POLITECNICO DI TORINO

Laboratorio di Alta Qualità
SISTEMI STRUTTURALI AEROMECCANICI
Sezione DIASP

Dipartimento di Ingegneria Aeronautica e Spaziale

AVVISO DI SEMINARIO

Nell'ambito delle attività finanziate dalla Regione Piemonte per il progetto "**GREAT2020**" e condotte presso il LAQ-AERMEC – Sezione DIASP

ALEXANDER TESSLER, PH. D.
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terrà un seminario su

From Shape-Sensing to Full-Field Reconstruction of Structural Response of Aerospace Vehicles: A Critical Assessment of NASA Dryden and LaRC Approaches

In recent years, substantial advances have been made in the development of robust sensing technologies and signal analysis. Much of this research has been in the area of fiber Bragg grating (FBG) optical sensors where NASA Langley has made major contributions. When bonded to or imbedded in load-carrying structures, FBG sensors may provide high-quality multi-point strain measurements in a variety of applications including civil, marine, and aerospace. The multi-point strain measurements lend themselves to the solution of an inverse problem where an accurate representation of the deformed structural shape can be calculated. Mathematically, this type of analysis represents an ill-posed inverse problem and is often referred to as *shape sensing*. Several shape-sensing algorithms have been explored and thus far applied to relatively simple structures. FBG optical sensors provide lightweight distributed capabilities for performing shape sensing computations which are essential in facilitating digital control of aerodynamic surfaces during flight. This is particularly relevant to flexible-wing vehicles, such as the Helios class of aircraft, requiring automated procedures to control wing dihedral in flight.

The shape-sensing research at NASA Dryden in California, aimed at monitoring wing deformations on an Unmanned Aerial Vehicle (UAV), employs a one-dimensional model, developed by Dr. William Ko, which is based on the classical bending theory of non-uniform beams. The general aim of Dryden's research is to derive substantial performance benefits using real-time wing surface control systems. Other aerospace applications of shape-sensing include large space structures, e.g., solar sails and membrane antennas, where the knowledge of the current three-dimensional shape of a structure is required in order to maximize the spacecraft performance.

NASA Langley Research Center has focused on developing affordable technologies for real-time monitoring of structural, propulsion, thermal protection, and other critical systems, for the purpose of mitigating aerospace vehicle accidents due to structural failures, with the program know as the Integrated Vehicle Health Management (IVHM). The aerospace vehicle and habitation structures will be designed with diverse arrays of distributed in-situ sensors. The sensing technologies will be part of advanced data systems architectures that will process, communicate, and store massive amounts of Structural Health Monitoring (SHM) data. Special-purpose structural analysis and design algorithms will be necessary to incorporate SHM sensing data for the diagnosis and prognosis of structural integrity. Structural integrity information will be utilized within an IVHM system, resulting in the safe and effective operational vehicle management and mission control.

To enable the full use of FBG strain-sensor information within the IVHM system, a powerful full-field reconstruction algorithm has been developed at NASA Langley, known as the inverse Finite Element Methods (iFEM). The iFEM is a high-fidelity, finite element based methodology, that is robust, versatile, and computationally efficient – necessary attributes for large-scale, real-time applications. The full-field capability enables the reconstruction of all response quantities such as displacements (shape-sensing), strains, stresses, external loading, and failure criteria to be calculated everywhere in the domain of the structural model which may be defined by beam, frame, or plate and shell inverse finite elements. Recent work in collaboration with Politecnico di Torino has demonstrated iFEM applications on the three-dimensional frame structures as well as the multilayered composite structures.

The presentation will provide an overview of the above mentioned shape-sensing and full-field computational methods, and will discuss various new applications and computational capabilities jointly developed by NASA Langley and Politecnico di Torino.

Il Seminario si terrà nella Sala Riunioni Carlo Ferrari del Dipartimento di Ingegneria Aeronautica e Spaziale (2° piano) - ingresso da C.so Einaudi 40 - secondo il seguente calendario:

Lunedì 21 Giugno
Ore 15.00

Tutti gli interessati sono cordialmente invitati a intervenire.

Per informazioni, contattare

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