

THE AERONAUTICAL JOURNAL

Covering all aspects of Aerospace

Volume 115 Number 1168

June 2011



THE AERONAUTICAL JOURNAL

Editor-in-chief: Prof Peter Bearman

Associate Editors

Chairman: Prof Mike Graham

Professor Chris Atkin
City University, London

Professor Holger Babinsky
University of Cambridge

Professor Ken Badcock
University of Liverpool

Professor Rene de Borst
Eindhoven University of Technology

Dr Trevor Birch
DSTL

Wg Cdr Mike Bratby
RAeS Air Power Group

Professor Richard Brown
University of Strathclyde, Glasgow

Dr Jon Carrotte
Loughborough University

Professor Jonathan Cooper
University of Liverpool

Mr Anthony Cross
BAE Systems, Warton

Professor Glyn Davies
Imperial College, London

Dr Olivier Dessens
University of Cambridge

Professor Dimitris Drikakis
Cranfield University

Mr Chris Fielding
BAE Systems, Warton

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

Dr John Loizou
VEGA Space

Professor Ken Morgan
Swansea University

Dr Ravi Nayak
National Aerospace Laboratories, India

Professor Gareth Padfield
University of Liverpool

Professor Shahrokh Shahpar
Rolls-Royce

Dr Howard Smith
Cranfield University

Professor Marilyn Smith
Georgia Institute of Technology

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 or publications@aerosociety.com

Subscriptions

Non-members

Annual subscription (12 issues) £399, 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) £69, 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

All papers are available to view free of charge for subscribers and to purchase by others at: www.aerosociety.com



CONTENTS

Volume 115 Number 1168

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 FREng 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 4309
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

S C Luxmoore MBA FRAeS

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

Advertisement Sales

Ben David
Pelusa Media
Sweetlands Barn
Couchman Green Lane
Staplehurst
Kent, TN12 0RR, UK
Tel: +44 (0)20 8406 0820
email: ben@pelusa.co.uk

Printer

Sunday Publishing
Studio 2
First Floor
Enterprise House
1 - 2 Hatfields
London SE1 9P6, UK
ISSN: 0001-9240

Published monthly



Mixed Sources

Product group from well-managed
forests and other controlled sources
www.fsc.org Cert no. TT-COC-002794
© 1996 Forest Stewardship Council

- | | |
|---|-----|
| C. Xiao-Qing, H. Zhong-Xi, L. Jian-Xia and G. Xian-Zhong
Modification impact on aerodynamic performance of
hypersonic waverider | 325 |
| C.C. Beves, T.J. Barber and E. Leonardi
Aerofoil flow separation suppression using dimples | 335 |
| D. Wang
Algebraic analysis of stability and bifurcation for nonlinear flight dynamics | 345 |
| A. Seitz, D. Schmitt and S. Donnerhack
Emission comparison of turbofan and open rotor engines under special
consideration of aircraft and mission design aspects | 351 |
| A. Maneschijn, T. Jones and T.W. von Backström
An operability framework for unmanned aircraft systems | 361 |
| M.Y.M. Ahmed and N. Qin
Numerical investigation of aeroheating characteristics of spiked blunt
bodies at Mach six flight conditions | 377 |
| Book reviews | 387 |

Front Cover: Two RAeS commissioned concepts for a new generation single-aisle
aircraft.

(Concept by RAeS/computer rendering by Kactus Digital)