MULTIFUNCTIONAL DESIGN OF AEROSPACE STRUCTURES: AIR FORCE PERSPECTIVE

by

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Two major criteria governing the development of new aerospace structures have been: (a) the achievement of maximum load-carrying capability per unit weight/volume and (b) the incorporation of a variety of functional properties dictated by the system requirements (e.g. crack mitigation, lightening protection, thermal management, threat sensing, communication channel, power harvesting and storage, etc.) with minimum weight penalty. Traditionally, these two issues are addressed separately, resulting in incremental improvements in mono-functional materials that only carry mechanical load or only provide specific functional property. However, dramatic improvements in system-level efficiency can be achieved by: (1) developing "multifunctional" materials that inherently possess the capacity to simultaneously meet the requirements for specific functionality as well as mechanical load carrying capability and (2) designing "multifunctional" load-bearing structures with integrated functional properties.

The following key issues need to be examined for this endeavor:

- Structural integration of electronic devices
- Combination of load-carrying capabilities with functional requirements (e.g. thermal, power)
- Development of new adaptive, sensory and active materials
- Revolutionary concept of "autonomic" structures which sense, diagnose and respond for adjustment
- Hybridization of materials and lay-up for complex requirements
- Physics-based multi-scale modeling
- Neural network and information science aspects for the control of multifunctional structures
- Design for manufacture