

# THE AERONAUTICAL JOURNAL

Covering all aspects of aerospace

Volume 119

Number 1212

February 2015



ROYAL  
AERONAUTICAL  
SOCIETY

# THE AERONAUTICAL JOURNAL

**Editor-in-chief: Professor Peter Bearman**

## **Associate Editors**

**Chairman: Professor Mike Graham**

**Deputy Chairman: Professor Chris Atkin**

**Professor Christian Allen**  
University of Bristol

**Professor David Allerton**  
University of Sheffield

**Professor Holger Babinsky**  
University of Cambridge

**Professor Rene de Borst**  
University of Glasgow

**Wg Cdr Mike Bratby**  
RAeS Air Power Group

**Professor Jonathan Cooper**  
University of Bristol

**Mr Peter Curtis**  
Aircraft Research Association

**Professor Laurent Dala**  
Council for Scientific & Industrial Research (CSIR)  
Pretoria, South Africa

**Professor Dimitris Drikakis**  
Cranfield University

**Professor Brian Falzon**  
Queen's University, Belfast

**Mr Chris Fielding**  
BAE Systems, Warton

**Professor Antonio Filippone**  
University of Manchester

**Professor Ed Galea**  
Greenwich University

**Professor Victor Giurgiutiu**  
University of South Carolina

**Dr Guy Gratton**  
Brunel University

**Dr John Green**  
Consultant Chief Scientist, ARA

**Professor Ismet Gursul**  
University of Bath

**Professor Keith Hayward**  
RAeS Head of Research

**Professor Li He**  
University of Oxford

**Professor Michael Henshaw**  
Loughborough University

**Professor Konstantinos Kontis**  
University of Glasgow

**Dr M R Nayak**  
National Aerospace Laboratories, India

**Professor Gareth Padfield**  
University of Liverpool

**Professor Ning Qin**  
University of Sheffield

**Professor Srinivasan Raghunathan**  
Queen's University, Belfast

**Dr Arthur Richards**  
University of Bristol

**Mr Carl Russell**  
NASA Ames, USA

**Professor Shahrokh Shahpar**  
Rolls-Royce, Derby

**Professor Howard Smith**  
Cranfield University

**Professor Marilyn Smith**  
Georgia Institute of Technology, USA

**Professor Constantinos Soutis**  
University of Manchester

**Professor Constantinos Stavrinidis**  
European Space Agency

**Professor Anthony Waas**  
University of Michigan, USA

## **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, which include:

Aircraft design, aerodynamics, air law, air power, air transport, air navigation, airworthiness and maintenance, aviation medicine, avionics and systems, environmental issues, flight operations, flight simulation, fluid dynamics, fluid mechanics, general aviation, guided flight, human factors, human powered flight, light aviation, management studies, propulsion, rotorcraft, safety, space, structures and materials, structural mechanics, systems and test procedures and UAVs.

Papers are therefore 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. *The Aeronautical Journal* provides a platform for refereeing and presenting your work to an international audience.

Papers will be considered for publication in *The Aeronautical Journal* if they meet the terms and conditions listed in The Instructions for authors. 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, Royal Aeronautical Society, No.4 Hamilton Place,  
London W1J 7BQ, United Kingdom or [aerjournal@aerosociety.com](mailto:aerjournal@aerosociety.com)**

**Papers should be submitted at: [www.edmgr.com/aeroj](http://www.edmgr.com/aeroj)**



# CONTENTS

Volume 119 Number 1212

February 2015

**W. Schuster**

Trajectory prediction for future air traffic management –  
complex manoeuvres and taxiing 121

**U. Mehta, L. Huynh, P. Hagseth, J. Bowles and J. Melton**

Water injection pre-compressor cooling assist space access 145

**T. Baklacioglu**

Fuel flow-rate modelling of transport aircraft for the climb flight using  
genetic algorithms 173

**R. Vescovini and C. Bisagni**

A fast procedure for the design of composite stiffened panels 185

**L. W. Traub, R. Waghela and K. A. Bordignon**

Characterisation of a highly staggered spanwise cambered biplane 203

**W. Chen**

Runway foreign object detection using RGB 229

**Book reviews**

245

*Front cover:* Inside Heathrow Airport's air traffic control tower. (NATS)



**ROYAL  
AERONAUTICAL  
SOCIETY**

**Editor-in-Chief**  
Professor Peter Bearman

**Publishing Manager**  
Chris Male

**Production Editor**  
Wayne J Davis

**Publications Officer**  
Annabel Hallam

**Production**  
Bill Read  
Tim Robinson

**Book Review Editor**  
Brian Riddle

**Publisher**

Royal Aeronautical Society (RAeS)  
No.4 Hamilton Place  
London W1J 7BQ, UK  
Tel: +44 (0)20 7670 4300  
Fax: +44 (0)20 7670 4309  
email: [publications@aerosociety.com](mailto:publications@aerosociety.com)

<http://www.aerosociety.com>

**RAeS Chief Executive**  
Simon C Luxmoore

## Subscriptions

### Non-members

Annual subscription (12 issues) £460, Single copies, including back issues £40; Non-member subscription orders are available from; Royal Aeronautical Society, Publications Subscriptions Department, Dovetail Services Ltd, 800 Guillat Avenue, Kent Science Park, Sittingbourne, Kent ME9 8GU, UK.

T: +44 (0)844 848 8426, E: [raes@servicehelpline.co.uk](mailto:raes@servicehelpline.co.uk)

### RAeS members

Annual subscription (12 issues) £79, Single copies, including back issues £7; member subscription orders are available from; Membership Department, Royal Aeronautical Society, No.4 Hamilton Place, London W1J 7BQ, UK.

T: +44 (0)20 7670 4300, E: [subscriptions@aerosociety.com](mailto:subscriptions@aerosociety.com)

### RAeS Conference Proceedings

Details, price and availability of Royal Aeronautical Society Conference Proceedings can be obtained from; RAeS Conference and Events Department, No.4 Hamilton Place, London W1J 7BQ, UK. Tel: +44 (0)20 7670 4300, email: [conference@aerosociety.com](mailto:conference@aerosociety.com) or via [www.aerosociety.com/proceedings](http://www.aerosociety.com/proceedings)

*The Aeronautical Journal* now supports open access publication across its hardcopy and online platforms, and accepts papers to consider for publication under both the 'green' and 'gold' open access options.

Reproduction of any of the papers published in this journal is not permitted without the written consent of the Editor.

The content does not necessarily express the opinion of the Council of the Royal Aeronautical Society.

The Royal Aeronautical Society is a registered charity: No 313708

© 2014 The Royal Aeronautical Society

### Advertisement Sales

Emma Bossom  
+44 (0)20 7670 4342  
[emma.bossom@aerosociety.com](mailto:emma.bossom@aerosociety.com)

### Printer

Buxton Press Limited  
Palace Road  
Buxton  
Derbyshire SK17 6AE  
UK

ISSN: 0001-9240

**Published monthly**

**All papers are available to view free of charge for subscribers at:  
[www.aerosociety.com/news/publications/aero-journal](http://www.aerosociety.com/news/publications/aero-journal)**