POLITECNICO DI TORINO

Laboratorio di Alta Qualità
SISTEMI STRUTTURALI AEROMECCANICI
Sezione DIASP

LAQ AERMEC

Dipartimento di Ingegneria Aeronautica e Spaziale

AVVISO DI SEMINARIO

Nell'ambito delle attività finanziate dalla Regione Piemonte per il progetto "**Multidisciplinary Optimisation of Aerospace Structural Systems**" e condotte presso il LAQ-AERMEC – Sezione DIASP

ALEXANDER TESSLER, PH. D.
NASA Langley Research Center
Hampton, Virginia, U.S.A.

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terrà un seminario su

INVERSE FINITE ELEMENT METHOD FOR INTEGRATED VEHICLE HEALTH MANAGEMENT

The Integrated Vehicle Health Management (IVHM) research at NASA Langley Research Center explores safe, reliable, and affordable technologies for NASA's future long duration space missions requiring real-time monitoring of structural, propulsion, thermal protection, and other critical systems. To achieve such capabilities, space vehicles and habitation structures will be designed with diverse arrays of optimally distributed in-situ sensors. The sensing technologies will be part of advanced data systems architectures that will process, communicate, and store massive amounts of 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, and for the purpose of optimal design and construction of such structures.

In recent years, ample focus has been on advancing the state-of-the-art in sensing technologies and signal analysis. Much of this research has been in the area of fiber Bragg grating (FBG) optical sensors providing high-quality multi-point strain measurement. A key step in analyzing strain data is to infer or reconstruct an accurate representation of the deformed structural shape. Mathematically, this type of analysis represents an ill-posed inverse problem and has been referred to as *shape sensing*. 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 a Helios class of aircraft, requiring automated procedures to control wing dihedral in flight. In general, the class of Unmanned Aerial Vehicles (UAV) may derive substantial performance benefits using real-time wing surface control systems. For large space structures, including solar sails and membrane antennas, knowing the current three-dimensional shape of the structure may maximize spacecraft performance.

The presentation will review two notable full-field computational algorithms, known as Smoothing Element Analysis (SEA) and inverse Finite Element Methods (iFEM). The methods combine the attributes of computational efficiency, versatility, and robustness that are necessary for real-time, large-scale SHM applications. The algorithms may serve as both design tools for the development of optimal sensing systems and enabling tools for the processing of sensing information in real time. Following the mathematical description of SEA and iFEM and discussions of their salient features, several SHM applications of the two methods are highlighted. These include (1) shape sensing and structural anomaly detection in beam structures instrumented with FBG sensors, (2) identification of delamination damage in composite laminates, and (3) design of optimal strain sensor locations.

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:

Giovedì 5 Novembre
Ore 9.30

Tutti gli interessati sono cordialmente invitati a intervenire.

Per informazioni, contattare

Marco Di Sciuva	0115646826	marco.disciuva@polito.it
Marco Gherlone	0115646817	marco.gherlone@polito.it