Editorials

Journal of Adaptive Structures: A Premier Interdisciplinary Research Platform

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The Journal of Adaptive Structures (JAS) is a new peer-reviewed, open access journal, which aims to serve as an authoritative research platform for a wide range of professions, including researchers, academicians and people from industry. The aim is to bring together the latest advances in design, modelling, manufacturing and testing of adaptive structures and the major achievements in related investigations, by pursuing the progressive adoption of these revolutionary architectures on-board of next generation aircraft, space, terrestrial and marine vehicles, while extending those same concepts to other mechanical fields (engines, heavy and light machines, and so on). The journal covers a wide range of applications, spanning from innovative morphing wing devices, including flexible skins and topology optimized components, electromechanical actuation, sensing, and control, to deployable architectures, smart materials and engineered noise and vibration control platforms. Focus is also given to reliability and safety-related issues, and associated design aspects, by addressing integration of adaptive structures and embedded devices into operative mechanical systems.

Adaptive structures are defined in this journal as structural systems that are able to sense external stimuli and change their inherent characteristics to meet specific requirements by given commands or inner intelligence. Due to the increasing number of research organizations and industries involved in the development of adaptive structures, and the strong multidisciplinary nature of the related researches, the editors believe that this sector may attract a large number of scientists on a variegated set of interrelated topics, such as materials, structures, actuators, sensors, and controls, just to mention a few. Additionally, with the increasing capability of improving the overall behaviour of composite structures by embedded sensor and actuator networks, certain highly conservative design choices related to safety-related issues could be directly overcome. In this sense, further efforts are however necessary to comply with certification processes, and rationally update current regulations. That issue, critical for air and space platforms, is more and more relevant even for terrestrial and marine transportation systems.

In the last years, morphing wings have been becoming a topic of interest within aviation due to their remarkable ability to enhance aircraft aerodynamic performance and reduce critical structural loads during flight. Geometry and reconfiguration change in multiple shapes in order to match specific flight conditions needs may dramatically contribute to tackle some of the biggest environmental challenges including fuel efficiency increase, and noise and pollutant emissions abatement. Classical control surfaces such as ailerons or flaps, located on the edge of the wings, already provide aircraft with some basic adaptation capabilities for manoeuvring or lift increase during take-offs and landings. Morphing devices try to expand such capabilities in a more efficient perspective by providing aircraft with continuous wing geometry variations to improve efficiency and maximize aircraft performance.

Variable load control and alleviation tasks are suitable features even for marine and automotive applications. The rationale is based on the same foundations: fuel savings and enhanced performance. Adaptive surfaces installed on vehicles may increase or decrease down/ side forces as and when it is needed to reduce fuel usage, enact yaw control and boost stability of high-speed manoeuvres. The overall efficiency may be thus improved, with a lower-drag body design, possible if stability could be actioned by control surfaces rather than natural aerodynamics. This same technology can be applied to underwater keels or wing sails, enabling them with some intrinsic or driven adjustment capability. For instance, active aerofoils may be used to enhance stability and counteract overturning forces. This means a far smaller keel may attain the same performance, relying on adaptivity to generate hydro forces, instead of depending on mass and weight. Shape-variable wing

DOI: 10.3844/jas.2021.1.2

sails can be retrofitted to internal-combustion-powered vessels for reducing consumption and increasing range.

Any adaptive structure interfacing with an external fluid, either gaseous or liquid, needs a skin to maximize penetration. This journal pursues therefore the aim to foster international exchange of knowledge and broad discussion on technology development, and theoretical, experimental and numerical models of adaptive skins, capable of providing large in-plane deformations, low resistance to fluid-dynamic loads and low weight, at the same time. To meet usual shape-changing needs, highly anisotropic and variable stiffness structures shall be tailored to guarantee low normal stiffness to minimize actuation energy demand, and high transversal rigidity to resist external forces, contemporarily. This is one of the major obstacles that prevents this technology from being integrated in the current industrial processes. The journal intends to cover novel skin designs that morph into efficient shapes for fitting different conditions. In this regard, cellular structures, segmented structures, elastomer composites, and corrugated structures, are just few examples of possible engineered answers to the rising demand of structural and flexible skins.

Design of state-of-the-art mechanical devices starts from the kinematic synthesis of the target systems and the preliminary design of the actuation architecture, typically in a multidisciplinary and multi-objective environment involving at least aerodynamic, electronics, and structural activity. The mechanisms and actuating drive train are structurally sized to suitably address specific certification requirements, which in turn have an impact on target weight, power consumption, and operating costs. Complexity, topology, part count and connectivity are crucial parameters that affect both manufacturing and maintenance costs, as well as reliability. All these features make this task particularly difficult and often cause the design process to be iterative, thus resulting into suboptimal scenarios. Intrinsically prone to design issues involving size, weight and accuracy of motion, they naturally lead to many compromises in performance and consistency.

In this overall context, the journal is open to novel and high-quality research contributions both in the field of compliant mechanisms, requiring fewer components to achieve the desired mobility (possibly leading to one-piece solutions), and rigid-body architectures, where the absence of contacts reduces wear, need of lubrication and possible backlash, thus increasing precision. Structural concepts can be implemented with a variety of materials including metals and composites and have the potential to be combined with decentralized actuation and sensor networks to realize engineered “intelligent” systems. In this framework, the actuator system evolution includes smart material-based devices, full electrical drivers, and many other challenges for ultimately improving actuation performance in mechanical industry for safety-critical applications such as those related to commercial and military aircraft, helicopters and space vehicles, but also terrestrial, marine, and amphibious means of transport.

Given these considerations, usually implemented in well-established design processes which are characterized by a clear sequence of design activities, significant improvements can be made either by refining traditional design strategies or implementing new design paradigms. This poses short- and long-term challenges in the adaptive structures community usually broken down into two main categories: cost reduction and increased performance.

In this perspective, the Journal of Adaptive Structures (JAS) publishes original research papers, including full-length original papers, as well as review papers, case studies, technical notes, short research letters and patent alerts on the latest innovations in methodologies, technologies and products within the fields of adaptive structures. To this aim, all papers are subjected to blind review process by distinguished teams of international experts. On behalf of the Editorial Office and Editorial Board, we feel much honoured to invite all interested authors to submit their valuable contributions and to join our team as editorial board members or reviewers.

The Editor-In-Chief and the Associate Editors.