VESSELS (COPV)

¹Gilmar Pereira, ²Joana Figueiredo, ²Hugo Faria, ³António T. Marques

*¹DTU, Denmark
gfpe@dtu.dk*

*²INEGI, Portugal
hfaria@inegi.up.pt ;*

*³FEUP, Portugal
marques@fe.up.pt*

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Summary: Composite overwrapped pressure vessels (COPV) have been increasingly pointed to be the most effective solution for high pressure storage of liquid and gaseous fluids. Their characteristic high stiffness-to-weight ratios make them suitable for both static and mobile applications. However, since higher operating pressures are sought continually, due to the need of getting higher energy densities in storage systems, safety aspects become critical. Thus, reliable design procedures and non-invasive monitoring techniques are required to reduce the risks of undesired and unpredicted failures. An in-service health monitoring system contributes to the product design and optimization, as well as to minimize the risks and improve the public acceptance.

Within the scope of developing different COPV models for a wide range of pressures, optical fibre Bragg grating (FBG) sensors were embedded in the liner-composite and composite-composite interfaces during their manufacture in order to allow the online strain monitoring during testing and service-life. Several limitations were found in this application, such as limited measuring range of the sensors and signal loss due to compaction of the laminate during winding and consolidation. These problems were characterized and the applicability of the technique was evaluated.

The technology developments in smart composite structures suggest that self-sensing capabilities of the CFRP laminates can be used directly into monitoring their own behaviour throughout its service life. Within this scope, a novel smart COPV concept is drawn and its implementation plan foreseen herewith.