

ISSN 0001-9240



ROYAL  
AERONAUTICAL  
SOCIETY

# THE AERONAUTICAL JOURNAL

Covering all aspects of aerospace

Volume 123

Number 1267

September 2019



CAMBRIDGE  
UNIVERSITY PRESS

# THE AERONAUTICAL JOURNAL

**Editor-in-Chief: Professor Holger Babinsky**

## **Editorial Board**

**Chairman: Professor Mike Graham Deputy Chairman: Professor Chris Atkin**

## **Associate Editors**

<b>Professor Christian Allen</b> University of Bristol	<b>Dr Guy Gratton</b> Cranfield University	<b>Dr G Satheesh Reddy</b> MoD, India
<b>Professor George Barakos</b> University of Glasgow	<b>Professor Ismet Gursul</b> University of Bath	<b>Professor Kenichi Rinoie</b> University of Tokyo
<b>Professor Cees Bil</b> RMIT University, Australia	<b>Professor Li He</b> University of Oxford	<b>Professor Ulrich Rist</b> University of Stuttgart, Germany
<b>Professor Rene de Borst</b> University of Sheffield	<b>Professor Michael Henshaw</b> Loughborough University	<b>Carl Russell</b> NASA Ames, USA
<b>Professor Jonathan Cooper</b> University of Bristol	<b>Professor Konstantinos Kontis</b> University of Glasgow	<b>Dr Matthew Santer</b> Imperial College, London
<b>Peter Curtis</b> Aircraft Research Association	<b>Dr Arnab Majumdar</b> Imperial College, London	<b>Professor Ömer Savas,</b> University of California, Berkeley
<b>Professor Laurent Dala</b> University of Northumbria	<b>Professor Jim McGuirk</b> Loughborough University	<b>Professor Shahrokh Shahpar</b> Rolls-Royce, Derby
<b>Professor Dimitris Drikakis</b> University of Nicosia, Cyprus	<b>Professor Jack McNamara</b> Ohio State University	<b>Professor Howard Smith</b> Cranfield University
<b>Professor Brian Falzon</b> Queen's University, Belfast	<b>Dr Richard Markiewicz</b> DSTL	<b>Professor Marilyn Smith</b> Georgia Institute of Technology, USA
<b>Professor Antonio Filippone</b> University of Manchester	<b>Professor Pierangelo Masarati</b> University of Milan	<b>Professor Constantinos Soutis</b> University of Manchester
<b>Professor Song Fu</b> Tsinghua University, China	<b>Professor Ning Qin</b> University of Sheffield	<b>Professor Anthony Waas</b> University of Washington, USA
<b>Professor Ed Galea</b> Greenwich University	<b>Professor Jason Ralph</b> University of Liverpool	
<b>Professor Victor Giurgiutiu</b> University of South Carolina		

## **Aims and Scope**

The aims and scope of *The Aeronautical Journal* are intended to reflect the objectives of the Royal Aeronautical Society as expressed in its Charter of Incorporation. Briefly, these are to encourage and foster the advancement of all aspects of aeronautical and space science. Thus the topics of *The Aeronautical Journal* include most of those covered by the various Specialist Groups of the Society. Topics covered in *The Aeronautical Journal* include:

Aircraft design, aerodynamics, airworthiness and maintenance, air traffic Management, avionics and systems, composites, environmental issues, flight operations, flight simulation, fluid dynamics, fluid mechanics, guided flight, human factors, human powered flight, light aviation, propulsion, rotorcraft, safety, space, structures and materials, structural mechanics and UAVs.

Papers are solicited on all aspects of research, design and development, construction and operation of aircraft and space vehicles. Papers are also welcomed which review, comprehensively, the results of recent research developments in any of the above topics.

We recognise the inhibiting pressures of time and confidentiality, and acknowledge that many of the design testing, manufacturing and operational problems that industry has to solve contain important information for the whole aerospace community. Be assured that *The Aeronautical Journal* provides a renowned platform for refereeing and presenting your work to the broadest international audience.

Papers will be considered for publication in *The Aeronautical Journal* if they meet the terms and conditions listed in our instructions for authors available at: <http://journals.cambridge.org/AER>. If these are not met, the Editor reserves the right to withdraw the paper without redress, which may be at any time up to publication.

**Enquiries should be sent to: Wayne J Davis, RAeS Production Editor: [aerjournal@aerosociety.com](mailto:aerjournal@aerosociety.com)**

**Subscription enquiries should be sent to: [journals@cambridge.org](mailto:journals@cambridge.org) Papers should be submitted at: [www.edmgr.com/aerj](http://www.edmgr.com/aerj)**