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22-25 March 2021**



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Monday, March 22

8:00 PM – 10:30 PM

A1L-A: MEMS Gyroscopes I USA

Session Chair(s): Brian Grantham (DEVCOM AvMC)

8:00 PM

Invited Talk: Platform Technologies for High-Performance Inertial Sensors N/A

Jeff DeNatale, Teledyne Technologies, USA

8:25 PM

Monocrystalline 4H Silicon Carbide-on-Insulator Substrates for Nav-Grade Planar BAW Gyroscopes 1

Benoit Hamelin, Jeremy Yang, Zhenming Liu, Farrokh Ayazi

Georgia Institute of Technology, United States

8:50 PM

Vibration Immune, Long-Term Stable and Low Noise Synchronized Mass MEMS Gyroscopes 5

Igor Prikhodko^{2}, John Geen^{1}, Carey Merritt^{2}, Sam Zhang^{2}

{1}Analog Devices, United States; {2}Analog Devices, Inc, United States

9:15 PM

Effect of EAM on Quality Factor and Noise in MEMS Vibratory Gyroscopes 9

Danmeng Wang, Andrei Shkel

University of California, Irvine, United States

Monday, March 22 / Tuesday, March 23

11:00 PM – 1:10 AM

B1L-A: Rate Integrating Gyroscopes - USA / China

Session Chair(s): Takashiro Tsukamoto (Tohoku University)

11:00 PM

A High-Performance Rate-Integrating Hemispherical Resonant Gyros with 0.00753°/h Bias Instability 13

Yongmeng Zhang^{1}, Sheng Yu^{2}, Kechen Guo^{1}, Jiangkun Sun^{1}, Xuezhong Wu^{1}, Dingbang Xiao^{1}

{1}National University of Defense Technology, China; {2}National University of Defense Technology, Hunan MEMS Research Center, China

11:25 PM

Identification of Gain Mismatches in Control Electronics of Rate Integrating CVGs 17

Daryosh Vatanparvar, Andrei Shkel

University of California, Irvine, United States

11:50 PM

Invited Talk: R&D FOR COMMERCIALIZATION OF MEMS RATE INTEGRATING GYROSCOPE: CHALLENGES AND PRACTICAL APPROACHS N/A

Ryunosuke Gando, Toshiba, Japan

Tuesday, March 23

1:30 AM – 4:05 AM

B2L-A: MEMS Gyroscopes II Asia

Session Chair(s): Ryuta Araki (SUMITOMO PRECISION PRODUCTS CO)

1:30 AM

Invited Talk: High Performance Rate-Integrated MEMS Gyroscope Around the Corner N/A

Xiao Dingbang, National University of Defense Technology, China

2:00 AM

Theoretical Consideration of Mismatch Compensation for MEMS Resonator Having Unaligned Principle Axes 21

Takashiro Tsukamoto, Shuji Tanaka

Tohoku University, Japan

2:25 AM

The Parametric Amplification in MEMS Gyroscopes Based on Triple Resonant Frequency Signal 25

Kai Wu, Kuo Lu, Qingsong Li, Hao Zhang, Ming Zhuo, Xuezhong Wu, Dingbang Xiao

National University of Defense Technology, China

2:50 AM

Mode-Matched Multi-Ring Disk Resonator Using Single Crystal (100) Silicon 29

Jianlin Chen, Takashiro Tsukamoto, Shuji Tanaka

Tohoku University, Japan

8:00 AM – 10:35 AM

B3L-A: MEMS Gyroscopes III Europe

Session Chair(s): Raphaël Levy (Onera)

8:00 AM

Invited Talk: High performance MEMS accelerometer and gyro with a unique SMD and digital interface N/A

Antoine Filipe, Tronic's Microsystems SA, France

8:30 AM

Exploiting Nonlinearities for Frequency-Matched MEMS Gyroscopes Tuning 33

Jacopo Marconi^{1}, Giacomo Bonaccorsi^{1}, Daniele Giannini^{1}, Luca Falorni^{2}, Francesco Braghin^{1}

^{1}Politecnico di Milano, Italy; ^{2}STMicroelectronics, Italy

8:55 AM

Digital Control of MEMS Gyroscopes: A Robust Approach 37

Fabrcio Saggin^{2}, Cécile Pernin^{2}, Anton Korniienko^{2}, Gérard Scorletti^{2}, Christophe Le Blanc^{1}

^{1}Asygn, France; ^{2}Ecole Centrale de Lyon, Laboratoire Ampère, France

9:20 AM

600 μ dps/ \sqrt Hz, 1.2 mm² MEMS Pitch Gyroscope 41

Marco Gadola^{1}, Marc Sansa Perna^{2}, Monica Allieri^{1}, Philippe Robert^{2}, Thierry Verdot^{2}, Audrey Berthelot^{2},

Giacomo Langfelder^{1}

^{1}Politecnico di Milano, Italy; ^{2}Université Grenoble Alpes, CEA-Leti, France

11:00 AM – 1:35 PM

B4L-A: MEMS Inertial Europe

Session Chair(s): Joan Giner (Bosch)

11:00 AM

Invited Talk: AI + MEMS N/A

Markus Ulm, Bosch Sensortec

11:30 AM

Experimental Investigation of Parametric Evasion Properties of Resonant Sensors Using Electrostatic Gap-Closing Actuation 45

Jerome Juillard^{2}, Antonio Somma^{2}, Alexis Brenes^{1}

{1}LISITE, ISEP, France; {2}UMR8507, CNRS, CentraleSupélec, Université Paris-Saclay, Sorbonne Université, France

11:55 AM

Analysis and Compensation of Cross-Axis Sensitivity in Low-Cost MEMS Inertial Sensors 49

Tobias Hiller^{1}, Lukas Blocher^{1}, Milos Vujadinović^{1}, Zsigmond Péntek^{2}, Alexander Buhmann^{1}, Hubert Roth^{3}

{1}Robert Bosch GmbH, Germany; {2}Robert Bosch Kft, Hungary; {3}University of Siegen, Germany

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Finding the Critical Impact Energy for Micro Debris Generation in MEMS Inertial Sensors 53

Leonardo Gaffuri Pagani^{1}, Luca Guerinoni^{2}, Luca Falorni^{2}, Patrick Fedeli^{2}, Giacomo Langfelder^{1}

{1}Politecnico di Milano, Italy; {2}STMicroelectronics, Italy

3:00 PM – 5:55 PM

B5L-A: Accelerometers - Europe / USA

Session Chair(s): John Reinke (Honeywell International)

3:00 PM

Resonant Accelerometer with Compliant Parallel Motion Linkage Force Amplification Mechanism 57

Omer HaLevy, Stella Lulinsky, Slava Krylov

Tel Aviv University, Israel

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SWaP Reduction for High Dynamic Navigation Grade Accelerometer Based on Quartz VBA Technology 61

Rachid Taïbi, Olivier Jolly, Thomas Kerrien, Pascal Labarthe, Karl Aubry, Gauthier Le Bihan, Stéphanie Michel

iXblue, France

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A 10 Nano-G/Rt-Hz Resonant MEMS Accelerometer Employing Anti-Aliasing Control 65

Millind Pandit^{1}, Guillermo Sobreviela^{1}, Callisto Pili^{1}, Philipp Steinmann^{1}, Douglas Young^{1}, Chun Zhao^{2}, Colin

Baker^{1}, Ashwin Seshia^{2}

{1}Silicon Microgravity Ltd., United Kingdom; {2}University of Cambridge, United Kingdom

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Megahertz Bandwidth Bulk Micromachined Optomechanical Accelerometer with Fiber Optical Interconnects 69

Daniel Dominguez, Lisa Hackett, Michael Miller, Jennifer Restrepo, Katya Casper, Matt Eichenfield

Sandia National Laboratories, United States

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Method for the Synchronization of Data Recorders by Coupling Accelerometer Data 73

José Ricardo Scarpari^{3}, Camila Deolindo^{1}, Maria Adelia Aratansa^{1}, Mauricio Ribeiro^{1}, Anderson de Souza^{2},

Elisa Kozasa^{1}, Daisy Hirata^{3}, José Elias Matieli^{3}, Roberto Gil Annes Da Silva^{3}, Carlos Henrique Forster^{3}

{1}Hospital Israelita Albert Einstein, Brazil; {2}Instituto de Pesquisas e Ensaio em Voos, Brazil; {3}Technological Institute

of Aeronautics, Brazil

7:00 PM – 10:05 PM

B6L-A: Atomic Sensors - Europe / USA

Session Chair(s): Philippe Bouyer (Institut d'Optique Graduate School)

7:00 PM

Invited Talk: Atom Interferometer Accelerometer N/A

John Close, Australian National University, Australia

7:30 PM

The Development of a High Data Rate Atom Interferometric Gravimeter (HIDRAG) for Gravity Map Matching Navigation 77

Benjamin Adams{2}, Calum Macrae{2}, Mani Entezami{2}, Kevin Ridley{2}, Archie Kubba{2}, Yu-Hung Lien{2}, Sachin Kinge{1}, Kai Bongs{2}

{1}Toyota Motor Europe, Belgium; {2}University of Birmingham, United Kingdom

7:55 PM

Invited Talk: Packaging for Cold Atom Sensors N/A

Dana Anderson, ColdQuanta

8:25 PM

Cold Atom Interferometers Based on Diffractive Optics and Integrated Photonics (No Pub) N/A

Jongmin Lee

Sandia National Laboratories, United States

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Scale-Factor Stability Control Technique for Closed-Loop All-Fiber Interferometric Optical Gyroscope 81

Michal Skalský, Jiří Fialka, Ladislav Kopečný, Zdeněk Havránek

Brno University of Technology, Czech Rep.

Tuesday, March 23 / Wednesday, March 24

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B7L-A: Aided Navigation - Asia / USA

Session Chair(s): Charles Lange (Johns Hopkins University Applied Physics Laboratory)

Toshiyuki Tsuchiya (Kyoto University)

11:00 PM

Sensor Fusion to Improve State Estimate Accuracy Using Multiple Inertial Measurement Units 85

Ujival Patel, Imraan Faruque

Oklahoma State University, United States

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Simulation Design of Thermopile and Magnetometer Aided INS/GPS Navigation System for UAV Navigation 89

Atsumi Toda, Yoshikazu Koike

Shibaura Institute of Technology, Japan

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Performance Analysis of 3D NDT Scan Matching for Autonomous Vehicles Using INS/GNSS/3D LIDAR-SLAM Integration Scheme 93

Surachet Srinara, Chi-Ming Lee, Syun Tsai, Guang-Je Tsai, Kai-Wei Chiang

National Cheng Kung University, Taiwan

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FaStER: Fast, Stable, Expendable and Reliable Radio Map for Indoor Localization 97

Md Abdulla Al Mamun, David Vera Anaya, Mehmet Rasit Yuce

Monash University, Australia

12:40 AM

Invited Talk: Magnetic Navigation Aiding N/A

Aaron Canciani

Wednesday, March 24

12:00 PM – 2:30 PM

C1L-A: Human Activity Recognition - Europe / USA

Session Chair(s): Sina Askari (ECS Federal - DARPA SETA), Radwan Noor (KACST)

12:00 PM

Towards the Automatic Data Annotation for Human Activity Recognition Based on Wearables and BLE Beacons 101

Florenc Demrozi{2}, Marin Jereghi{1}, Graziano Pravadelli{1} {1}Computer Science, University of Verona, Italy; {2}University of Verona, Italy

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Insole-Based Real-Time Gait Analysis: Feature Extraction and Classification 105

Arif Reza Anwary{3}, Damla Arifoglu{4}, Michael Jones{1}, Michael Vassallo{2}, Hamid Bouchachia{1} {1}Bournemouth University, United Kingdom; {2}Royal Bournemouth Hospital, United Kingdom; {3}Swansea University, United Kingdom; {4}University College London, United Kingdom

12:50 PM

Trains Detection Using State of Polarization Changes Measurement and Convolutional Neural Networks 109

Petr Dejar, Vojtech Myska, Petr Munster, Radim Burget
Brno University of Technology, Czech Rep.

1:15 PM

Improved Sensor Based Human Activity Recognition via Hybrid Convolutional and Recurrent Neural Networks 113

Sonia Perez-Gamboa, Qingquan Sun, Yan Zhang
California State University San Bernardino, United States

3:00 PM – 5:05 PM

C2L-A: Industry MEMS Inertials - Europe / USA

Session Chair(s): Jenna F. Chan (U.S. Army CCD Army Research)

3:00 PM

Purely Inertial Navigation with a Low-Cost MEMS Sensor Array 117

Lukas Blocher{3}, Wolfram Mayer{3}, Marco Arena{3}, Dušan Radović{2}, Tobias Hiller{3}, Joachim Gerlach{1}, Oliver Bringmann{4}
{1}Albstadt-Sigmaringen University, Germany; {2}Bosch Sensortec GmbH, Germany; {3}Robert Bosch GmbH, Germany; {4}University of Tuebingen, Germany

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Development of a Navigation-Grade MEMS IMU 121

Burgess Johnson{1}, Curt Albrecht{1}, Todd Braman{1}, Kevin Christ{2}, Patrick Duffy{1}, Dan Endean{1}, Markus Gnerlich{1}, John Reinke{1}
{1}Honeywell International, United States; {2}Medtronic, United States

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Polaris - a Low Cost MEMS Fabrication Platform for Navigation-Grade Inertial Sensors 125

David Lin, Robert Macdonald, Dorin Calbaza, Jeremy Popp, Tammy Johnson, Emad Andarawis, Marco Aimì
GE Research, United States

Thursday, March 25

2:00 AM

Student Awards and 2022 Promo Asia

Michael Larsen (Northrop Grumman), Olivier Le Traon (ONERA)

8:20 AM – 9:10 AM

D1L-A: Late News Asia

Session Chair(s): Tamio Ikehashi (Waseda University)

8:20 AM

A Technique for Modeling and Simulating Transistor Based MEMS Sensors 129

Pramod Martha{2}, Anju Sebastian{1}, V Seena{2}, Naveen Kadayinti{3}

{1}Indian Institute of Science, Bangalore, India; {2}Indian Institute of Space Science and Technology, Trivandrum, India;

{3}Indian Institute of Technology, Dharwad, India

8:45 AM

A 3-D Capacitive-Detection Electrode for a Single Gold Proof-Mass Three-Axis MEMS Accelerometer 131

Takashi Ichikawa{2}, Akihiro Uchiyama{2}, Kohei Shibata{2}, Shinichi Iida{1}, Sangyeop Lee{2}, Noboru Ishihara{2},

Katsuyuki Machida{2}, Kazuya Masu{2}, Hiroyuki Ito{2}

{1}NTT Advanced Technology Corp., Japan; {2}Tokyo Institute of Technology, Japan

3:00 PM

Student Awards and 2022 Promo Europe / USA N/A

Michael Larsen (Northrop Grumman), Olivier Le Traon (ONERA)

3:20 PM – 4:35 PM

D2L-A: Late News USA

Session Chair(s): Giacomo Langfelder (Politecnico di Milano)

Sina Askari (ECS Federal - DARPA SETA)

3:20 PM

A Sub-Micro-G Resolution Frequency-Modulated Piezoelectric In-Plane Accelerometer 134

Seungyong Shin, Anosh Daruwalla, Zhenming Liu, Farrokh Ayazi

Georgia Institute of Technology, United States

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A Novel Spring Disk Resonator Gyroscope for Maximizing Q/F 136

Christopher Cameron{1}, Dustin Gerrard{2}, Janna Rodriguez{1}, Yushi Yang{1}, Eldwin Ng{1}, Thomas Kenny{1}

{1}Stanford University, United States; {2}Waymo, United States

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Microfabricated Optically Pumped Gradiometer with Uniform Buffer Gases 138

Austin Parrish{2}, Radwan Noor{1}, Andrei Shkel{2}

{1}King Abdulaziz City for Science and Technology, Saudi Arabia; {2}University of California, Irvine, United States

4:35 PM

Closing Remarks N/A

Michael Larsen (Northrop Grumman), Ron Polcawich (DARPA)
