Flight structures fundamental research in the United States of America

Foreword

I have the great pleasure to introduce to you the second of the Special Issues of the *Aeronautical Journal* dedicated to Flight structures fundamental research in the United States of America. I was fortunate to serve a three-year assignment as Program Manager for Structural Mechanics at the US Air Force Office of Scientific Research. During this assignment, I had the opportunity to meet and interact with outstanding US researchers; this interaction has germinated the idea of dedicating a special issue of the *Aeronautical Journal* to the fundamental research results in the field of Flight Structures. The Editorial Board received my proposal with great interest and gave me the go ahead. Three large applications areas are considered:

1. Future flight structures
2. Structural performance sustainment
3. Structural dynamics and vibration control

These three broad areas are covered at various levels of complexity and detail. Modeling and understanding is needed from material-level nano-scale properties through grain level analysis and coupon-level understanding of material behaviour up to structural level analysis and operational life prognosis. New design paradigms are needed, such as novel bio-inspired structural design, new optimization methods, design for reducing life-cycle costs, etc. Control of dynamic response of extremely flexible nonlinear flight structures in interaction with air flow, unsteady heating, directed energy, and servo-controls at various Mach and Reynolds numbers is continually improved, though a host of problems are still unresolved. Probabilistic risk-based structural analysis that accounts for variability due to materials, processing, fabrication, maintenance actions, changing usage profiles is required. Novel structural sensing concepts and technology, that could be permanently installed on flight structures (i.e., embedded NDI/NDE) to monitor its behaviour throughout the operational life are need to work together with probabilistic structural analysis to generate a risk-based prognosis of remaining useful life. The emergence of affordable active materials that could change their properties on demand under activation through electric, magnetic, thermal field open new opportunities for novel solutions to shape-changing morphing aircraft that would optimally cover the complete flight envelope from low-speed loitering through high-speed dash.

The response from the US research community has been enthusiastic and has generated 15 articles; part of them were included in the June 2009 special issue; the other half is being included in this December 2009 issue and in the coming January 2010 issue. Thanks are due and should be addressed to the journal's editorial board under the wise leadership of Professor Peter Bearman, and to the very qualified administrative team of Wayne J. Davis and Annabel Hallam. Enjoy!

Professor Victor Giurgiutiu
University of South Carolina, USA

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