**EPSRC DLA PhD Studentships**

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| **Additional Supervisor** |  |

**Section 2 – *Project Information***

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| **Project Title** | Digital Propulsion: physics-informed machine learning based digital twins for aircraft propulsion system prognostics and health management |
| **Project Summary** | |
| UK government and aviation industry are committed to achieving net zero emissions by 2050 whilst enhancing UK’s aviation competitiveness in global market. Significant advancements have been made in zero carbon emission aircraft propulsion components and system architecture. However, these novel zero carbon emission aircraft propulsion architectures with inherent system complexity introduces substantial operational challenges, e.g., new health indicators & failure modes, cascading failure prorogation caused by tightly coupled subsystem interactions, which are not encountered in traditional propulsion systems.  To address these challenges, this project will develop a novel digital twin framework for zero carbon emission aircraft propulsion systems with prognostics and health management capabilities. It will fuse physics-based and deep learning approaches to model component-level digital twins and facilitate their integration with computational feasibility. By leveraging physics-informed machine learning, it will function as virtual replicas of zero carbon emission aircraft propulsion through real-time data streaming and modelling, facilitating real-time health monitoring & prediction, further health-informed decision making to enhance operational efficiency and reliability. The objectives include:  1. Develop a digital twin framework for zero carbon emission aircraft propulsion systems leveraging physics-based and data fusion approach for real-time health state estimation.  2. Investigate subsystem interactions and failures modes based on digital twin framework to identify critical components and mitigate potential failures.  3. Develop operational strategies for energy management and maintenance scheduling to enhance operational efficiency and reliability.  The student will benefit from interdisciplinary research collaborations within the School of Engineering and School of Computing and Mathematical Sciences at the University of Leicester. The successful candidate will also work with industry supervisors for industrial validation. And there will be plenty of opportunities to participate in national workshops and international conferences to showcase your research, engage with research community and establish connections with leading academics and industry professionals. Interested candidates are encouraged to contact the project supervisor to discuss their interests and suitability for the project. | |
| **References** | |
| [1] Zhang, J., Roumeliotis, I., & Zolotas, A. (2022). Model-based fully coupled propulsion-aerodynamics optimization for hybrid electric aircraft energy management strategy. *Energy*, *245*, 123239.  [2] Zhang, J., Roumeliotis, I., & Zolotas, A. (2021). Nonlinear model predictive control-based optimal energy management for hybrid electric aircraft considering aerodynamics-propulsion coupling effects. *IEEE Transactions on Transportation Electrification*, *8*(2), 2640-2653. | |