

Welcome Message

Dear Colleagues/Friends,

We welcome you back to Hawaii – this time to the Island of Kauai – to present, exhibit, and participate in the 4th IEEE International Symposium on Inertial Sensors and Systems (INERTIAL'17). This year event continues our recently established tradition, started in 2014 in Laguna Beach, CA, of informal international meetings discussing the latest developments in the area of modern inertial sensors and emerging applications enabled by inertial sensors. The IEEE INERTIAL is sponsored by the IEEE Sensors Council and is the only IEEE event exclusively dedicated to the Inertial Sensors and Systems technology. The acceptance of technology is growing fast, with the MEMS Inertial Sensors market alone projected to exceed \$2.0B by 2020.

The event offers a rare opportunity to meet and network with leaders in the field of Inertial Sensors and Systems in an informal atmosphere of a focused, international, technical gathering. We hope the atmosphere, research topics, and the quality of invited and contributed technical presentations will make the INERTIAL a 'must attend' event for you every year. The INERTIAL has an ambition to establish itself as the premier forum for reporting the latest research, development, and commercialization results in modern Inertial Sensors technology. You will hear from the world experts the latest in materials and micro-fabrication processes, innovative designs, and new physical principles.

The technical program this year covers two and a half days of technical presentations. By design, this is a single track symposium with high quality oral and poster presentations. Each presentation was carefully reviewed and selected by our Technical Program Committee, after a careful evaluation by at least three independent reviewers. Our three distinct invited speakers will open the morning session every day. The contributed papers will be presented in oral and poster formats, with poster sessions preceded by brief oral sessions introducing the posters. Following the success of last year, we expanded our program by a day of tutorials. On Monday, there will be three tutorials offered, this year in the area of Atomic Sensors for Inertial Navigation, Non-GPS Aiding of Inertial Navigation Systems (INS), and the Fiber Optic Gyroscopes. The tutorials are organized and chaired by Dr. Michael Larsen.

The Digest of Technical Papers for the 2017 IEEE Inertial Sensors contains four-page versions of regular oral and poster presentations and 2-pagers of "late news" presentations, all provided to attendees in an electronic form. Most (but not all) presented papers will be available in the IEEE Xplore after the symposium. This Year we added a few new events – the "Lighting Round" by Exhibitors and "Open Posters" by Participants. On Tuesday morning, our exhibitors will be invited to briefly introduce their companies, products, and services, stimulating interactions with attendees throughout the meeting. The "Open Posters" session on Tuesday night will offer an opportunity for all attendees to discuss informally the latest and greatest from the labs.

On Wednesday morning, Dr. Kari Moran will be hosting a breakfast for "Women in Inertial Sensors". This event is sponsored by IEEE Sensors Council and will promote the discussion on the role of women-engineers in the modern work force.

This year, for the first time, the Technical Program Committee will select two Best Student Papers, one from the oral track and another from the poster track. Dr. Giacomo Langfelder will be chairing the Award Committee this year. Good luck to all presenting students!

We would like to express our special thanks to the Advisory Board Committee and the Technical Program Committee who contributed their time to evaluate submissions. We thank the IEEE Sensors Council for sponsoring the 2017 IEEE Inertial Sensors as well as our Patrons and Exhibitors. Our special thanks to Tom Wehner (Alliance Management Group, LLC) for submission administration and Cynda Covert, Chris Dyer, and the entire staff at Conference Catalysts, LLC for administrative support.

Finally, we thank all speakers, presenters, and attendees for making the 2017 IEEE Inertial Sensors such a unique event. We hope that you find the INERTIAL'17 Symposium professionally stimulating and enjoyable, and of course, we are looking forward to seeing you back next year for the INERTIAL'18.



A. Shkel

Andrei M. Shkel
Symposium Chair
Professor, University of California, Irvine

IEEE Inertial Sensors & Systems Symposium 2017

Organizers

Symposium Chair:

Andrei Shkel, University of California, Irvine, United States

Symposium Treasurer:

Alexander Trusov, Northrop Grumman, United States

Tutorials Chair:

Mike Larsen, Northrop Grumman, United States

Advisory Board:

Earl Benser, Honeywell, United States

Anthony Kourepenis, Draper Laboratory, United States

Robert Lutwak, DARPA, United States

Doug Meyer, Northrop Grumman, United States

Technical Program Committee:

Ryuta Araki, Sumitomo Precision Products Co., LTD, Japan

Cenk Acar, ON Semiconductors, United States

Jenna Fu Chan, ECS Federal, LLC, United States

Joan Giner, Hitachi Center for Technology Innovation, Japan

Randall Jaffe, L-3 Communications, United States

David Johnson, Draper Laboratory, United States

Giacomo Langfelder, Politecnico di Milano, Italy

Michael Larsen, Northrop Grumman, United States

Olivier Le Traon, ONERA, France

Ryan Lu, SPAWAR Systems Center Pacific, United States

Kari Moran, SPAWAR Systems Center Pacific, United States

Chris Painter, Apple Inc., United States

Igor Prikhodko, Analog Devices Inc., United States

Adam R. Schofield, US Army CERDEC, United States

Doruk Senkal, InvenSense Inc., United States

Diego Serrano, Qualtre, United States

Ryan Supino, Honeywell, United States

Shuji Tanaka, Tohoku University, Japan

Alessandro Tocchio, ST Microelectronics Inc., Italy

Alexander Trusov, Northrop Grumman, United States

Rong Zhang, Tsinghua University, China

Sergey Zotov, GE, United States

Symposium Management:

Conference Catalysts, LLC, United States

Technical Reviewers:

Cenk Acar
James Adleman
Chaehyuck Ahn
Greg Alman
Leonardo Baldassarre
Michael Berarducci
Jonathan Bernstein
Matthew Bottkol
Béatrice Bourgeteau
Humberto Campanella
Dorian Challoner
Jenna Chan
Jae Yoong Cho
Kevin Christ
Eugene Cook
Paul De La Houssaye
Stefano Dellea
Bill Dillard
Eric Ducloux
Dan Endean
Kenan Ezal
Stefano Facchinetti
Paul Fortier
Federico Giacci
Joan Giner
Brian Grantham
Jeffrey Gregory
Jean Guerard
Mohammad H. Asadian
Wes Hawkinson
Ryan Hennessy
Tracy Hudson
Eugene Hwang
Randall Jaffe
Alain Jeanroy
Yaesuk Jeong
Burgess Johnson
Ryan Knight

Joshua Kvatle
Giacomo Langfelder
Olivier Le Traon
Herve Lefevre
Olivier Lefort
Grant Lodden
Ryan Lu
Daisuke Maeda
Marc McConley
Doug Meyer
Piotr Michalik
John Miranda
Sarah Nitzan
Arashk Norouz-Pour Shirazi
Kazuo Ono
Takashi Oshima
Yves Paturel
Laura Popa
Igor Prikhodko
Amir Rahafrooz
Maxime Rattier
John Reinke
David Rozelle
Adam Schofield
Doruk Senkal
George Shoemaker
Logan Sorenson
Lavern Starman
Paul Swanson
Igor Tchertkov
Alessandro Tocchio
Alexander Trusov
Arantxa Uranga
Larry Vallot
Marc Weinberg
Ahmed Zaki
Sam Zhang
Sergei Zotov

Gold Patrons



Silver Patrons



Media Patron



Exhibitors

ACUTRONIC

ASYGN



THALES

Exhibits will be in the Jasmine Room 1. Opening at 8:00 AM, Tuesday, March 28 and closing at 4:00 PM, Wednesday, March 29.

Tutorials

Monday, March 27

08:00 - 10:00

Atomic Sensors for Inertial Navigation

Room: Jasmine 2

Instructor: Dr. John Kitching, NSIT

Abstract: We will discuss the physics, design, operation and performance of sensors for inertial navigation based on atomic spectroscopy, with a focus on atom interferometers and gyroscopes based on nuclear magnetic resonance. These instruments have been under development for some time, as just now being released into the commercial marketplace, and are poised to bring new capabilities to the inertial sensors arena, such as exceptional bias and scale factor stability. We will review the atomic physics that underlies each of these instruments, present several example instrument designs, discuss the performance of each instrument in the context of the broader inertial sensors technology area, and present the prospects for commercialization, miniaturization and ultimate use in a variety of application spaces.

10:30 - 12:30

Non-GPS Aiding of INS

Room: Jasmine 2

Instructor: Dr. John Raquet, AFIT

Abstract: Most inertial navigation systems are integrated with other sensors in order to remove long-term drift. While GPS is an ideal aiding sensor for inertial systems, there is increasing interest in non-GPS aiding sources to be used in situations where GPS is not available. This tutorial will provide a survey of several different non-GNSS navigation techniques. A variety of non-GNSS alternatives will be covered at the phenomenology level, describing the overall characteristics of each of the possible phenomenologies that can be used to navigate, including the limits of performance that result from use of these phenomenologies (where they can be used, when they can be used, expected accuracies, etc.). Then, for some of the more common approaches, we will describe some of the practical implementation issues that are faced when implementing a real-world system. Examples of phenomenologies useful for navigation to be covered include vision, signals of opportunity, lidar, pseudolites/beacons, magnetic field variations, and star trackers.

Tutorials

14:00 - 16:00

The Fiber Optic Gyroscope: From Principles to Future Prospects

Room: Jasmine 2

Instructor: Professor Michel Digonnet, Stanford Photonics Research Center

Abstract: This short course will review the basic principles of the fiber optic gyroscope (FOG), starting from the fundamental Sagnac effect and the Sagnac interferometer and building up to the closed-loop gyroscope developed for commercial applications. This will include biasing techniques, sources of noise and drift, and the means that have been developed over the years to overcome them. It will then discuss the more recent research developments in laser-driven FOGs, which now exhibit for the first time the low noise and low drift required to navigate an aircraft. The course will conclude with a discussion of future prospects for further improving the performance and reducing the cost of the FOG, including the use of optical resonators and a discussion of the impact of slow light on sensitivity.

Invited Speakers

Tuesday, March 28
09:00 - 09:30
A1L-A: Invited Talk
Room: Jasmine 2

Precise Robust Inertial Guidance for Munitions (PRIGM)

Robert Lutwak, Defense Advanced Research Projects Agency, United States

Abstract:

The DARPA Precise Robust Inertial Guidance for Munitions (PRIGM) program is developing next-generation inertial sensors with sufficiently low size, weight, and power to enable precision-guided munitions in GPS-degraded or –denied environments. The PRIGM program comprises two main thrusts: a near-term transition effort to develop a MEMS-based Navigation-Grade Inertial Measurement Unit (PRIGM:NGIMU) and fundamental research on Advanced Inertial Micro-Sensors (PRIGM:AIMS). PRIGM:NGIMU performers are developing an interface-compatible drop-in replacement for currently deployed tactical-grade MEMS IMUs, while PRIGM:AIMS performers are investigating novel architectures, materials, and operating modalities for future inertial sensors that are capable of providing extraordinary navigation performance under extreme operating conditions.

This presentation will outline the PRIGM:NGIMU and PRIGM:AIMS goals as well as provide an overview of the technical approaches under investigation in these programs.

Wednesday, March 29
09:00 - 09:30
B1L-A: Invited Talk
Room: Jasmine 2

Where are We Heading: A Brief History and Future of Navigation

Douglas Meyer, Northrop Grumman, United States

Abstract:

For at least the past 200,000 years modern humans have been exploring the world around them. These explorations were driven by the need for food, water, better shelter, and in some cases possibly just for curiosity... *'what is over that next mountain ridge or on the other side of the valley...'* The earliest explorations were most likely tied to changing of the seasons, animal migration paths and were done without out the aid of navigation tools. As the sphere of human exploration increased beyond the known realm, the need for navigation tools became paramount to provide a means for charting where they went, allow a means of returning home, and provide a method of return to the newly discovered lands. Over the course of time more sophisticated navigation tools, such as the sextant and naval chronometer, were developed to allow one's present position to be determined relative to a starting location or a destination. A significant turning point occurred in the 17th Century with Sir Isaac Newton's development of the laws of motion. While not obvious at the time, these are the foundation of modern inertial navigation. This paper will discuss some of the methods; evolution of navigation tools used by early navigators and will conclude with the current state of the art and what future technologies and sensing modalities hold for the art of navigation.

Invited Speakers

Thursday, March 30
09:00 - 09:30
C1L-A: Invited Talk
Room: Jasmine 2

3D RF Localization within an LTE Network: Challenges and Opportunities

David A. Howe, Group Leader, Time and Frequency Division, NIST, United States

Abstract:

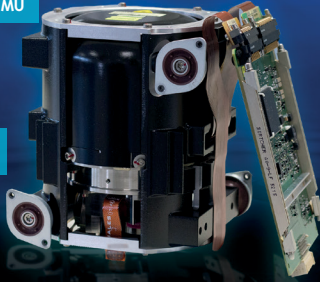
NIST's Communications Technology Laboratory and its Public Safety Communications Research (PSCR) Division is leading a first-of-its-kind nationwide cell-phone network that will enable improved interoperable broadband communications and new functionalities. As this network becomes a reality, public safety stakeholders have set unprecedented metrics for Location Based Services (LBS) as one of its primary goals. This presentation will provide an overview of these criteria for 3D indoor localization (vertical and horizontal local positioning) necessary for servicing large numbers of first responders in emergencies that have especially challenging, unique operations in a dense, urban environment. Cell phone modulation protocols and 4G LTE standards use RF spectra that does not include precise 3D positioning at this time but is primarily focused on spectrum-shared, robust communications. I will discuss PSCR research that directs 5G LTE formats and RF modulation protocols that potentially achieves 0.1m 3D uncertainty in real-time position and velocity dynamics for hours-long durations. Lastly, I will present the significant benefits of small, low-phase noise atomic oscillators that can be introduced into future cell phone networks to obtain high precision 3D RF localization and improved data capacity.

TopAxyz IMU

High-performance Inertial Measurement Unit

Wherever safety and security matter, we deliver

RING LASER GYRO TECHNOLOGY IMU



ADAPTED TO ALL APPLICATIONS

NAVIGATION GRADE IMU



OUTSTANDING STABILITY

Everyday millions of critical decisions are made in safety and security, Thales is at the heart of these. Thales has more than 62,000 talented people across 56 countries. Together, we innovate with our customers to build smarter solutions. Our intelligent technologies are dedicated to protecting people, property and information worldwide in Space, Aerospace, Security, Ground Transportation, Defence and Cyberspace markets. Every moment of every day, wherever safety and security are critical, Thales delivers.

2 CHANNELS FOR NAVIGATION AND STABILIZATION

Search: Thalesgroup



THALES
Together • Safer • Everywhere

It Knows Where You're Headed



Systron Donner's SDN500 INS/GPS delivers a highly accurate, tightly coupled navigation, stabilization and geolocation solution featuring < 1.0°/ hr. in-run gyro bias. The SDN500 is environmentally robust and maintains tactical-grade performance during GPS outages.



SYSTRON DONNER
INERTIAL

The Inertial MEMS Performance Leader

for specifications and a quote see us at ISISS or visit www.systron.com

Monday, March 27

07:00 - 16:00

Tutorial Registration

Room: Jasmine Foyer

08:00 - 10:00

Tutorial 1: Atomic Sensors for Inertial Navigation

Instructor: Dr. John Kitching, NIST

Room: Jasmine 2

10:00 - 10:30

Coffee Break

Room: Jasmine Foyer

10:30 - 12:30

Tutorial 2: Non-GPS Aiding of INS

Instructor: Dr. John Raquet, AFIT

Room: Jasmine 2

12:30 - 14:00

Lunch

Room: Jasmine 3

14:00 – 16:00

Tutorial 3: The Fiber Optic Gyroscope: From Principles to Future Prospects

Instructor: Prof. Michel Digonnet, Stanford Photonics Research Center

Room: Jasmine 2

18:00 - 20:00

Welcome Reception

Room: Jasmine 3

All attendees are invited to the Welcome Reception for drinks and light hors d'oeuvres.

Tuesday, March 28

08:00 - 18:00

Registration

Room: Jasmine Foyer

08:45 - 09:00

Opening Remarks

Andrei Shkel, 2017 General Chair

Room: Jasmine 2

09:00 - 09:30

A1L-A: Invited Talk: Robert Lutwak, DARPA

Room: Jasmine 2

Session Chair: Andrei Shkel, University of California, Irvine, USA

Precise Robust Inertial Guidance for Munitions (PRIGM)

Robert Lutwak

DARPA, United States

09:30 - 10:30

A2L-A: Special Session: Advances in Precision Inertial Sensors - I

Room: Jasmine 2

Session Chair: Michael Larsen, Northrop Grumman, USA

Co-Chair: Kari Moran, SPAWAR SCP, USA

Effect of Direct PRBS Modulation on Laser Driven Fiber Optic Gyroscope

Sarat Gundavarapu, Tin Komljenovic, Minh Tran, Michael Belt, John Bowers, Daniel Blumenthal

University of California, Santa Barbara, United States

Trade-Offs in Size and Performance for a Point Source Interferometer Gyroscope

Gregory Hoth, Bruno Pelle, John Kitching, Elizabeth Donley

National Institute of Standards and Technology, United States

On a Feasibility of a Resonant Stimulated RAMAN Scattering Gyroscope

Wei Liang, Vladimir Ilchenko, Danny Eliyahu, Anatoliy Savchenkov, Andrey Matsko, Lute Maleki

OEwaves Inc., United States

10:30 - 11:00

Exhibitors' Highlights

Room: Jasmine 2

11:00 - 11:30

Coffee Break & Exhibits

Room: Jasmine 1

Tuesday, March 28

11:30 - 12:30

A3L-A: Sensors Phenomena and Modeling - I

Room: Jasmine 2

Session Chair: Jenna Chan, ECS Federal, USA

Session Co-Chair: Diego Serrano, Panasonic, USA

FM/Rate Integrating MEMS Gyroscope Using Independently Controlled CW/CCW Mode Oscillations on a Single Resonator

Takashihiro Tsukamoto, Shuji Tanaka

Tohoku University, Japan

Half-a-Month 0.2 Degree-Per-Hour Stable Mode-Matched MEMS Gyroscope

Igor Prikhodko, Jeffrey Gregory, William Clark, Michael Judy

Analog Devices, Inc., United States

Controlled Capacitive Gaps for Electrostatic Actuation and Tuning of 3D Fused Silica Micro-Wineglass Resonator Gyroscope

Mohammad Asadian, Yusheng Wang, Sina Askari, Andrei Shkel

University of California, Irvine, United States

12:30 - 14:00

Lunch

Room: Jasmine 3

14:00 - 15:00

A4L-A: Inertial Microsystems

Room: Jasmine 2

Session Chair: Shuji Tanaka, Tohoku University, Japan

Co-Chair: Alexander Trusov, Northrop Grumman, USA

Tactical-Grade Dual-Chip Inertial Sensor Assembly

Daniel Edean, Xiao Zhu Fan, Max Glenn, Robert Horning, John Reinke, Barry Roberts

Honeywell International, United States

Electrostatic Compensation of Structural Imperfections in Dynamically Amplified Dual-Mass Gyroscope

Alexandra Efimovskaya, Yu-Wei Lin, Danmeng Wang, Andrei Shkel

University of California Irvine, United States

On-Chip Characterization of Scale Factor of a MEMS Gyroscope via a Micro Calibration Platform

Ethem Erkan Aktakka, Jong-Kwan Woo, Khalil Najafi

University of Michigan, Ann Arbor, United States

15:00 - 15:30

Coffee Break & Exhibits

Room: Jasmine 1

Tuesday, March 28

15:30 - 17:00

A5P-B: Sensors Phenomena and Modeling

Room: Jasmine Foyer

Session Chair: Ryan Lu, SPAWAR SPC, USA

Co-Chair: Giacomo Langfelder, Politecnico di Milano, Italy

****Session will be "Lightning Round" Presentations (2 min X 13 posters) in Jasmine 2**

A5P-1: Miniature Accelerometer for High Dynamic Precision Guided Systems

Jose Beitia, Pierre Loisel, Chris Fell

InnaLabs Ltd, Ireland

A5P-2: Drift Modeling and Compensation for MEMS-Based Gyroscope Using a Wiener-Type Recurrent Neural Network

Yu-Liang Hsu¹, Po-Huan Chou², Yu-Chen Kou¹

¹*Feng Chia University, Taiwan;* ²*Industrial Technology Research Institute, Taiwan*

A5P-3: Incorporating Geometric Nonlinearities in Reduced Order Models for MEMS Gyroscopes

Martin Putnik¹, Mateusz Sniegucki¹, Stefano Cardanobile¹, Steven Kehrberg¹, Matthias Kuehnel¹, Peter Degenfeld-Schonburg¹, Cristian Nagel¹, Jan Mehner²

¹*Robert Bosch GmbH, Germany;* ²*Technische Universitaet Chemnitz, Germany*

A5P-4: The First Integrated Optical Driver Chip for Fiber Optic Gyroscopes

Minh Tran, Jared Hulme, Tin Komljenovic, Mj Kennedy, Daniel Blumenthal, John Bowers

University of California Santa Barbara, United States

A5P-5: A Catch-and-Release Drive MEMS Gyroscope with Enhanced Sensitivity by Mode-Matching

Ryunosuke Gando, Kubo Haruka, Kei Masunishi, Tamio Ikehashi, Yasushi Tomizawa, Etsuji Ogawa, Shunta Maeda, Yohei Hatakeyama, Tetsuro Itakura

Toshiba Corporation, Japan

A5P-6: A Novel Dual- Threshold MEMS Accelerations Latching Switch

Weirong Nie, Zhijian Zhou, Zhanwen Xi, Chao Bu, Qiao Luo

Nanjing University of Science and Technology, China

A5P-7: Nonlinear Vibration and its Influence on the Vibratory Cylinder Gyroscope

Yongmeng Zhang, Xuezhong Wu, Yulie Wu, Xiang Xi, Dingbang Xiao

National University of Defense Technology, China

A5P-8: Noise Contributions in a Closed-Loop MEMS Gyroscope for Automotive Applications

Tobias Hiller¹, Burkhard Kuhlmann¹, Alexander Buhmann¹, Hubert Roth²

¹*Robert Bosch GmbH, Germany;* ²*University of Siegen, Germany*

A5P-9: Optical Self-Excitation and Detection for Inertial MEMS Sensors

Ansas Kasten, William Challener, Mengli Wang, Yizhen Lin, Loucas Tsakalacos, Todd Miller, Sergey Zotov

GE Global Research, United States

A5P-10: Parametric Drive of a Micro Rate Integrating Gyroscope Using Discrete Electrodes

Mingliang Song, Bin Zhou, Tian Zhang, Bo Hou, Rong Zhang

Tsinghua University, China

Tuesday, March 28

A5P-11: Numerical Study of Impact of Surface Roughness on THERMOELASTIC Loss of Micro-Resonators

Behrouz Shiari, Tal Nagourney, Ali Darvishian, Jaeyoung Cho, Khalil Najafi
University of Michigan, United States

A5P-12: Frequency Split Reduction by Directional Lapping of Fused Quartz Micro Wineglass Resonators

Yusheng Wang, Mohammad Asadian, Andrei Shkel
University of California, Irvine, United States

A5P-13: A Comparative Study of Conventional Single-Mass and Amplitude Amplified Dual-Mass MEMS Vibratory Gyroscopes

Danmeng Wang, Mohammad Asadian, Alexandra Efimovskaya, Andrei Shkel
University of California, Irvine, United States

17:00 - 18:00

Open Posters

Room: Jasmine Foyer

Session Chair: Ryan Lu, SPAWAR SPC, USA

Co-Chair: Giacomo Langfelder, Politecnico di Milano, Italy

1: Body Frame Calibration without Known Stimuli for 3-AXIS Accelerometers Used in Directional Drilling

M. V. Gheorghe
Ideal Aerosmith. Inc., United States

2: High Flux Atom Beam Gyroscopes

Li Chao, Chandra Raman
Georgia Institute of Technology, United States

3: 3D High Aspect-Ratio Glass Axisymmetric Shell Resonators

Bin Luo¹, Chenyue Lu², Ming-ai Zhang¹, Jintang Zhang¹, Ching-Ping Wong³
¹*Southeast University, China;* ²*Nanyang Technological University, Singapore;* ³*The Chinese University of Hong Kong, Hong Kong*

4: Ultra-Stable μ Torr-Level Vacuum Packaging for High Performance MEMS Inertial Sensors

Mohammad H. Asadian, Sina Askari, Andrei M. Shkel
University of California, Irvine, United States

5: 3D MEMS for Inertial Navigation

Alexandra Efimovskaya, Yu-Wei Lin, Mohammad H. Asadian, Yusheng Wang, Danmeng Wang, Bahram Seifi, Radwan Mohammednoor
University of California, Irvine, United States

All attendees are invited to the Open Poster Session for drinks and light hors d'oeuvres

Wednesday, March 29

07:00 - 08:30

Women in Inertial Sensors Breakfast

Room: Ginger Room

08:00 - 17:00

Registration

Room: Jasmine Foyer

08:45 - 09:00

Welcome Comments, Day 2

Andrei Shkel, 2017 General Chair

Room: Jasmine 2

09:00 - 09:30

B1L-A: Invited Speaker: Doug Meyer, Northrop Grumman

Room: Jasmine 2

Session Chair: Andrei Shkel, University of California, Irvine, USA

Where are We Heading: A Brief History and Future of Navigation

Doug Meyer

Northrop Grumman, United States

09:30 - 10:30

B2L-A: Emerging Applications

Room: Jasmine 2

Session Chair: Chris Painter, Apple, USA

Co-Chair: Adam Schofield, CERDEC Army, USA

A Comprehensive Study of NEMS-Based Piezoresistive Gyroscopes for Vestibular Implant Systems

Stefano Dellea⁴, Antonio Longoni⁴, Giulia Mantini³, Raimund Naschberger³, Antonios Nikas², Olivier Leman², Johann Hauer², Patrice Rey¹, Giacomo Langfelder⁴

¹CEA Leti, France; ²Fraunhofer Institut, Germany; ³MEDEL, Austria; ⁴Politecnico di Milano, Italy

Accurate Indoor Localization and Tracking Using Mobile Phone Inertial Sensor, WiFi and iBeacon

Han Zou², Zhenghua Chen², Hao Jiang¹, Lihua Xie², Costas Spanos¹

¹Fuzhou University, China; ²Nanyang Technological University, Singapore

Quantifying Important Differences in Athlete Movement During Collision-Based Team Sports: Accelerometers Outperform Global Positioning Systems

Samuel Howe¹, William Hopkins¹, Andrew Stewart¹, Bryce Cavanagh², Robert Aughey¹

¹Institute of Sport, Exercise and Active Living, Victoria University, Australia; ²Melbourne Rebels Rugby Union Team, Australia

10:30 - 11:00

Coffee Break & Exhibits

Room: Jasmine 1

Wednesday, March 29

11:00 - 12:30

B3P-B: Emerging Systems & Late News

Room: Jasmine Foyer

Session Chair: Igor Prikhodko, Analog Devices, USA

Co-Chair: Rong Zhang, Tsinghua University, China

****Session will be "Lightning Round" Presentations (2 min X 18 posters) in Jasmine 2**

B3P-1: Inertial Sensor for an Autonomous Data Acquisition of a Novel Automotive Acoustic Measurement System

Johannes Masino, Matthias Luh, Michael Frey, Frank Gauterin
Karlsruhe Institute of Technology, Germany

B3P-2: Micro Shell Resonator with T-Shape Masses Fabricated by Improved Process Using Whirling Platform and Femtosecond Laser Ablation

Kun Lu, Wei Li, Dingbang Xiao, Zhanqiang Hou, Yan Shi, Xuezhong Wu, Yulie Wu
National University of Defense Technology, China

B3P-3: A New Approach to Vacuum Packaging of Getter-Less and Gettered Ceramic Chip Carriers

Ryan Knight, Ronald Polcawich
US Army Research Laboratory, United States

B3P-4: Inertial Navigation System with Acoustic Obstacle Detection for Pedestrian Applications

Joshua Jaekel, Mohammed Jalal Ahamed
University of Windsor, Canada

B3P-5: Fabrication of Wide and Deep Cavities for Silicon MEMS Devices Without Wafer Bonding

Yunhan Chen², Ian Flader², Dongsuk Shin², Chae Ahn¹, Thomas Kenny²
¹*InvenSense Inc., United States*; ²*Stanford University, United States*

B3P-6: Iteratively reweighted Kalman Filter for NLOS Mitigation and Sensor Data Fusion

Joan Bordoy, Rui Zhang, Fabian Höflinger, Christian Schindelbauer, Leonhard Reindl
University of Freiburg, Germany

B3P-7: What Is the Best Displacement Transducer for a Seismic Sensor?

Peter Novotny¹, Benjamin Aimard², Gael Balik², Laurent Brunetti², Bernard Caron³, Andrea Gaddi¹
¹*CERN, Switzerland*; ²*LAPP-IN2P3-CNRS Université Savoie Mont-Blanc, France*; ³*Université Savoie Mont-Blanc, France*

B3P-8: Development of a Complete Model to Evaluate the Zero Rate Level Drift Over Temperature in MEMS Coriolis Vibrating Gyroscopes

Stefano Facchinetti, Luca Guerinoni, Luca Giuseppe Falorni, Andrea Donadel, Carlo Valzasina
STMicroelectronics, Italy

B3P-9: A Universal Electronics Approach for Rate Integrating Gyroscopes

Anthony Challoner, Jeremy Popp, Peter Bond
InertialWave Inc, United States

B3P-10: Study of Environmental Survivability and Stability of Folded MEMS IMU

Yu-Wei Lin, Alexandra Efimovskaya, Andrei Shkel
University of California Irvine, United States

Wednesday, March 29

B3P-11: 3-Axis MEMS Gyroscope Calibration Stage: Magnetic Actuation Enabled Out of Plane Dither for Piezoelectric in-Plane Calibration

Visarute Pinrod, Sachin Nadig, Benyamin Davaji, Amit Lal
Cornell University, United States

B3P-12: Study on the Thermoforming Process of Hemispherical Resonator Gyro (HRGs)

Tian Zhang, Zhihui Lin, Mingliang Song, Bin Zhou, Rong Zhang
Tsinghua University, Beijing

B3P-13: A Programmable Emulator of MEMS Inertial Sensors

Leonardo Gaffuri Pagani, Giacomo Langfelder, Paolo Minotti, Nicola Aresi,
Politecnico di Milano, Italy

B3P-14: A Static Approach for the Frequency Shift of Parasitic Excitations in MEMS Gyroscopes with Geometric Nonlinear Drive Mode

Martin Putnik¹, Stefano Cardanobile¹, Steven Kehrberg¹, Cristian Nagel¹, Peter Degenfeld-Schonburg¹, Matthias Kuehnel¹, Jan Mehner²
¹Robert Bosch GmbH, Germany; ²Technische Universitaet Chemnitz, Germany

B3P-15: A 160 μ A, 8 mdps/ $\sqrt{\text{Hz}}$ Frequency-Modulated MEMS Gyroscope

Paolo Minotti¹, Giorgio Mussi¹, Stefano Dellea¹, Claudia Comi¹, Valentina Zega¹, Stefano Facchinetti², Alessandro Tocchio², Andrea Bonfanti¹, Andrea Leonardo Lacaita¹, Giacomo Langfelder¹
¹Politecnico di Milano, Italy; ²STMicroelectronics, Italy

B3P-16: Thermally Induced Bias Errors for a Fiber Coil with Practical Quadruple Winding

Berk Osunluk, Serdar Ogut, Ekmel Ozbay
Bilkent University, Turkey

B3P-17: A Status on Components Development for Folded Micro NMR Gyro

Radwan M. Noor, Venu Gundeti, Andrei M. Shkel
University of California, Irvine, United States

B3P-18: Atom Interferometer Gyroscope Based on Continious Cold Atomic Beam

Tae Hyun Kim, Sangkyung Lee, Kyu Min Shim, Sin Hyuk Yim
Agency for Defense Development, Korea

12:30 - 14:30

Lunch

Room: Jasmine 3

14:30 - 15:10

B4L-A: Sensors Phenomena and Modeling - II

Room: Jasmine 2

Session Chair: Doug Meyer, Northrop Grumman, USA

Co-Chair: Alessandro Tocchio, ST Microelectronics, Italy

Dual-Resonator MEMS LORENTZ Force Magnetometer Based on Differential Frequency Modulation

Soner Sonmezoglu², Ian B. Flader¹, Yunhan Chen¹, Dongsuk D. Shin¹, Thomas W. Kenny¹, David A. Horsley²
¹Stanford University, United States; ²University of California, Davis, United States

Wednesday, March 29

Electrostatic Tuning of Temperature Coefficient of Frequency of Anisotropic Disk-Shaped Resonators

Dongsuk Shin³, Chae Ahn², Yunhan Chen³, Vu Hong¹, Eldwin Ng², Yushi Yang², Thomas Kenny³

¹Apple Incorporated, United States; ²InvenSense Incorporated, United States; ³Stanford University, United States

15:10 - 16:00

Coffee Break & Exhibits

Room: Jasmine 2

16:00 - 17:00

B5L-A: Special Session: Advances in Precision Inertial Sensors - II

Room: Jasmine 2

Session Chair: Earl Benser, Honeywell, USA

Co-Chair: Ryuta Araki, Sumitomo, Japan

Development of Compact Resonator Fiber Optic Gyroscopes

Glen Sanders, Lee Strandjord, Jianfeng Wu, Marc Smiciklas, Mary Salit, Tiequn Qiu, Wes Willaims, Chellappan Narayanan

Honeywell International, United States

Coil and Gyro-Level Performance of Sagnac Coils

Mansoor Alam, Jan Khan, Lilja Gudmundsdottir, Amanda Robinson

Nufern Inc., United States

A Test Bed for High-Order Inertial Phase Shifts in Time-Domain Atom Interferometers

Grant Biedermann

Sandia National Laboratories, Albuquerque, New Mexico

18:00 - 20:00

Banquet Dinner

Room: Jasmine 3

Thursday, March 30

08:00 - 12:00

Registration

Room: Jasmine Foyer

08:45 - 09:00

Welcome Comments, Day 3

Andrei Shkel, 2017 General Chair

Room: Jasmine 2

09:00 - 09:30

C1L-A: Invited Talk: David A. Howe, NIST

Room: Jasmine 2

Session Chair: Andrei Shkel, University of California, Irvine, United States

3D RF Localization within an LTE Network: Challenges and Opportunities

David A. Howe

National Institute of Standards and Technology, United States

09:30 - 10:30

Late News 1

Room: Jasmine 2

Effect of Drive-Axis Displacement on MEMS Birdbath Resonator Gyroscope Performance

Christopher Boyd, Jong-Kwan Woo, Jaeyoong Cho, Tal Nagourney, Ali Darvishian, Behrouz Shiari, Khalil Najafi

University of Michigan, United States

Theoretical Foundations for Scale Factor Improvement of the Disk Resonant Gyroscope

Andrew Sabater, Paul Swanson, Kari Moran

SPAWAR Systems Center Pacific, United States

Localization System Based on Handheld Inertial Sensors and UWB

Fabian Höflinger, Rui Zhang, Patrick Fehrenbach, Joan Bordoy, Leonhard Reindl, Christian Schindelbauer

Albert-Ludwigs-Universität Freiburg, Germany

Compact Roll-Pitch-Yaw Gyroscope Implemented in Wafer-Level Epitaxial Silicon Encapsulation Process

Alexandra Efimovskaya, Yushi Yang, Eldwin Ng, Yunhan Chen, Ian B. Flader, Thomas W. Kenny, Andrei M. Shkel

University of California, Irvine, United States

10:30 - 11:00

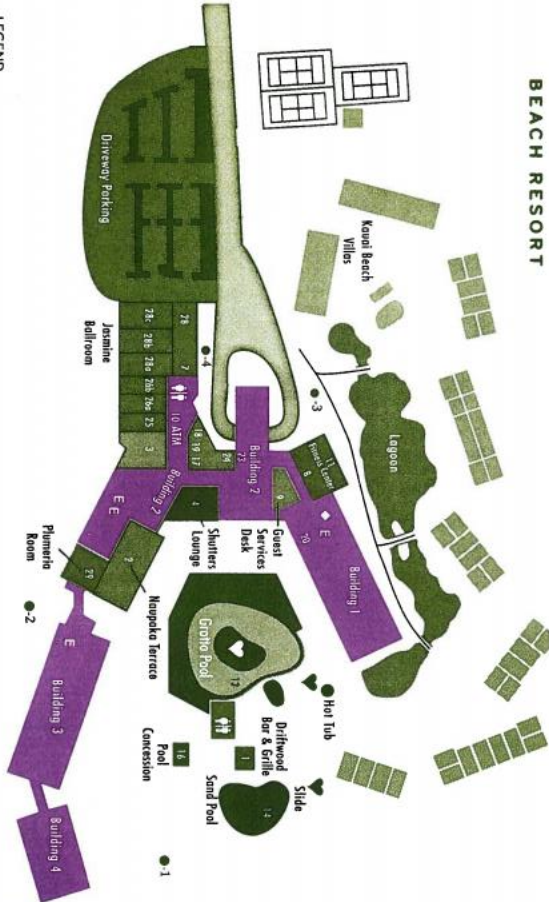
Closing Remarks

Andrei Shkel, 2017 General Chair

Room: Jasmine 2

Hotel Floor Plan

KAUAI BEACH RESORT



Room Numbers: Building 1: 1105 - 1135, 1201 - 1235, 1301 - 1335
 Building 2: 2301 - 2349, 2401 - 2449, 2501 - 2549
 Building 3: 3101 - 3132, 3201 - 3232, 3301 - 3332
 Building 4: 4104 - 4114, 4201 - 4214

Beach Path —
(3.5 miles)
Pacific Ocean

DIRECTORY

RESTAURANT & LOUNGE	14 Sand Barroom
1 D'Arbonne Bar	Pool Grill (Pool Deck Side)
2 E. Grill	16 Pool Concession
3 Response Terrace	19 Hawaiian Grill/Steak & Seafood
4 Island Market Place & Gifts	200
5 Sports Lounge	
RETAIL OUTLET	SERVICE & BUSINESS CENTER
1 Island Market Place & Gifts	110 Afta Upper Lobby
	117 Security Office
	118 Business Services Center
	20 Executive Offices
	23 Banquet & Wedding Reception
	24 Free Press Reception
RESORT ENTERTAINMENT	
1 Sports Lounge	
2 Sports Lounge	
3 Sports Lounge	
4 Sports Lounge	
5 Sports Lounge	
6 Sports Lounge	
7 Sports Lounge	
8 Sports Lounge	
9 Sports Lounge	
10 Sports Lounge	
11 Sports Lounge	
12 Sports Lounge	
13 Sports Lounge	
14 Sports Lounge	
15 Sports Lounge	
16 Sports Lounge	
17 Sports Lounge	
18 Sports Lounge	
19 Sports Lounge	
20 Sports Lounge	
21 Sports Lounge	
22 Sports Lounge	
23 Sports Lounge	
24 Sports Lounge	
25 Sports Lounge	
26 Sports Lounge	
27 Sports Lounge	
28 Sports Lounge	
29 Sports Lounge	
30 Sports Lounge	
31 Sports Lounge	
32 Sports Lounge	
33 Sports Lounge	
34 Sports Lounge	
35 Sports Lounge	
36 Sports Lounge	
37 Sports Lounge	
38 Sports Lounge	
39 Sports Lounge	
40 Sports Lounge	
41 Sports Lounge	
42 Sports Lounge	
43 Sports Lounge	
44 Sports Lounge	
45 Sports Lounge	
46 Sports Lounge	
47 Sports Lounge	
48 Sports Lounge	
49 Sports Lounge	
50 Sports Lounge	
51 Sports Lounge	
52 Sports Lounge	
53 Sports Lounge	
54 Sports Lounge	
55 Sports Lounge	
56 Sports Lounge	
57 Sports Lounge	
58 Sports Lounge	
59 Sports Lounge	
60 Sports Lounge	
61 Sports Lounge	
62 Sports Lounge	
63 Sports Lounge	
64 Sports Lounge	
65 Sports Lounge	
66 Sports Lounge	
67 Sports Lounge	
68 Sports Lounge	
69 Sports Lounge	
70 Sports Lounge	
71 Sports Lounge	
72 Sports Lounge	
73 Sports Lounge	
74 Sports Lounge	
75 Sports Lounge	
76 Sports Lounge	
77 Sports Lounge	
78 Sports Lounge	
79 Sports Lounge	
80 Sports Lounge	
81 Sports Lounge	
82 Sports Lounge	
83 Sports Lounge	
84 Sports Lounge	
85 Sports Lounge	
86 Sports Lounge	
87 Sports Lounge	
88 Sports Lounge	
89 Sports Lounge	
90 Sports Lounge	
91 Sports Lounge	
92 Sports Lounge	
93 Sports Lounge	
94 Sports Lounge	
95 Sports Lounge	
96 Sports Lounge	
97 Sports Lounge	
98 Sports Lounge	
99 Sports Lounge	
100 Sports Lounge	