

Short course

Integrated Navigation System Design

26 - 30 April 2010



Course overview

This one-week course has been specially designed for the practical needs of navigation system engineers. It will give knowledge in sensor selection, integrated navigation design and development, sensor failure detection and fault-tolerant navigation system design. It presents the fundamentals of inertial and satellite navigation systems, practical methods for the design of integrated navigation filters, as well as development models for integrated navigation systems, as below:

Course content

Inertial Sensor Technologies (Module 1)

- Accelerometer technology
- Gyros technology
- MEMS inertial sensors
- Inertial sensor performance
- Inertial system configurations

Inertial Navigation Algorithms (Module 2)

- Coordinate systems and their transformation
- General inertial navigation equation
- Strapdown navigation mechanisation
- Navigation algorithm design
- Initial alignment of inertial systems

Satellite Navigation System (Module 3)

- Introduction to GPS
 - Satellite single structure
 - GPS receiver principles
- GPS positioning principle
- GPS attitude determination
- GPS error analysis
- Differential GPS techniques
 - local-area augmentation
 - wide-area augmentation

Modern Estimation Techniques (Module 4)

- Random variables and random process
- Modelling dynamic systems
- Linear Kalman filter and information filter
- Linearised and Extended Kalman filters
- Practical Kalman filtering algorithms
- Kalman filter statistical analysis

FDI Techniques (Module 5)

- Statistical hypothesis testing methods
- Redundant inertial system design
- Redundant measurements
- Parity space methods
- GLRT methods
- Kalman filter residual test

Integrated Navigation System Design (Module 6)

- General design principle
- Multisensor navigation system design model
- Hardware redundancy
- Analytical redundancy
 - Redundant system architectures
 - Integrated navigation filter architectures
- Example and Simulation
 - Inertial system error dynamic model
 - Redundant navigation-aiding measurements
 - Navigation filter design
 - Simulation

Who should attend

- Navigation systems engineers, navigation algorithm developers
- Avionics systems engineers
- Avionics system development managers
- Navigation system maintenance and repair engineers
- Engineers, PhD students and research scientists who have interests in the design of multisensor guidance, navigation and control systems for various vehicles

Objectives

- To provide an understanding of the principles and techniques in inertial and satellite navigation systems
- To provide a comprehensive understanding of design methods of advanced integrated navigation systems
- To provide practical methods to design and develop integrated navigation systems
- To make engineers and decision-makers aware of problem areas in fault-tolerant, multisensor navigation systems

General information

Date:	26 - 30 April 2010
Course fee:	£1220 (£1190 if also attending Introduction to Avionics)
Accommodation fee:	£435

Key speakers

Dr David Zammit-Mangion

Lecturer in Avionics, Cranfield University

Dr Ing David Zammit-Mangion graduated with a Bachelor's degree in Electrical Engineering from the University of Malta and worked in the semi-conductor manufacturing industry before joining the University of Malta in 1992 to lecture in electronics and electronic systems. Graduating with a Master's degree in Electronic System Design from the College of Aeronautics, Cranfield University in 1996, Dr. Zammit-Mangion returned to Cranfield to conduct research in aircraft performance monitoring and cockpit display design. He was awarded a doctorate degree for his work in 2001. Dr Zammit-Mangion has several years' experience in electronic hardware and software design for both the aerospace and general industries. He joined Cranfield University as Lecturer in Avionics in 2003 and has since furthered his product-oriented research activity in the fields of airborne safety and surveillance systems, traffic collision avoidance and cockpit display design.

Dr Huamin Jia

Course Director, Lecturer in Avionics Systems, Cranfield University

Dr Jia obtained his MSc(Eng.) in Computer Software Engineering from University of Science and Technology of China, and his PhD from College of Aeronautics, Cranfield University. His PhD study focused on data fusion methodologies for aircraft multisensor navigation systems. His background covers inertial and satellite navigation systems, control engineering and software engineering. Dr Jia has more than 15 years experience in the design and development of various integrated multisensor navigation systems. His research interests includes data fusion methodologies for vehicle guidance, navigation and control, integrated navigation systems, distributed sensor network systems and data fusion algorithms, sensors/systems failure detection and isolation, as well as avionics system safety assessment. He lectures and carries out research in the areas of inertial and satellite navigation systems, integrated navigation system design, fault-tolerant avionics system design and software engineering, and provides supervision for PhD and masters research projects. Speakers

For further information on the course content, Dr Jia can be contacted on:

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F: +44 (0) 1234 751550

E: h.jia@cranfield.ac.uk

Booking information

How to register

The registration form overleaf should be completed and sent as soon as possible. Late registrations may be accepted, subject to availability of places on the course.

Alternatively, a registration form can be found on our website www.cranfield.ac.uk/soe/shortcourses which can be down-loaded and faxed/ posted back. Information, contact names and details of all courses can also be found on our web site.

Group discount

Where more than two delegates are booking from within one site of one organisation, a discount of 10% will apply to the invoice for the course tuition fee. Accommodation fees are not included in the discount scheme. Please ask about our discount scheme at time of booking.

Booking conditions

Course fees quoted include tuition, course materials, lunch, refreshments and course dinner where appropriate.

On confirmation of the booking an invoice will be sent to you. Payment is required no later than eight weeks before the course starts, or immediately for bookings made within eight weeks of the beginning of the course.

Fees are payable to Cranfield University. Cheques should be drawn on a UK bank in £ Sterling and made payable to Cranfield University.

Further Information

Academic Operations Unit,
Cranfield University
Cranfield, Bedfordshire
MK43 0AL

T: +44 (0) 1234 754 192
E: shortcourse@cranfield.ac.uk

www.cranfield.ac.uk/soe

Cancellations – We regret that a fee must be charged when confirmed bookings are cancelled or transferred to future dates. In the event of a cancellation, you may nominate a substitute but if a suitable substitute cannot be found the following scale of charges will apply:

More than 56 days before the programme starts, the fee is refunded in full.

56 days or less	50%
28 days or less	25%
14 days or less	0%

Transfers – Within the eight week period preceding the start of the programme, we are unable to transfer a booking to a later programme free of charge, since it is seldom possible to arrange the attendance of a replacement. Withdrawal and transfer to a later programme at this stage will therefore also be subject to the charges as detailed above.

Accommodation – Participants are usually accommodated within the University Campus, either in Mitchell Hall or in the Conference Centre. Occasionally other accommodation is used as an alternative. If this is the case it will be made clear in the joining information.

Cranfield School of Engineering reserves the right to amend published information.

Location

The campus is located approximately 50 miles north of London, close to junctions 13 and 14 of the M1 motorway. Mainline train services from London to Milton Keynes are frequent, with a journey time of approximately 35-60 minutes. Alternatively, the University has its own commercial airport on campus.

This document is available on line or as a text file in large font.

Registration form

Course Title **Integrated Navigation System Design**

Course Dates from **26 April 2010** to **30 April 2010**

Fee Payable _____

Delegate's details

Title Mr Mrs Miss Dr Other, *please specify* _____

First name _____ **Surname** _____

Job title _____

Email _____ **Nationality** _____

Organisation's details

Organisation name _____

Organisation address _____

Town _____ **County/Region** _____

Country _____ **Postcode/Zipcode** _____

Direct line telephone number and fax:

<small>Country code</small>	<small>Area code</small>	<small>Telephone number</small>	<small>Ext. no.</small>	<small>Fax no.</small>

Contact details for correspondence (if different from delegate address)

Name and address _____

Town _____ **County/Region** _____

Country _____ **Postcode/Zipcode** _____

Contact telephone number and fax:

<small>Country code</small>	<small>Area code</small>	<small>Telephone number</small>	<small>Ext. no.</small>	<small>Fax no.</small>

Authorisation of Payment/Invoice details (if different from the above)

I have read and I accept the Booking Conditions and understand that upon confirmation of this booking I/ the organisation will become liable for all charges including cancellation and transfer charges if applicable.

Contact name _____ **Purchase order no (if applicable)** _____

Full Address _____

Address _____

Postcode (if in UK): _____ **Email:** _____

Telephone (inc code): _____ **Fax:** _____

CREDIT CARD PAYMENT If you would like to pay by credit card, please complete the following:

Card type: MASTERCARD / VISA / AMERICAN EXPRESS *
* delete as appropriate **Expiry date:** / /

Card number:

3-digit security code (on reverse of card):

Cardholder name:

Cardholder address:

Cardholder or authorised signature:

Complete and return to: Post Academic Operations Unit, Cranfield University, Beds, MK43 0AL Fax +44 (0) 1234 751206