
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.

© 2018 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 3 MAY 2018

CONTENTS

GNSS Threat Monitoring and Reporting: Past, Present, and a Proposed Future Sarang Thombre, M. Zahidul H. Bhuiyan, Patrik Eliardsson, Björn Gabrielsson, Michael Pattinson, Mark Dumville, Dimitrios Fryganiotis, Steve Hill, Venkatesh Manikundalam, Martin Pölöskey, Sanguk Lee, Laura Ruotsalainen, Stefan Söderholm and Heidi Kuusniemi	513
Absolute Navigation and Positioning of Mars Rover Using Gravity-Aided Odometry Jiandong Liu, Erhu Wei, Shuanggen Jin and Jingnan Liu	530
Planning Navigation in Inland Waterways with Tidal Depth Restrictions Jesús Muñozuri, Elena Barbadilla, Alejandro Escudero-Santana and Luis Onieva	547
Enhanced Kalman Filter using Noisy Input Gaussian Process Regression for Bridging GPS Outages in a POS Wen Ye, Zhanchao Liu, Chi Li and Jiancheng Fang	565
Performance Comparison among Different Precise Satellite Ephemeris and Clock Products for PPP/INS/UWB Tightly Coupled Positioning Zengke Li, Nanshan Zheng, Jian Wang and Jingxiang Gao	585
Strong Tracking Sigma Point Predictive Variable Structure Filter for Attitude Synchronisation Estimation Lu Cao, Dong Qiao, Han Lei and Gongbo Wang	607
A Novel Robust Sparse-Grid Quadrature Kalman Filter Design for HCV Transfer Alignment Against Model Parameter Uncertainty Hongmei Chen and Jianjuan Liu	625
An Adaptive ΔM-ICCP Geomagnetic Matching Algorithm Jing Xiao, Xiusheng Duan and Xiaohui Qi	649
AIS Data-based Decision Model for Navigation Risk in Sea Areas Lianbo Li, Wenyu Lu, Jiawei Niu, Junpo Liu and Dexin Liu	664
Derivative-free Nonlinear Version of Extended Recursive Three-step Filter for State and Parameter Estimation during Mars Entry Mengli Xiao, Yongbo Zhang, Huimin Fu and Zhihua Wang	679
Fast Fine Initial Self-alignment of INS in Erecting Process on Stationary Base Jianli Li, Yiqi Li and Baiqi Liu	697
A Real-time Gravity Compensation Method for a High-Precision Airborne Position and Orientation System based on a Gravity Map Zhuangsheng Zhu, Yiyang Guo and Wen Ye	711
Assessment and Impact on BDS Positioning Performance Analysis of Recent BDS IGSO-6 Satellite Yidong Lou, Xianjie Li, Fu Zheng, Yang Liu and Hailin Guo	729
A DDF-based IMM-TFS Approach for the Accuracy Evaluation Problem of Rapid Transfer Alignment Dapeng Zhou and Lei Guo	749

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