EVOLUTIONARY COMPUTATION IN AEROSPACE SCIENCE AND ENGINEERING

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In an expanding world with limited resources and increasing complexity, optimisation and computational intelligence become a necessity. Optimisation can turn a problem into a solution and computational intelligence can offer new solutions to effectively make complexity manageable.

All this is particularly true in space and aerospace where complex systems need to operate optimally often in harsh and inhospitable environment with high level of reliability. In Space and Aerospace Sciences, many applications require the solution of global single and/or multi-objective optimisation problems, including mixed variables, multi-modal and non-differentiable quantities, and involving highly expensive objectivefunction evaluations. From global trajectory optimisation to multidisciplinary aircraft and spacecraft design, from planning and scheduling for autonomous vehicles to the synthesis of robust controllers for airplanes or satellites, computational intelligence techniques have become an important – and in many cases inevitable – tool for tackling these kinds of problems, providing useful and non-intuitive solutions. Not only have Aerospace Sciences paved the way for the ubiquitous application of computational intelligence, but moreover, they have also led to the development of new approaches and methods.

In the last two decades, evolutionary computing, fuzzy logic, bio-inspired computing, artificial neural networks, swarm intelligence and other computational intelligence techniques have been used to find optimal trajectories, design optimal constellations or formations, evolve hardware, design robust and optimal aerospace systems (e.g. reusable launch vehicles, re-entry vehicles, time-efficient fuel burn, etc.), evolve scheduled plans for unmanned aerial vehicles, optimise the aerodynamic design (e.g. airfoil and vehicle shape), engine turbomachinery (e.g. tip clearance) and whole engine design, optimise structures, and the control of aerospace vehicles, regulate air traffic, do the prognostics and diagnostics of aircraft and vehicles, etc.

This special session intends to collect many, diverse efforts made in the application of computational intelligence techniques, or related methods, to aerospace problems. The session seeks to bring together researchers from around the globe for a stimulating discussion on recent advances in evolutionary methods for the solution of space and aerospace problems.

In particular evolutionary methods specifically devised, adapted or tailored to address problems in space and aerospace applications or evolutionary methods that were demonstrated to be particularly effective at solving aerospace related problems are welcome. Besides standalone evolutionary approaches, contributions that use machine learning paradigms to address new aerospace optimisation problems, or to enhance the evolutionary methods for existing ones, are encouraged.

Topics

- Multi-objective optimisation for space and aerospace applications
- Surrogate based approaches for design optimisation and analysis
- Design optimisation under uncertainties of aerospace systems and missions
- Bayesian optimisation and uncertainty handling in aircraft design
- Distributed global optimisation
- Advances in machine learning paradigms for aerospace optimisation problems
- Intelligent decision aid systems for aerospace design optimisation and analysis
- Intelligent algorithms for prognostics, fault identification, diagnosis and repair
- Evolutionary computation for concurrent engineering
- Multidisciplinary design for aerospace missions and system design
- Global trajectory optimisation
- Formation and constellation design and control
- Optimal control of spacecraft and rovers
- Planning and scheduling for autonomous systems in space, aircraft routing, and airline network design
- Optimal planning of aerial manned and unmanned military missions
- Optimisation of engine emissions, fuel consumption, and noise
- Full engine optimal design
- Multipoint aircraft optimisation
- Resource allocation and programmatics
- Mission planning and control

- Intelligent search and optimisation frameworks in aerospace applications
- Performance evaluation and comparison methods for particular aerospace problems
- Image analysis for guidance, navigation and control
- Autonomous exploration of interplanetary and planetary environments
- Implications of emerging AI fields such as artificial life or swarm intelligence on future space research
- Multi-agent systems approach and bio-inspired solutions for system design and control
- Intelligent interfaces for human-machine interaction
- Knowledge discovery, data mining and presentation of large data sets