THE AERONAUTICAL JOURNAL

Covering all aspects of aerospace

Volume 119 Number 1218

August 2015





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

Wg Cdr Mike Bratby RAeS Air Power Group

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

> Mr Chris Fielding BAE Systems, Warton

Professor Victor Giurgiutiu University of South Carolina

Professor Ismet Gursul University of Bath

Professor Michael Henshaw Loughborough University

Professor Gareth Padfield University of Liverpool

> Dr Arthur Richards University of Bristol

Professor Howard Smith Cranfield University

> Professor Constantinos Stavrinidis European Space Agency

Professor Holger Babinsky University of Cambridge

Professor Jonathan Cooper University of Bristol

Professor Dimitris Drikakis Cranfield University

Professor Antonio Filippone University of Manchester

> Dr Guy Gratton Brunel University

Professor Keith Hayward Former Head of Research, RAeS

Professor Konstantinos Kontis University of Glasgow

> Professor Ning Qin University of Sheffield

Mr Carl Russell NASA Ames, USA

Professor Marilyn Smith Georgia Institute of Technology, USA Professor Rene de Borst University of Glasgow

Mr Peter Curtis Aircraft Research Association

Professor Brian Falzon Queen's University, Belfast

Professor Ed Galea Greenwich University

Dr John Green Consultant Chief Scientist, ARA

> Professor Li He University of Oxford

Dr M R Nayak National Aerospace Laboratories, India

Professor Srinivasan Raghunathan Queen's University, Belfast

Professor Shahrokh Shahpar Rolls-Royce, Derby

Professor Constantinos Soutis University of Manchester

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 aerojournal@aerosociety.com

https://doi.org/10.1017/S0001924000011052 Published online by Campridge University Press



CONTENTS

Volume 119 Number 1218	August 2015
T. W. Pickhaver and P. M. Render A technique to predict the aerodynamic effects of battle damage on an aircraft's wing	937
P-D. Jameson and A. K. Cooke Reduced order system identification for UAVs	961
N. Anton and R. M. Botez Weight functions method for stability analysis applied as design too for Hawker 800XP aircraft	ıl 981
P. R. Thomas, S. Bullock, U. Bhandari and T. S. Richardson Fixed-wing approach techniques for complex environments	999
C-L Lin, S-L Hsieh and Y-P Lin Trajectory estimation based on extended state observer with Fal-filt	ter 1017
L. Yi, Y. Jun and K. Bin Static aeroelastic optimisation to wing structural weight estimation of an extremely manoeuvrable UAV	1035

Front cover: USAF F-16C #89-2034 of the 125th Fighter Squadron after its mishap from 20 October 2014 in which it collided with F-16C #89-2019 over Moline, Kansas, USA. The aircraft landed safely. (USAF)



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

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. +44 (0)844 848 8426 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. +44 (0)20 7670 4300 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 or via 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

© 2015 The Royal Aeronautical Society

Advertisement Sales Emma Bossom +44 (0)20 7670 4342 emma.bossom@aerosociety.com

Buxton Press Limited Palace Road Buxton Derbyshire SK17 6AE UK

Printer

ISSN: 0001-9240 Published monthly

All papers are available to view free of charge for subscribers at: www.aerosociety.com/news/publications/aero-journal