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Editorial

Unmanned Aerial System (UAS) Modeling, Simulation and Control

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Interest in UAS technology research is continuously increasing worldwide because of these technologies' high potential, in terms of saving time, money and lives, for industrial and governmental users. UAS design, modeling, simulation and control technologies are being developed worldwide for military and civil purposes with the aim of increasing the benefits for a high number of applications and users.

This Special Issue on the "Unmanned Aerial System (UAS) Modeling, Simulation and Control—Part I" focuses on publishing original manuscripts and literature review papers in the areas of UAS modeling, simulation, robust control, artificial intelligent control, design, aerodynamics, aeroelasticity, morphing systems, trajectory optimization, flight tests, wind tunnel tests and other areas closely related to UAS technology improvement. This Special Issue presents research on various UASs and other systems, including the UAS-S45 from the Mexican company Hydra Technologies [1], quadrotors [2,3], drone collision avoidance systems [4], Remotely Piloted Aircraft Systems (RPASs) in [5] and satellite trajectories tracking by radar [6].

In ''Optimization and Design of a Flexible Droop-Nose Leading-Edge Morphing Wing Based on a Novel Black Widow Optimization Algorithm—Part I" [1], an aerodynamic optimization for a Droop-Nose Leading-Edge (DNLE) morphing of the UAS-S45 was proposed by using a novel Black Widow Optimization (BWO) algorithm. This approach integrated the optimization algorithm with a modified Class-Shape Transformation (CST) parameterization method to minimize drag and maximize aerodynamic endurance, thus enhancing the UAS-S45 aerodynamic performance at the cruise flight condition. The CST technique was used to parameterize the reference airfoil by changing the airfoil's local shapes and by providing skin flexibility to obtain various optimized morphing airfoil configurations. The optimization framework used an in-house MATLAB algorithm, while the aerodynamic calculations used the XFoil solver with flow-transition estimation criteria. The results were validated with a CFD solver by utilizing the Transition ($\gamma-\mathrm{Re}\theta$) Shear Stress Transport (SST) turbulence model. The optimized airfoils have shown a significant improvement in the overall aerodynamic performance by up to 12.18% drag reduction and an increase in aerodynamic endurance by up to 10% for the UAS-S45 optimized airfoil configurations over its reference airfoil. These results have shown the importance of leading-edge morphing in enhancing the UAS-S45 airfoil's aerodynamic efficiency.

In ''On the Effect of Flexibility on the Dynamics of a Suspended Payload Carried by a Quadrotor" [2], while suspended payloads were usually carried out by a quadrotor with a rigid attachment, an elastic attachment was designed to assess the vibrations' impact on the quadrotor and on its payload. Since the payload dynamics can impact the flight performance, sensor measurement accuracy and payload integrity, an Adaptive Sliding Mode Control (ASMC) was used to guide the quadrotor in its desired trajectory and to compensate for payload dynamics. To reduce the need for position sensors, a Reduced-Dimension Observer (RDO) was designed to estimate the quadrotor payload trajectory, as well as its motion under external disturbances. Numerical simulation results have shown that the flexibility influenced the quadrotor's dynamics and that it created residual oscillation in its payload.

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It is known that among the structural parts of a quadcopter rotary wing configuration, its central body frame is the component with the highest part of its total weight. In ''Design and Development of Unibody Quadcopter Structure Using Optimization and Additive Manufacturing Techniques'' [3], the frame's high weight was reduced, while the structural integrity was ensured through an approach integrating Topology Optimization and Design for Additive Manufacturing (DFAM). Then, the frame was re-engineered as a monocoque structure with benefits such as reduced weight and assembly time. The re-engineered quadcopter structure was manufactured through Fused Filament Fabrication (FFF) while taking into account structural, vibrational and fatigue characteristics. Modal Analysis, Computational Fluid Dynamics and Wind Tunnel Testing revealed close numerical versus experimental results within 3%.

In ''Product Tests in Virtual Reality: Lessons Learned during Collision Avoidance Development for Drones'' [4], the Virtual Reality (VR) testing of a collision avoidance system for drones was investigated and further analyzed in terms of economic benefits. The obtained results have shown that VR tests had benefits expressed in terms of the reduction in the development time, risks and, therefore, costs of the drone collision-avoidance system.

In ''Secured Multi-Dimensional Robust Optimization Model for Remotely Piloted Aircraft System (RPAS) Delivery Network Based on the SORA Standard'' [5], a multi-objective location-routing optimization model was proposed for Remotely Piloted Aircraft Systems (RPASs) by specifying time window constraints, simultaneous pick-up and delivery demands, and the possibility of recharging used batteries for reducing the transport costs, delivery times and estimated risks. The model's delivery time has been reduced and thus optimized to increase its accuracy based on the uncertain conditions of possible traffic scenarios. The assessment of risk indicators was conducted based on the Specific Operations Risk Assessment (SORA) standard to define three objective functions. The NSGA-II meta-heuristic algorithm was developed in this paper successfully and optimized the objective functions by an average of 31%.

In ''An Improved Extended Kalman Filter for Radar Tracking of Satellite Trajectories'' [6], an improved Extended Kalman Filter (iEKF) method was successfully validated in a realistic simulation of satellite orbit estimation and its transfer. The iEKF method is an improved version of the classical Extended Kalman Filter (EKF), which has many limitations, including poor convergence, erratic behaviors, or inadequate linearization when applied to highly nonlinear systems. It was concluded that the iEKF was an excellent method for non-linear state estimation, such as satellite trajectory tracking by radar, for both case studies analyzed in this paper.

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