

# THE AERONAUTICAL JOURNAL

Covering all aspects of Aerospace

Volume 113 Number 1142

April 2009



# THE AERONAUTICAL JOURNAL

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

## Associate Editors

**Chairman: Prof Mike Graham**

**Dr Holger Babinsky**  
Cambridge University

**Dr Trevor Birch**  
Dstl

**Professor Rene de Borst**  
Eindhoven University of Technology

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

**Professor Richard Brown**  
Glasgow University

**Dr Jon Carrotte**  
Loughborough University

**Dr Graham Coleman**  
Ex-Dstl

**Professor Jonathan Cooper**  
University of Liverpool

**Mr Anthony Cross**  
BAE Systems Warton

**Professor Richard Crowther**  
Rutherford Appleton Lab

**Professor Glyn Davies**  
Imperial College, London

**Dr Olivier Dessens**  
Cambridge University

**Professor Dimitris Drikakis**  
Cranfield University

**Mr Chris Fielding**  
BAE Systems, Warton

**Professor John Fielding**  
Cranfield University

**Professor Nabil Gindy**  
University of Nottingham

**Professor Victor Giurgiutiu**  
University of South Carolina

**Professor Ismet Gursul**  
University of Bath

**Professor Keith Hayward**  
RAeS Head of Research

**Professor Michael J de C Henshaw**  
Loughborough University

**Professor Richard Hillier**  
Imperial College, London

**Professor Howard Hodson**  
University of Cambridge

**Mr Julian Lea-Jones**  
Systems Consultant

**Professor Ken Morgan**  
University of Wales, Swansea

**Dr Ravi Nayak**  
National Aerospace Laboratories, India

**Professor Gareth Padfield**  
University of Liverpool

**Dr Shahrokh Shahpar**  
Rolls-Royce

**Professor Constantinos Soutis**  
University of Sheffield

**Professor John Stollery**  
Cranfield University

**Professor Anthony Waas**  
University of Michigan

### 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.

Papers should be sent to: Prof Peter Bearman, Royal Aeronautical Society, No. 4 Hamilton Place, London W1J 7BQ, United Kingdom.

### Subscriptions

#### Non-members

Annual subscription (12 issues) £390, Single copies, including back issues £36; *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.

Tel: +44 (0)844 848 8426, Fax: +44 (0)844 856 0650, email: ras@servicehelpline.co.uk

#### RAeS members

Annual subscription (12 issues) £65, Single copies, including back issues £6; *member subscription orders are available from;* Membership Department, Royal Aeronautical Society, No. 4 Hamilton Place, London W1J 7BQ, UK. Tel: +44 (0)20 7670 4300, Fax: +44 (0)20 7670 4309, email: membership@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 or via [www.aerosociety.com/proceedings](http://www.aerosociety.com/proceedings)

**All papers are available to view free of charge for subscribers and to purchase by others at: [www.aerosociety.com](http://www.aerosociety.com)**



# CONTENTS

Volume 113 Number 1142

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

**Editor-in-Chief**

Professor P W Bearman FEng, FCGI, FRAeS

**Managing Editor**

C S C Male BSc(Eng) MRAeS

**Production Editor**

W J Davis BA ARAeS

**Publications Officer**

A L Hallam BA ARAeS

**Production**

W I I Read MA(Econ)  
T C Robinson BA

**Book Review Editor**

B L Riddle BLib

**Publisher**

Royal Aeronautical Society (RAeS)  
No.4 Hamilton Place  
London W1J 7BQ, UK  
Tel: +44 (0)20 7670 4300  
Fax: +44 (0)20 7670 4359  
e-mail: publications@aerosociety.com  
raes@aerosociety.com

<http://www.aerosociety.com>

The Royal Aeronautical Society  
is a registered charity: No 313708

**RAeS Chief Executive**

K D R Mans BA FRAeS

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

**Advertisement Sales**

David Lancaster, Group Sales Manager  
Ten Alps Publishing  
9 Savoy Street  
London WC2E 7HR, UK  
Tel: +44 (0)20 7878 2316  
Fax: +44 (0)20 7379 7118/7155  
email: david.lancaster@tenalpspublishing.com

**Printer**

Manor Creative Limited  
7 and 8 Edison Road  
Eastbourne  
East Sussex  
BN23 6PT  
United Kingdom  
ISSN: 0001-9240

Published monthly



**Mixed Sources**  
Product group from well-managed  
forests and other controlled sources  
[www.fsc.org](http://www.fsc.org) Cert no: TIC-COC-022794  
© 1996 Forest Stewardship Council

- L. Meirovitch, I. Tuzcu and W.D. McGrory**  
predicting the response of low-aspect ratio, flexible aircraft 207
- J.-L. Hantrais-Gervois, R. Grenon and A. Mann**  
Downward pointing winglet design and assessment within the M-DAW research project 221
- Z.C. Zheng and W. Li**  
Dependence of radiated sound frequency  
on vortex core dynamics in multiple vortex interactions 233
- N.K. Peyada and A.K. Ghosh**  
Aircraft parameter estimation using a new filtering technique  
based upon a neural network and Gauss-Newton method 243
- P.C. Wilkins and K. Knowles**  
The leading-edge vortex and aerodynamics of insect-based  
flapping-wing micro air vehicles 253
- J. Chang, D. Yu, W. Bao, Z. Xie and Y. Fan**  
A CFD assessment of classifications for hypersonic inlet  
start/unstart phenomena 263
- Book Reviews** 272

Front cover: