



The
**AERONAUTICAL
JOURNAL**



The UAV Special Issue

Volume 107, Number 1068

February 2003

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 *Journal* include most of those covered by the various Specialist Groups of the Society, which are: aerodynamics, air law, air transport, airworthiness and maintenance, aviation medicine, avionics and systems, flight operations, flight simulation, guided flight, human factors, human powered flight, light aviation, management studies, propulsion, rotorcraft, space, structures and materials, systems and test procedures.

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.

Editorial Advisory Committee

Chairman: Prof Peter Bearman
Editor: Prof John Stollery

Aerodynamics

Tony Cross Manager — Aerodynamic Technology
BAE Systems

Avionics/Simulation

Prof David Allerton Head, Department of Avionics, College of
Aeronautics, Cranfield University

Materials

Dr Mike Hicks Head of Materials, Rolls-Royce Aerospace

Propulsion

Dr Peter Stow Head of Aerothermal Methods,
Rolls-Royce Aerospace Group

Rotorcraft

Alan Vincent Head of Engineering, GKN Westland
Dr Gareth Padfield James Bibby Professorship, Aerospace
Engineering, University of Liverpool

Space

Roy Gibson Consultant (Former Director General of
the European Space Agency)

Structures

Prof Glyn Davies Senior Research Fellow, Department of
Aeronautics, Imperial College, London

Systems

Prof Donald McLean Professor of Flight Control, Department of
Aeronautics and Astronautics,
University of Southampton

Testing

Dr Graham Coleman Chief Scientist (Aircraft Systems),
DERA Farnborough

Environment

Dr Kathy Law Programme Manager, NERC UTLS Ozone

Subscriptions

The Aeronautical Journal

Non-members

Annual subscription (12 issues) £299
Single copies, including back issues £30

From: Royal Aeronautical Society
Publications Subscriptions Department
Bradley Pavilions
Bradley Stoke North
Bristol BS32 0PP, UK
Tel: +44 (0)1454 642485 Fax: +44 (0)1454 620080
e-mail: cihotline@aol.com

RAeS members

Annual subscription (12 issues) £50
Single copies, including back issues £5

From: Professional Affairs Department
Royal Aeronautical Society
4 Hamilton Place
London W1J 7BQ, UK
Tel: +44 (0)20 7670 4300 Fax: +44 (0)20 7499 6230
e-mail: professional@raes.org.uk

RAeS Conference Proceedings

Details, price and availability of Royal Aeronautical Society
Conference Proceedings can be obtained from:

Conference Department
Royal Aeronautical Society
4 Hamilton Place
London W1J 7BQ, UK
Tel: +44 (0)20 7670 4300 Fax: +44 (0)20 7670 4349
e-mail: conference@raes.org.uk

Submissions

To submit a paper to *The Aeronautical Journal*, THREE printed manuscripts along with high quality figures (see *Guidelines for Authors*, p *iv*) should be sent to the Editor at

John Stollery
Royal Aeronautical Society
4 Hamilton Place
London
W1J 7BQ
United Kingdom

For further advice on submitting papers to *The Aeronautical Journal*, please refer to the *Guidance for Authors* on page *iv*. If previously agreed with the editorial staff, it may be possible to supply a paper in a different format.

The Royal Aeronautical Society reserves the right to reject a paper which is not submitted in the required manner.



Contents

Volume 107, Number 1068

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

Editor

Professor J L Stollery CBE DSc(Eng) FEng FAIAA
HonFRaES

Managing Editor

C S C Male BSc(Eng) MRaES

Production Editor

W I I Read MA(Econ)

News Editor

T C Robinson BA

Production Coordinator

W J Davis BA

Publisher

Royal Aeronautical Society (RAeS)
4 Hamilton Place
London W1J 7BQ, UK
Tel: +44 (0)20 7670 4300
Fax: +44 (0)20 7670 4359
e-mail: publications@raes.org.uk
raes@raes.org.uk

<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 Holmes, Advertisement Sales Director
The Media Centre
East Rudham
King's Lynn
Norfolk PE31 8RD
United Kingdom
Tel: +44 (0)1485 528020
Fax: +44 (0)1485 528022
e-mail: mcentre@aol.com

Subscriptions
See left

Printer
Manor Creative Limited
7 and 8 Edison Road
Eastbourne
East Sussex
BN23 6PT
United Kingdom

ISSN: 0001-9240

Published monthly

R.G. Austin

Robotic rotorcraft

65

D.R. Haddon and C.J. Whittaker

Aircraft airworthiness certification standards for civil UAVs

79

A.R. Harvey and R. Appleby

Passive mm-wave imaging from UAVs using aperture synthesis

87

B. Crowther

Flocking of autonomous unmanned air vehicles

99

A.D White

The human – machine partnership in UCAV operations

111

S. Watkins

Development of a micro air vehicle

117

Book reviews

110

The Aeronautical Journal – A special Issue devoted to unmanned aircraft

Unmanned aircraft are becoming increasingly important and this is reflected in the growing interest in the annual conference at the University of Bristol devoted to the subject. Following the 2002 meeting, the committee selected a number of papers to be considered for publication in the Journal. Those papers were then refereed in the normal way and those accepted are published in this special issue.

This year's conference, the 18th in the series, is entitled Unmanned Air Vehicle systems. It will be held again at the University of Bristol from 31 March – 2 April 2003.

Application forms and further details can be obtained from:

Mr N.A. Mitchell
University of Bristol
Dept of Aerospace Engineering
Queens Building
University Walk
Bristol BS8 1TR, UK

Tel: +44 (0)117 928 9764 Fax: +44 (0)117 927 2771
Email: aero-uav@bristol.ac.uk

Professor J.L. Stollery
Editor

Front cover: Northrop Grumman Fire Scout.

Guidelines for authors

Papers will be considered for publication in *The Aeronautical Journal* if they meet the terms and conditions below. 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.

1.0 PREPARATION OF PAPERS

1.1 General

For a paper to be considered, three clearly typed (double spaced) copies must be sent to the Editor with photocopies of figures (including any photographs) if not included within the printed text. Handwritten manuscripts are not acceptable. The accompanying letter must state that the paper has not been published previously or submitted for publication elsewhere.

The receipt of papers will be acknowledged by return, with a copy of these conditions and a reference number which should be used in all correspondence.

Prior to submission, manuscripts should be read critically by a third party who is familiar with the subject area and has a good grasp of the English language. Authors must also obtain permission where necessary to use any material in a paper which is copyright or the property of any other persons or entity, including their employers. Any fees incurred are the sole responsibility of the authors.

1.2 Figures

All figures must be provided by the authors. Illustrations should be kept to a minimum and should, where appropriate, be produced to the same scale. A list of figures helps in the production of the paper.

1.3 Full paper format

Formal papers should comply with the structural guidelines below and should preferably not exceed 10,000 words. The following is the recommended generic format:

Title: The title should be kept short and concise.

Abstract: A single paragraph abstract of around 150 words which summarises the paper and contains no references.

Nomenclature: A list of all symbols used in the text and figures, whether familiar or not, should be given in alphabetical order, with, for example, c before C and all English letters listed before Greek symbols. Subscripts and superscripts should be listed separately where possible. SI units should be used throughout and are thus not required to be shown here.

MAIN TEXT

- 1. Introduction:** Discuss the *raison d'être* of the work, including previous work by others and how the work being presented aims to advance or complement this.
- 2. Descriptive section:** This could be either description of apparatus if an experimental paper, or a discussion of the practical applications if a more theoretical paper.
- 3. Theoretical section:** Equations should be numbered in the order given and referred to in the text by number as, for example, Equation (19). Complex groupings should not be included in text, but should be numbered as equations.
- 4. Procedural section:** Describe the procedure which utilises that described in (2) above.
- 5. Presentation and discussion of results:** Tables of results, numbered in order, should be referred to here and should include only the main results. Errors should be considered an important part of any analysis.
- 6. Conclusions:** This section should be very concise and bullet points are recommended for clarity. The degree to which the aims have been achieved should be portrayed clearly to the reader. Suggestions for future work or work in progress are encouraged.

References: References should be numbered sequentially in the text as they occur. For example, most commonly for papers⁽¹⁾ and reports⁽²⁾

1. Miller, P and Wilson, M. Wall jets created by single and twin high pressure jet impingement, *Aeronaut J*, March 1993, 97, (963), pp 87-100.
2. Green, J.E., Weeks, D.J. and Brooman, J.W.F. Prediction of turbulent boundary layers and wakes in compressible flow, ARC R&M No 3791, 1979.
3. King-Hele, D. *Satellite Orbits in an Atmosphere*, Blackie, Glasgow, 1987.

Appendices: If no suitable reference is available appendices may be used to clarify certain points, such as a step in the theoretical analysis.

1.4 Technical Notes

These can be up to 2,000 words in length and have no set form. They can be abstracts, comments upon unpublished papers, notes on interim results or a call for further research. They do not have to contain figures or nomenclature and may be in the form of a letter.

1.5 Engineering Notes

These are a maximum of one page and may be used to communicate practical solutions to problems encountered on the shop floor or in the laboratory.

2.0 THE REFEREEING PROCESS

2.1 Initial refereeing

Two referees are used for a paper: one for a Technical or Engineering Note and it is requested that authors suggest the names and addresses of three possible independent referees to review their papers although the Editor reserves the right not to use them. One copy of the manuscript is sent to each referee with a Referee Report Form and a request that the referee reply within three weeks or suggest an alternative referee. Hence, in some cases, delays may occur in finding a referee with suitable experience who is willing to review the paper.

2.2 Revising the paper

Once both referees have replied, their comments are sent to the authors who are invited to revise the paper as suggested. It is helpful if a list of those changes included by the author is provided.

A paper will be rejected at this stage only if this is suggested by both referees. Authors are reminded that the process is confidential, and that only referees of the highest calibre are used.

2.3 Secondary refereeing

Unless a paper has been accepted 'as is' by both referees, a revised manuscript will be sent once more to the referees, with another Report Form. If the Editor feels, having considered the second reviews, that the authors have not responded adequately to the original reviews of the referees, then the paper may be rejected. Thus it is imperative that all comments are addressed properly by authors. A third referee may be approached if the Editor thinks this is appropriate. The Editor ultimately reserves the right to reject a paper on grounds of quality or lack of co-operation from authors.

2.4 Acceptance

Once a paper is accepted, the authors will be invited to send the latest version of the text on disk or by e-mail, without any structure (i.e. no codes — tabs, bold, italics, embedded figures, tables, equations etc). The preferred text format is an Ascii text file on either a 3.5" or Zip disk. Please note that LATEX is NOT acceptable.

The positions of equations should be indicated in the saved text. Original figures should also be sent at this stage, a set being required without annotation or borders as well as one with. For computer generated figures only those in 300 dpi TIFF format can be accepted, on either CD-ROM or Zip disk.

2.5 Following acceptance

About one month before the cover date, authors are sent galley proofs for checking, and should keep this in mind if likely to be away during this time. Authors are jointly entitled to 50 complimentary reprints of their paper, and may order any number of additional reprints at a price subject to quotation. These will be considerably cheaper if ordered to coincide with the original print run, and in any case will not be available if ordered later than two months after the cover date. The original manuscript, figures and disk will be returned at this time if requested.

CONDITIONS OF PUBLICATION

Unless specifically attributed, no material in *The Aeronautical Journal* shall be taken to represent the opinion of the RAeS and its Council.