Contribution ID: **250** Type: **Poster**

Advanced Space Systems Enabled by Fiber Optic Sensors: Rocket Propulsion Systems Application

The design of modern spacecraft systems and launch vehicles is more oriented towards reducing system-level assembly, integration, testing, and qualifications complexities while aiming at raising the systems' performance. In order to maintain high overall system performance while reducing these complexities among others, the use of smart materials and structures is of rising interest to advanced space systems' designers. This study discusses a well-known concept: smart space structures made of carbon fiber composites embedded with Fiber Optic Sensors (FOS), with a focus on their applications in modern spacecraft. The concept and applications referred to are nowadays sought-after for utilization in several modern spacecraft and launch vehicles design concepts, made feasible by several technological advancements. First, the significant progress in manufacturing techniques such as additive manufacturing and advanced composites manufacturing. Secondly, the emergence of the photonic integrated circuits technology realizing the miniaturization of the FOS data acquisition systems (i.e., interrogators). This technology and its miniaturization enable the employment of FOS systems in harsh space environments and a myriad of spacecraft designs. A case study on rocket propulsion of spacecraft is presented that considers the employment of FOS in the structure and propellant storage of propulsion systems to advance their operational and condition monitoring (OCM) as well as the structural health monitoring (SHM) and integrity, towards realizing the new generation of intelligent spacecraft propulsion. The study identified a number of possible future applications and assessed their employment feasibility in lights of the current technological advancements' challenges and foreseen opportunities. In addition, a novel mathematical strain-transfer model is presented to serve the proposed fiber optic sensors' embedding technique in carbon fiber structures of spacecraft.

Primary author: NOSSEIR, Ahmed E S (Scuola Superiore Sant'Anna / University of Trento)

Co-authors: Prof. OTON, Claudio J. (Scuola Superiore Sant'Anna); Prof. DI PASQUALE, Fabrizio (Scuola Superiore Sant'Anna); Prof. CERVONE, Angelo (Technical University of Delft (TU Delft)); Prof. MANFLETTI, Chiara (Technical University of Munich (TUM))