



5 Reasons to Join the Royal Institute of Navigation...

1

The International Navigation Conference

Discounted registration fees for members and be the first to hear the latest news about the RIN's highly anticipated annual navigation conference.



Special Interest Groups

The RIN has 6 active Special Interest Groups, ranging from Future Positioning, Navigation and Timing to General Aviation Navigation and Cognitive Navigation.

2

3

Navigation News

The Institute's bimonthly magazine for members, featuring the latest news and fantastic features from around the world of navigation.



Professional Registration

The RIN offers a route to professional registration to the Chartered Engineer (CEng), Incorporated Engineer (IEng) and Engineering Technician (EngTech) registers

4

5

The Journal of Navigation

RIN Members receive full access to the world-renowned Journal of Navigation, featuring the best new academic research in navigation.

Plus... did you know that membership of the RIN entitles you to the use of the post-nominal letters 'MRIN'?

**To join us today, visit our website: rin.org.uk
or e-mail membership@rin.org.uk**



Advance Notice & Call for Papers

10th RIN Conference on Animal Navigation

10-12 April 2019
Royal Holloway College, UK

The Royal Institute of Navigation's Animal Navigation Group (ANG) is pleased to announce that the 10th International Conference on Animal Navigation will be held at Royal Holloway, University of London, Egham, UK, from midday 10 April until midday 12 April 2019.

The 10th conference in this series will bring together scientists from the whole range of disciplines that relate to animal navigation including:

Animal Behaviour, Sensory Biology & Cognition, Evolution & Ecology, Molecular Biology & Genetics, Neurobiology & Physiology, Spin Chemistry, Physics, Robotics & Tracking Technology.

CONFERENCE SCOPE

- Long distance navigation and short distance homing
- Sensory aspects, neuronal integration and cognition of orientation and navigation
- The role of spatial memory and learning in migration and homing
- Genetics of orientation and migration
- Avoiding ambiguity with multimodal sensors
- Theoretical modelling
- Instrumentation and technological developments
- The application of animal navigation techniques

Submit your abstract by 1 October 2018

The Organising Committee invites applications for oral and poster presentations via www.rin.org.uk/page/RIN19. Synopses should be of ~250 words, and must include the paper or poster title, and the name(s), affiliation(s) and address(es) of the author(s).

For registration details and further information please visit www.rin.org.uk/page/RIN19

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 6 NOVEMBER 2018

CONTENTS

Fault Exclusion in Multi-Constellation Global Navigation Satellite Systems Yawei Zhai, Mathieu Joerger and Boris Pervan	1281
Egocentric Leisure Boat Navigation in a Smartphone-based Augmented Reality Application Thomas Porathe and Jonas Ekskog	1299
Autonomous In-motion Alignment for Land Vehicle Strapdown Inertial Navigation System without the Aid of External Sensors Qiangwen Fu, Yang Liu, Zhenbo Liu, Sihai Li and Bofan Guan	1312
Minimum Sigma Set SR-UKF for Quadrifocal Tensor-based Binocular Stereo Vision-IMU Tightly-coupled System Maosong Wang, Wenqi Wu, Naser El-Sheimy and Zhiwen Xian	1329
Stand-alone Celestial Navigation Positioning Method Frankiskos Pierros	1344
Improvement of Multi-GNSS Precise Point Positioning Performances with Real Meteorological Data Ke Su and Shuanggen Jin	1363
An Interplanetary Network for Spacecraft Autonomous Navigation Shijun Xin, Yidi Wang, Wei Zheng, Yunhe Meng and Dapeng Zhang	1381
Dynamically Adjusting Filter Gain Method for Suppressing GNSS Observation Outliers in Integrated Navigation Lihui Wang, Kangyi Zhi, Bin Li and Yuexin Zhang	1396
A Novel Approach to Visual Navigation based on Feature Line Correspondences for Precision Landing Wei Shao, Tianhao Gu, Yin Ma, Jincheng Xie and Liang Cao	1413
ATOA/AOA Underwater Acoustic Positioning System Based on the Equivalent Sound Speed Mingzhen Xin, Fanlin Yang, Faxing Wang, Bo Shi, Kai Zhang and Hui Liu	1431
Real-time Terrain Matching Based on 3D Zernike Moments Kedong Wang, Tongqian Zhu and Jinling Wang	1441
Improved Transversal Polar Navigation Mechanism for Strapdown INS using Ellipsoidal Earth Model Fangjun Qin, Lubin Chang and An Li	1460
A Fast Adaptive-Gain Complementary Filter Algorithm for Attitude Estimation of an Unmanned Aerial Vehicle - CORRIGENDUM Qing-quan Yang, Ling-ling Sun and Longzhao Yang	1477
A Fast Adaptive-Gain Complementary Filter Algorithm for Attitude Estimation of an Unmanned Aerial Vehicle Qing-quan Yang, Ling-ling Sun and Longzhao Yang	1478
A New Cycle Slip Detection and Repair Method for Single-Frequency GNSS Data Qusen Chen, Hua Chen, Weiping Jiang, Xiaohui Zhou and Peng Yuan	1492
A Unified Dual-frequency Constant Envelope Multiplexing Design Framework for Modernised GNSS Signals Tao Yan, Bo Qu, Ying Wang, Guoyong Wang, Wenying Lei, Lang Bian and Yansong Meng	1511
Navigation Information Fusion in a Redundant Marine Rotational Inertial Navigation System Configuration Lin Wang, Wenqi Wu, Guo Wei, Xianfei Pan and Junxiang Lian	1531
Ocean Vehicle Inertial Navigation Method based on Dynamic Constraints Jiazen Lu and Lili Xie	1553
A High-accuracy SINS/CNS Integrated Navigation Scheme Based on Overall Optimal Correction Jiafang Zhu, Xinlong Wang, Hengnian Li, Huan Che and Qunsheng Li	1567
A Markley Variables-based Attitude Estimation Method Using Optical Flow and a Star Vector for Spinning Spacecraft Xiaolin Ning, Zonghe Ding, Mingzhu Xu, Jiancheng Fang and Gang Liu	1589

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