DIMOSS, A NOVEL STRUCTURAL SHAPE AND STRESS MONITORING SOFTWARE: THEORETICAL BACKGROUND AND APPLICATIONS REVIEW

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ABSTRACT

Structural components of aircraft, civil and marine structures are prone to deterioration and require complex and costly maintenance activities. In recent years, much effort has been put into shifting from a preventive maintenance model, based on statistically scheduled interventions, to a predictive one, based on monitoring the actual health of the structure. With this new paradigm, it is possible to improve the efficiency of interventions, reduce their costs and increase safety. The development of DIMOSS (DIsplacement MOnitoring using Strain Sensors) [1] software fits this context. DIMOSS is a structural monitoring software for reconstructing fundamental quantities to assess the health of a structure, displacements and stresses. In contrast to other technologies, which require complex sensors to install, DIMOSS reconstructs the quantities of interest using sensors already widely used in industry, such as strain sensors. The software is based on the inverse Finite Element Method [2]. This method uses an FEM discretisation of the displacement field of a structure and, consequently, an FEM discretisation of the strain field. The discretised strain field, expressed in terms of the nodal degrees of freedom (DOFs), is compared to the one discretely measured using strain sensors so that the nodal DOFs are fitted to the measured strain in a least-square sense. To summarise, the method integrates and extrapolates sparse discrete strains to obtain the strain and displacement field on the entire monitored structure. These quantities allow the computation of the stress field as well, using the constitutive equations. Since the iFEM is sensitive to the sensors' configuration, in addition to enabling monitoring, DIMOSS integrates several modules that will allow the design of the optimal sensor system to achieve the most efficient monitoring system possible. DIMOSS has been successfully tested on the whole process of sensors' configuration design and monitoring on several experimental structures, including airfoil beams [3] and stiffened aluminium [4] and composite panels [5]. Moreover, the live monitoring of an aluminium beam, instrumented with fibre optic strain sensors, has been recently performed, thus allowing the realisation of a real-time *Digital Twin* for the structure. This work represents a review of the DIMOSS software and its successful applications, with a focus on the iFEM and its development history within the software.

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