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Spacecraft Informatics

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EDITORIAL

Spacecraft Informatics

Spacecraft informatics is one of the most exciting and contemporary research topics in recent years. Many countries are deploying related technologies such as AI, robotics, machine learning, etc., in the deep-space explorations. Moreover, considering the high-complexity, high cost and high risk involved in spacecraft, advanced technologies in information modelling, simulation, optimisation and decision support methods are required to improve the effectiveness, efficiencies, reliabilities and safety of the space operations (Du et al. 2017; Rui et al. 2014). The emerging informatics approach offers the benefit to the area of spacecraft regarding in-orbit spacecraft, satellites, space-stations of any types in deep-space exploration missions from ground control, user payload, space weather and conditions, remote sensing and telemetry, and many more spaceflight missions and activities of designing, forecasting, planning and control. To contribute the present and future space exploration and spacecraft development, in this special issue, we have collected excellent papers of research in spacecraft informatics. Each paper underwent a double-blind peer review by independent, anonymous expert referees. After the reviewing processes, eight high-quality papers were accepted and are published in this issue.

The first paper is 'Optimisation problems and resolution methods in satellite scheduling and spacecraft operation: a survey' by Xhafa and Ip (2019). This paper aims to study the state of the art in the satellite scheduling regarding the spacecraft design, operation and satellite deployment system. With heuristics methods, the constraint features in satellite mission planning, including window accessibility and visibility requirements can be addressed for producing small- and low-cost satellites. The second paper, entitled 'Moon image segmentation with a new mixture histogram model' by Hsu et al. (2019) is related to an application of image processing technology in the spacecraft. This paper aims to develop a histogram mixture model with genetic algorithm for improving the effectiveness in segmenting the moon surface image. Instead of the manual parameters measurement, the parameters can be obtained by a genetic algorithm. The results show that the proposed algorithm improved the drawbacks of previous non-parametric methods for moon image segmentation.

In the papers, entitled 'Blockchain adoption for information sharing: risk decision-making in spacecraft supply chain' by Zheng et al. (2019) and 'A framework for rocket and satellite launch information management systems based on blockchain technology' by Li, Wang, and Zhang (2019), they employed blockchain technology for information management and sharing in the spacecraft supply chain. The use of blockchain technology allows the stakeholders in the spacecraft to (i) reduce transaction cost and risks, and (ii) improve the reliability and traceability of the spacecraft information to enhance the overall effectiveness and efficiency of the supply chain.

The paper 'Health condition estimation of spacecraft key components using belief rule base' by Tang et al. (2019) developed a semi-quantitative method to examine the

health status of spacecraft key components using belief rule base. Comparing with traditional optimisation method in training the expert's knowledge, the Markov Chain Monto Carlo technique is embedded in the proposed method to overcome the problem of overfitting in a backpropagation network. The linguistic outputs of belief degree are more natural and acceptable to human users to deal with the uncertainties in the spacecraft during deep-space explorations. Another paper entitled 'An information integration approach to spacecraft fault diagnosis' by Shi et al. (2020) also concerned about the faults of spacecraft; it describes an information integration approach to acquire, collect and analyse the information about the whole life cycle of a spacecraft. The function–behaviour structure theory is then applied to develop the human–machine interface for diagnosing the spacecraft faults. With the information integration of spacecraft system, a proactive and rapid response illustrates the application in the spacecraft rolling bearing faults.

In the paper 'A new architecture for simultaneous localisation and mapping: an application of a planetary rover' by Tseng et al. (2019), it presented a novel simultaneous localisation and mapping system to track the unconstraint motion of the mobile robot in the moon or Mars. Through the integration with ellipse search algorithm and Modified coVariance Extended Kalman Filter (MVEKF) filter, the proposed system enhances the grid-based feature point extraction with satisfying performance and low error rate for Lunar rover's locating tasks. The last paper entitled 'A decision approach for multi-stage combined design of solid rocket' by Meng, Wang, and Wang (2020) developed a decision support system to facilitate the selection of optimal compositional scheme under a multi-attributes environment with a generalised compensative weighted averaging aggregation operator. By aggregating the defined attributes in each scheme of a solid rocket, the optimal compositional scheme can be determined, which improves the effectiveness and feasibility in decision support of the spacecraft. It is a novel approach in solving a complex multi-level problem, ordering and decision-making of multi-scheme, multi-index and rapid optimisation.

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