
THE ROYAL INSTITUTE OF NAVIGATION

Aims and Objects

The objects of the Institute are to unite in one body those who are concerned with or who are interested in navigation and to further its development. Navigation is conceived as applying to locomotion of all kinds and is perceived as encompassing aspects of: command and control, psychology and zoology, operational research, risk analysis, theoretical physics, operation in hostile environments, instrumentation, ergonomics, financial planning and law as well as electronics, astronomy, mathematics, cartography and other subjects traditionally associated with navigation.

The aims of the Institute are to encourage the creation and dissemination of knowledge through research and development, to co-ordinate information from all the disciplines involved, to provide a forum in which new ideas and new products can have the benefit of informed and professional scrutiny and to further education and communication. The Institute initiates conferences and symposia on specific subjects and has a programme of meetings at which lectures are given and discussed. There are standing Special Interest Groups (SIGs), which keep under constant review pertinent aspects of navigation. The success of these Special Interest Groups is crucially dependent on the active involvement of members.

The SIGs include: Land Navigation and Location Group (LN&L), General Aviation Navigation Group (GANG), History of Air Navigation Group (HANG), Civil and Military Air Group (CMAG), Marine Traffic & Navigation Group (MT&NG), Small Craft Group (SCG), Space Group (Space), Animal Navigation Group (ANG) and Research & Development Group (R&D).

The Institute publishes *The Journal of Navigation* six times a year. It contains papers which have been presented at meetings, other original papers and selected papers and reports from Special Interest Groups. The Institute also publishes *Navigation News* six times a year which contains a full account of the Institute's proceedings and activities. This includes Branch News, a record of current navigational work, a diary of events, topical articles, news about Membership and advertising. A great deal of the Institute's work is international in character and is coordinated with that of similar organisations in other countries.

Membership

There are nine classes of membership under which individuals or organisations may apply to join the Institute. Details of the various membership criteria and current subscriptions are available on the RIN website (Home / Join the RIN / Membership Types <http://www.rin.org.uk/general.aspx?ID=59>) and from the Membership Secretary (membership@rin.org.uk Tel: +44(0)20 7591 3130 Fax: 44(0)20 7591 3131).

- (1) Ordinary Membership
- (2) Associate Membership
- (3) Associate Fellow Membership
- (4) Student Membership
- (5) Junior Associate Membership
- (6) Corporate Membership
- (7) Small Business Membership
- (8) Affiliate College University Membership
- (9) Affiliate Club Membership

Additional membership classes of Fellowship, Honorary Fellowship, Retired Membership and Affiliate Membership also exist and details are available from the Membership Secretary.

The subscription price (excluding VAT) to *The Journal* (ISSN 0373-4633) for Volume 71, 2018, which includes print and electronic access, is £635 (USA, Canada and Mexico US \$1147) and includes delivery by air; single parts are available at £115 (USA, Canada and Mexico US \$208) plus postage. The electronic-only price available to institutional subscribers is £492 (USA, Canada and Mexico US \$897). EU subscribers (outside the UK) who are not registered for VAT should add VAT at their country's rate. VAT registered subscribers should provide their VAT registration number. *The Journal* is issued free to all Members of the Institute. Orders, which must be accompanied by payment, may be sent to any bookseller or subscription agent or direct to the publishers: Cambridge University Press, UPH, Shaftesbury Road, Cambridge CB2 8BS, or in the USA, Canada and Mexico to Cambridge University Press, Journals Fulfillment Department, 1 Liberty Plaza, Floor 20, New York, NY 10006, USA. Japanese prices for institutions are available from Kinokuniya Company Ltd, P.O. Box 55, Chitose, Tokyo 156, Japan.

© 2017 The Royal Institute of Navigation

This journal issue has been printed on FSC-certified paper and cover board. FSC is an independent, non-governmental, not-for-profit organization established to promote the responsible management of the world's forests. Please see www.fsc.org for information.

THE JOURNAL OF NAVIGATION

VOLUME 71 NUMBER 1 JANUARY 2018

CONTENTS

- Intelligent Urban Positioning: Integration of Shadow Matching with 3D-Mapping-Aided GNSS Ranging** 1
Mounir Adjrard and Paul D. Groves
- Observability-based Mars Autonomous Navigation Using Formation Flying Spacecraft** 21
Yangwei Ou and Hongbo Zhang
- Application of the Nonlinear Tschauner-Hempel Equations to Satellite Relative Position Estimation and Control** 44
Ranjan Vepa
- Probabilistic Analysis of the Impact of Vessel Speed Restrictions on Navigational Safety: Accounting for the Right Whale Rule** 65
Matteo Convertino and L. James Valverde, Jr.
- Implementation and Analysis of Tightly Integrated INS/Stereo VO for Land Vehicle Navigation** 83
Fei Liu, Yashar Balazadegan Sarvood and Yang Gao
- Research on Ship Classification Based on Trajectory Features** 100
Kai Sheng, Zhong Liu, Dechao Zhou, Ailin He and Chengxu Feng
- Long-Term GNSS Analysis for Local Geodetic Datum After 2011 Tohoku Earthquake** 117
Su-Kyung Kim and Tae-Suk Bae
- Integrated GNSS Attitude and Position Determination based on an Affine Constrained Model** 134
Haiying Liu, Lei Xu, Xiaolin Meng, Xibei Chen and Junyi Li
- Optimal Collision-Avoidance Manoeuvres to Minimise Bunker Consumption under the Two-Ship Crossing Situation** 151
Kang Zhou, Jihong Chen and Xiang Liu
- Detection of Spoofing Attack using Machine Learning based on Multi-Layer Neural Network in Single-Frequency GPS Receivers** 169
E. Shafiee, M. R. Mosavi and M. Moazedi
- Detecting Turns and Correcting Headings Using Low-Cost INS** 189
Mohd Nazrin Muhammad, Zoran Salcic and Kevin I-Kai Wang
- Multi-Sensor, Adjustable-Period Integrated Navigation Method Based on Multi-Stage Signal Trigger for Underwater Vehicles** 208
Yanshun Zhang, Baichao Ding, Xiaojuan Huang, Tao Yang and Xiaodong Liu
- Velocity-aided In-motion Alignment for SINS Based on Pseudo-Earth Frame** 221
Meng Liu, Guangchun Li, Yanbin Gao, Shutong Li and Lianwu Guan
- Obstacle Avoidance Approaches for Autonomous Navigation of Unmanned Surface Vehicles** 241
Riccardo Polvara, Sanjay Sharma, Jian Wan, Andrew Manning and Robert Sutton

Cambridge Core

For further information about this journal
please go to the journal website at:
cambridge.org/nav



MIX
Paper from
responsible sources
FSC® C007785

CAMBRIDGE
UNIVERSITY PRESS