

2010 IEEE International Frequency Control Symposium (FCS 2010)

**Newport Beach, California, USA
1 – 4 June 2010**



**IEEE Catalog Number: CFP10FRE-PRT
ISBN: 978-1-4244-6399-2**

TABLE OF CONTENTS

PLENARY SESSION – Encapsulated MEMS Resonators

Encapsulated MEMS Resonators – A Technology Path for MEMS into Frequency Control Applications	1
<i>B. Kim, Stanford University; R. Melamud, Stanford University; R.A. Candler, Stanford University; M.A. Hopcroft, Stanford University; C.M. Jha, Stanford University; S. Chandorkar, Stanford University; T.W. Kenny, Stanford University</i>	

Resonator I

Single-Ended-to-Differential and Differential-to-Differential Channel-Select Filters based on Piezoelectric AlN Contour-Mode MEMS Resonators	5
<i>Chengjie Zuo, University of Pennsylvania; Gianluca Piazza, University of Pennsylvania</i>	

Fine Frequency Selection Techniques for Aluminum Nitride Lamb Wave Resonators	9
<i>Ting-Ta Yen, University of California, Berkeley; Chih-Ming Lin, University of California, Berkeley; Yun-Ju Lai, University of California, Berkeley; Damien Wittwer, University of California, Berkeley; Matthew A. Hopcroft, University of California, Berkeley; Albert P. Pisano, University of California, Berkeley</i>	

Thermal Compensation for Aluminum Nitride Lamb Wave Resonators Operating at High Temperature	14
<i>Chih-Ming Lin, University of California, Berkeley; Ting-Ta Yen, University of California, Berkeley; Valery V. Felmetzger, OEM Group Inc.; Matthew A. Hopcroft, Hewlett-Packard Labs; Jan H. Kuypers, University of California, Berkeley; Albert P. Pisano, University of California, Berkeley</i>	

Higher-Order Dielectrically Transduced Bulk-Mode Ring Resonator with Low Motional Resistance	19
<i>Maryam Ziaei-Moayyed, Stanford University; Roger T. Howe, Stanford University</i>	

Quartz Crystal Oscillators

Reducing the Acceleration Sensitivity of AT-Strip Quartz Crystal Oscillators	25
<i>Steven J. Fry, Greenray Industries; Gregory A. Burnett, Statek Corp.</i>	

Combination of FEM/Harmonic Balance Analysis of OCXO	31
<i>Manabu Ito, Nihon Dempa Kogyo Co., Ltd.; Hiroyuki Mitome, Nihon Dempa Kogyo Co., Ltd.; Takeo Oita, Nihon Dempa Kogyo Co., Ltd.</i>	

Adaptive Correction Method for an OCXO	35
<i>Hui Zhou, Carleton University; Thomas Kunz, Carleton University; Howard Schwartz, Carleton University</i>	

EMI Dynamics in High Frequency Crystal Oscillator Circuits	39
<i>Ulrich L. Rohde, University of Cottbus; Ajay K. Poddar, Synergy Microwave Corp.</i>	

Toward Full Crystal Oscillator Integration for RF Applications	46
<i>Pierre Tinguy, FEMTO-ST Institute; Franck Lardet-Vieudrin, FEMTO-ST Institute; Johnny Leost, TEMEX; Laurent Couteleau, TEMEX; Bernard Dulmet, FEMTO-ST Institute</i>	

Zero Temperature Coefficient Characteristic of Four-Corner-Truncated Square Quartz Resonator Supported at Four Nodal Points in Lamé Mode	52
<i>Hisashi Kanie, Tokyo University of Science; Yusuke Todo, Tokyo University of Science; Yuto Hirota, Tokyo University of Science; Masaaki Furukawa, Tokyo University of Science; Tasuku Ueno, Tokyo University of Science; Kana Tadamatsu, Tokyo University of Science</i>	

Optical Clocks

Frequency Shifts of Colliding Fermions in Optical Lattice Clocks	56
<i>Kurt Gibble, The Pennsylvania State University</i>	

Blackbody Radiation Shifts and Magic Wavelengths for Atomic Clock Research	59
<i>M.S. Safronova, University of Delaware; M.G. Kozlov, PNPI; Dansha Jiang, University of Delaware; U.I. Safronova, University of Nevada, Reno</i>	

Recent Progress on the NRC $^{88}\text{Sr}^+$ Single-Ion Optical Frequency Standard	65
<i>P. Dubé, NRC; A.A. Madej, NRC; J.E. Bernard, NRC; G. Humphrey, NRC; M. Vainio, Center for Metrology & Accreditation; J. Jiang, University of British Columbia; D.J. Jones, University of British Columbia</i>	

MEMS Sensors

Acoustic MEMS Transducers for Biomedical Applications	71
<i>Eun Sok Kim, University of Southern California</i>	

Actuation and Sensing Integration Challenges at the Microscale: The <i>Gordian Knot</i> of the Resonant BioMEMS Realm	77
<i>Liviu Nicu, LAAS-CNRS; Thomas Alava, LAAS-CNRS; Fabrice Mathieu, LAAS-CNRS; Cedric Ayela, IMS-CNRS; Caroline Soyer, IEMN-CNRS; Denis Remiens, IEMN-CNRS</i>	

50nm Thick AlN Resonant Micro-Cantilever for Gas Sensing Application	81
<i>P. Ivaldi, CEA/LETI-MINATEC; J. Abergel, CEA/LETI-MINATEC; G. Arndt, CEA/LETI- MINATEC; P. Robert, CEA/LETI-MINATEC; P. Andreucci, CEA/LETI-MINATEC; H. Blanc, CEA/LETI-MINATEC; S. Hentz, CEA/LETI-MINATEC; E. Defay, CEA/LETI-MINATEC</i>	

Resonant Microcantilevers Vibrating Laterally in Viscous Liquid Media	85
<i>Fabien Josse, Marquette University; Russell Cox, Marquette University; Stephen Heinrich, Marquette University; Isabelle Dufour, Université de Bordeaux; Oliver Brand, Georgia Institute of Technology</i>	

Ultrasensitive Mode-Localized Micromechanical Electrometer	91
<i>P. Thiruvengathan, University of Cambridge; J. Yan, University of Cambridge; A.A. Seshia, University of Cambridge</i>	

Noise & Measurement Techniques

Simultaneous Digital Measurement of Phase and Amplitude Noise	97
<i>Laura B. Ruppalt, Johns Hopkins University; David R. McKinstry, Johns Hopkins University; Keir C. Lauritzen, Johns Hopkins University; Albert K. Wu, Johns Hopkins University; Shawn A. Phillips, Johns Hopkins University; Salvador H. Talisa, Johns Hopkins University</i>	
A Silicon Die as a Frequency Source	103
<i>M.S. McCorquodale, Integrated Device Technology, Inc.; B. Gupta, Integrated Device Technology, Inc.; W.E. Armstrong, Integrated Device Technology, Inc.; R. Beaudouin, Integrated Device Technology, Inc.; G. Carichner, Integrated Device Technology, Inc.; P. Chaudhari, Integrated Device Technology, Inc.; N. Fayyaz, Integrated Device Technology, Inc.; N. Gaskin, Integrated Device Technology, Inc.; J. Kuhn, Integrated Device Technology, Inc.; D. Linebarger, Integrated Device Technology, Inc.; E. Marsman, Integrated Device Technology, Inc.; J. O'Day, Integrated Device Technology, Inc.; S. Pernia, Integrated Device Technology, Inc.; D. Senderowicz, Integrated Device Technology, Inc.</i>	
Phase Noise in RF and Microwave Amplifiers	109
<i>Enrico Rubiola, FEMTO-ST Institute; Rodolphe Boudot, FEMTO-ST Institute</i>	
A Low-Power 4.6 GHz VCO for Chip-Scale Atomic Clocks	112
<i>J.S. Humble, Mayo Clinic; R.A. Philpott, Mayo Clinic; R. Lutwak, Symmetricom; B.K. Gilbert, Mayo Clinic; E.S. Daniel, Mayo Clinic</i>	
New Phase Noise Measurement Techniques and Ultra-Low Noise SAW Oscillators	116
<i>Guillaume De Giovanni, Noise eXtended Technologies; Michel Chomiki, TEMEX</i>	

Compact Atomic Clocks

All-Optical Integrated Atomic Clock	119
<i>L. Maleki, OEwaves Inc; V.S. Ilchenko, OEwaves Inc; M. Mohageg, OEwaves Inc; A.B. Matsko, OEwaves Inc; A.A. Savchenkov, OEwaves Inc; D. Seidel, OEwaves Inc; N.P. Wells, The Aerospace Corp.; J.C. Camparo, The Aerospace Corp.; B. Jaduszliwer, The Aerospace Corp.</i>	
Number Enhancement for Compact Laser-Cooled Atomic Samples by use of Stimulated Radiation Forces	125
<i>Elizabeth Donley, National Institute of Standards and Technology; Tara Cubel Liebisch, National Institute of Standards and Technology; Eric Blanshan, National Institute of Standards and Technology; John Kitching, National Institute of Standards and Technology</i>	
An Atomic Clock based on the Transient Coherent Population Trapping Detuning Oscillation Phenomenon	129
<i>Zhong Wang, Peking University; Tao Guo, Peking University; Ke Deng, Peking University; Xuzong Chen, Peking University</i>	

Materials, Resonators, & Resonator Circuits I

Direct Parameter Extraction in Capacitively Transduced Micromechanical Resonators using the Anti-Resonance	133
<i>Joshua E.-Y. Lee, City University of Hong Kong; Ashwin A. Seshia, University of Cambridge</i>	

Fabrication and Characterization of Acoustic Waveguides using Silicon/PPT/Silicon Structures and Analysis of Diffraction Effects for Various Modelings	137
<i>F. Bassignot, Institut FEMTO-ST; J.M. Lesage, CELAR; G. Ulliac, Institut FEMTO-ST; T. Laroche, Institut FEMTO-ST; J. Garcia, Institut FEMTO-ST; E. Courjon, Institut FEMTO-ST; S. Ballandras, Institut FEMTO-ST</i>	
Temperature Stability Analysis of LGS for SH-SAW Sensor Applications	142
<i>V. Carolina Ayala, IMTEK – University of Freiburg; David Eisele, IMTEK – University of Freiburg; Fabien Josse, Marquette University; Leonhard Reindl, IMTEK – University of Freiburg</i>	
Theoretical Considerations on Influence of Circuit Impedance to IMD2 Measurement of Radio-Frequency Bulk Acoustic Wave Duplexers	146
<i>Ken-Ya Hashimoto, Chiba University</i>	
MEMS Filters based on Traveling Flexural Waves	151
<i>Samer Hourri, Université Catholique de Louvain; Jean-Pierre Raskin, Université Catholique de Louvain; Laurent A. Francis, Université Catholique de Louvain</i>	
High Q Miniature Sapphire Acoustic Resonator	155
<i>Rabi T. Wang, Jet Propulsion Laboratory; R.L. Tjoelker, Jet Propulsion Laboratory</i>	
Linear Operation of a 11 MHz CMOS-MEMS Resonator	158
<i>E. Marigó, Universitat Autònoma de Barcelona; J.L. Muñoz-Gamarra, Universitat Autònoma de Barcelona; J. Giner, Universitat Autònoma de Barcelona; J.L. Lopez, Universitat Autònoma de Barcelona; F. Torres, Universitat Autònoma de Barcelona; J. Verd, Universitat de les Illes Balears; A. Uranga, Universitat Autònoma de Barcelona; N. Barniol, Universitat Autònoma de Barcelona</i>	
An Overview of Quartz MEMS Devices	162
<i>Masako Tanaka, Epson Toyocom Corp.</i>	
Oscillators, Synthesizers, Noise & Circuit Techniques I	
Studies of Optimal FIR Estimator of Clock State Employing Measurement of Time Errors	168
<i>Yuriy S. Shmaliy, Guanajuato University; Oscar Ibarra-Manzano, Guanajuato University</i>	
100 MHz Oscillator based on a Low Polarization Voltage Capacitive Lamé-Mode MEMS Resonator	174
<i>Eric Colinet, CEA, LETI, MINATEC; Julien Arcamone, CEA, LETI, MINATEC; Antoine Niel, CEA, LETI, MINATEC; Emerick Lorent, CEA, LETI, MINATEC; Sébastien Hentz, CEA, LETI, MINATEC; Eric Ollier, CEA, LETI, MINATEC</i>	
Optics to Microwave Low Phase Noise Frequency Division: Synchronization with Stability Below 100 Attoseconds	179
<i>Y. Le Coq, LNE-SYRTE; W. Zhang, LNE-SYRTE; Z. Xu, FEMTO-ST Institute; J. Millo, LNE-SYRTE; R. Boudot, LNE-SYRTE; M. Lours, LNE-SYRTE; A.N. Luiten, LNE-SYRTE; P.Y. Bourgeois, FEMTO-ST Institute; Y. Kersalé, FEMTO-ST Institute; G. Santarelli, LNE-SYRTE</i>	
Surface-Acoustic Wave Opto-Mechanical Oscillator	183
<i>A.B. Matsko, OEwaves Inc; A.A. Savchenkov, OEwaves Inc; V.S. Ilchenko, OEwaves Inc; D. Seidel, OEwaves Inc; L. Maleki, OEwaves Inc</i>	

A Low Phase Noise 10MHz Micromechanical Lamé-Mode Bulk Oscillator Operating in Nonlinear Region	189
<i>Tianfang Niu, National University of Singapore; Moorthi Palaniapan, National University of Singapore</i>	

Tunable Active Inductor Oscillator	195
<i>Ulrich L. Rohde, University of Cottbus; Ajay K. Poddar, Synergy Microwave Corp.</i>	
Active Inductor Oscillator Noise Dynamics	201
<i>Ulrich L. Rohde, University of Cottbus; Ajay K. Poddar, Synergy Microwave Corp.</i>	

Optical & Microwave Frequency Standards I

Vapor-Cell Clock Frequency and Environmental Pressure: Resonance-Cell Volume Changes	208
<i>M. Huang, The Aerospace Corporation; C.M. Klimcak, The Aerospace Corporation; J.C. Camparo, The Aerospace Corporation</i>	

Helium Pressure Shift of the Hyperfine Clock Transition in $^{201}\text{Hg}^+$	212
<i>S. Taghavi Larigani, Jet Propulsion Laboratory; E.A. Burt, Jet Propulsion Laboratory; R.L. Tjoelker, Jet Propulsion Laboratory</i>	

Phase-Locking of a 2.7 Terahertz Quantum Cascade Laser to a Mode-Locked Er-Fiber Laser	215
<i>G. Santarelli, LNE-SYRTE; S. Barbieri, Université Paris 7, CNRS; P. Gellie, Université Paris 7, CNRS; L. Ding, Université Paris 7, CNRS; W. Maineult, Université Paris 7, CNRS; C. Sirtori, Université Paris 7, CNRS; R. Colombelli, Université Paris Sud, CNRS; H. Beere, Cavendish Laboratory, Cambridge; D. Ritchie, Cavendish Laboratory, Cambridge</i>	

Repetitive Interrogation of 2-Level Quantum Systems	220
<i>John D. Prestage, Jet Propulsion Laboratory; Sang K. Chung, Jet Propulsion Laboratory</i>	

Progress of Active Optical Frequency Standard based on Thermal Ca Atomic Beam	222
<i>Wei Zhuang, Peking University; Jingbiao Chen, Peking University</i>	

Sensors & Transducers I

Love Wave Propagating in a Magneto-Electro-Elastic Material Structure Loaded with Viscous Liquid	224
<i>Jianke Du, Ningbo University; Xiaoyu Cheng, Ningbo University; Ji Wang, Ningbo University</i>	

Mass Sensitivity Evaluation of a Love Wave Sensor using the 3D Finite Element Method	228
<i>M.-I. Rocha Gaso, Universidad Politécnica de Valencia; R. Fernández-Díaz, Universidad Politécnica de Valencia; C. March-Iborra, Universidad Politécnica de Valencia; A. Arnau-Vives, Universidad Politécnica de Valencia</i>	

Rapid Detection of Organophosphates in Aqueous Solution using a Hybrid Organic/Inorganic Coating on SH-SAW Devices	232
<i>Arnold K. Mensah-Brown, Marquette University; Darlington Mlambo, Marquette University; Fabien Josse, Marquette University; Jeanne Hossenlopp, Marquette University</i>	

Thin-Film Piezoelectric-on-Silicon Particle Mass Sensors	238
<i>Brandon P. Harrington, Oklahoma State University; Arash Hajjam, University of Denver; James C. Wilson, University of Denver; Siavash Pourkamali, University of Denver; Reza Abdolvand, Oklahoma State University</i>	

A Study on the Aging of Ultra-Thin Palladium Films on SAW Hydrogen Gas Sensors	242
<i>B.H. Fisher, University of Central Florida; D.C. Malocha, University of Central Florida</i>	

Materials

High Performance 4GHz FBAR Prepared by Pb(Mn,Nb)O₃-Pb(Zr,Ti)O₃ Sputtered Thin Films	248
<i>T. Matsushima, Panasonic Electric Works Co., Ltd.; N. Yamauchi, Panasonic Electric Works Co., Ltd.; T. Shirai, Panasonic Electric Works Co., Ltd.; T. Yoshihara, Panasonic Electric Works Co., Ltd.; Y. Hayasaki, Panasonic Electric Works Co., Ltd.; T. Ueda, Panasonic Electric Works Co., Ltd.; I. Kanno, Kyoto University; K. Wasa, Kyoto University; H. Kotera, Kyoto University</i>	

Conductivity and Complex Permittivity of Langatate at High Temperature up to 900°C	252
<i>Peter Davulis, University of Maine; Mauricio Pereira Da Cunha, University of Maine</i>	

Development and Characterization of Biodegradable Conductive Polymers for the Next Generation of RF Bio-Resonators	258
<i>Clementine M. Boutry, ETH Zurich; Wei Sun, ETH Zurich; Tobias Strunz, ETH Zurich; Hengky Chandralim, ETH Zurich; Christofer Hierold, ETH Zurich</i>	

Optimal Cuts to Extract the Third-Order Elastic Constants of Langasite Single Crystals	262
<i>Haifeng Zhang, University of North Texas</i>	

Nano-, Opto- & Mechanical Oscillators

Phase Noise Modeling of Opto-Mechanical Oscillators	268
<i>Siddharth Tallur, Cornell University; Suresh Sridaran, Cornell University; Sunil A. Bhave, Cornell University; Tal Carmon, University of Michigan</i>	

Acceleration Sensitivity of Small-Gap Capacitive Micromechanical Resonator Oscillators	273
<i>Bongsang Kim, University of California, Berkeley; Mehmet Akgul, University of California, Berkeley; Yang Lin, University of California, Berkeley; Wei-Chang Li, University of California, Berkeley; Zeying Ren, University of California, Berkeley; Clark T.-C. Nguyen, University of California, Berkeley</i>	

Wireless Sensors

Multi-Track Low-Loss SAW Tags with Flexible Impedance Matching for Passive Wireless Sensor Applications	279
<i>N.Y. Kozlovski, University of Central Florida; D.C. Malocha, University of Central Florida</i>	
High Temperature Packaging for SAW Transponder	287
<i>R. Fachberger, Carinthian Tech Research AG; J. Bardong, Carinthian Tech Research AG</i>	
Wireless Wideband SAW Sensor – Antenna Design	291
<i>M.W. Gallagher, University of Central Florida; B.C. Santos, University of Central Florida; D.C. Malocha, University of Central Florida</i>	
Pulse-Mode Temperature Sensing with Langasite SAW Devices	297
<i>Peng Zheng, National Energy Technology Laboratory; T.-L. Chin, National Energy Technology Laboratory; David W. Greve, National Energy Technology Laboratory; Irving J. Oppenheim, National Energy Technology Laboratory; L. Cao, Carnegie Mellon University</i>	
Ultra Wide Band Dual Orthogonal Frequency Coded SAW Correlators using Harmonic Operation	301
<i>D.R. Gallagher, University of Central Florida; D.C. Malocha, University of Central Florida</i>	

Microwave Atomic Clocks

Measurements of the Distributed Cavity Phase Shift in the LNE-SYRTE FO2 Fountain	307
<i>J. Guéna, LNE-SYRTE; R. Li, The Pennsylvania State University; K. Gibble, The Pennsylvania State University; S. Bize, LNE-SYRTE; A. Clairon, LNE-SYRTE</i>	
Evaluation of NRC-FCs1: Mapping the C-Field using the Larmor Frequency	312
<i>Louis Marmet, National Research Council Canada; Marina Gertszov, National Research Council Canada</i>	
Medium-Term Frequency Stability of Hydrogen Masers as Measured by a Cesium Fountain	318
<i>T.E. Parker, National Institute of Standards and Technology; S.R. Jefferts, National Institute of Standards and Technology; T.P. Heavner, National Institute of Standards and Technology</i>	
Use of Bayesian Statistics to Reduce the Density Shift Uncertainty in Cesium Fountain	324
<i>D. Calonico, Istituto Nazionale di Ricerca Metrologica; F. Levi, Istituto Nazionale di Ricerca Metrologica; L. Lorini, Istituto Nazionale di Ricerca Metrologica; G. Mana, Istituto Nazionale di Ricerca Metrologica</i>	
Frequency Stabilization of Lasers by Locking to an Atomic Isoclinic Point	329
<i>N.P. Wells, The Aerospace Corporation; J.C. Camparo, The Aerospace Corporation</i>	

Resonator II

Vibrating Body Transistors: Enabling Fin-FET Nano-Electro-Mechanical Resonators	333
<i>Adrian M. Ionescu, Ecole Polytechnique Fédérale de Lausanne</i>	

Intrinsic Temperature Compensation of Highly Resistive High-Q Silicon Microresonators via Charge Carrier Depletion	334
<i>Ashwin K. Samaroo, Georgia Institute of Technology; Farrokh Ayazi, Georgia Institute of Technology</i>	
High-Q Integrated CMOS-MEMS Resonators with Deep-Submicron Gaps	340
<i>Wen-Chien Chen, National Tsing Hua University; Ming-Huang Li, National Tsing Hua University; Weileun Fang, National Tsing Hua University; Sheng-Shian Li, National Tsing Hua University</i>	
A CMOS-MEMS Filter using a V-Coupler and Electrical Phase Inversion	344
<i>J. Giner, Universidad Autonoma de Barcelona; A. Uranga, Universidad Autonoma de Barcelona; F. Torres, Universidad Autonoma de Barcelona; E. Marigo, Universidad Autonoma de Barcelona; J.L. Muñoz Gamarra, Universidad Autonoma de Barcelona; N. Barniol, Universidad Autonoma de Barcelona</i>	

Physical Sensors

Analysis and Comparison of Languisite versus Quartz for a Thickness Shear Vibratory Gyroscope	349
<i>Yook-Kong Yong, Rutgers University; Yoonkee Kim, US Army Communications-Electronics RD&E Center</i>	
Energy Trapping Thickness Mode Gyroscopes using High Performance Crystalline Materials	355
<i>J. Détaint, Universités Pierre et Marie Curie (Paris VI); B. Capelle, Universités Pierre et Marie Curie (Paris VI); Y. Epelboin, Universités Pierre et Marie Curie (Paris VI)</i>	
A Pressure Sensor based on a HBAR Micromachined Structure	361
<i>T. Baron, FEMTO-ST, Université de Franche-Comté; D. Gachon, FEMTO-ST, Université de Franche-Comté; J.P. Romand, FEMTO-ST, Université de Franche-Comté; S. Alzuaga, FEMTO-ST, Université de Franche-Comté; S. Ballandras, FEMTO-ST, Université de Franche-Comté; J. Masson, SENSEOR; L. Catherinot, XLim; M. Chatras, XLim</i>	
Simulation and Measurement of Low Permittivity Media with LiNbO₃ and LiTaO₃ LFE Resonators	365
<i>Jörg Fochtmann, Otto-von-Guericke University Magdeburg; Christian Peters, Otto-von-Guericke University Magdeburg; R. Fernandez Diaz, Otto-von-Guericke University Magdeburg; Ralf Lucklum, Otto-von-Guericke University Magdeburg; Jason McGann, University of Maine; John Vetelino, University of Maine; A. Arnau, Universidad Politécnica de Valencia</i>	

Atomic Magnetometers

A Two-Color Pump Probe Atomic Magnetometer for Magnetoencephalography	371
<i>Cort Johnson, Sandia National Laboratories; Peter D.D. Schwindt, Sandia National Laboratories</i>	
Low Frequency Characterization of MEMS-Based Portable Atomic Magnetometer	376
<i>Rahul R. Mhaskar, National Institute for Standards and Technology; Svenja Knappe, National Institute for Standards and Technology; John Kitching, National Institute for Standards and Technology</i>	

Materials, Resonators, & Resonator Circuits II

Real-Time Three-Dimensional Vibration Mode Visualization System based on Laser Speckle Interference	380
<i>Y. Yano, Tokyo Metropolitan University; Y. Watanabe, Tokyo Metropolitan University; T. Ishii, Tokyo Metropolitan University; S. Goka, Tokyo Metropolitan University; T. Sato, Tokyo Metropolitan University; H. Sekimoto, Tokyo Metropolitan University</i>	
Mode Shape Measurement System with Temperature Variation Function	384
<i>T. Ishii, Tokyo Metropolitan University; Y. Watanabe, Tokyo Metropolitan University; Y. Yano, Tokyo Metropolitan University; S. Goka, Tokyo Metropolitan University; T. Sato, Tokyo Metropolitan University; H. Sekimoto, Tokyo Metropolitan University</i>	
The Propagation of Rayleigh Waves in Layered Piezoelectric Structures with Viscosity	388
<i>Jinxiang Shen, Ningbo University; Ji Wang, Ningbo University; Jianke Du, Ningbo University; Dejin Huang, Ningbo University</i>	
Finite Element Analysis of Nonlinear Thickness-Shear Vibrations of AT-Cut Crystal Plates	392
<i>Ji Wang, Ningbo University; Leping Chen, Ningbo University; Jianke Du, Ningbo University; Yuantai Hu, Huazhong University of Science and Technology; Guoqing Li, Huazhong University of Science and Technology</i>	
Effects of Electrode Inertia and Stiffness on Vibration of Piezoelectric Plate with Dissipation	397
<i>Xin Yin, Ningbo University; Jianke Du, Ningbo University; Ji Wang, Ningbo University</i>	
Theoretical Study on Lamb Wave Characteristics of Composite Plates Including a Diamond Layer	401
<i>Yung-Yu Chen, Tatung University</i>	
Plate Mode Propagation Losses in Solidly Mounted Resonators	405
<i>Florian Thalmayr, Chiba University; Ken-Ya Hashimoto, Chiba University; Tatsuya Omori, Chiba University; Masatsune Yamaguchi, Chiba University</i>	
Experimental Study of the Effects of Size Variations on Piezoelectrically Transduced MEMS Resonators	410
<i>Antti Jaakkola, VTT Technical Research Centre of Finland; Jérôme Lamy, VTT Technical Research Centre of Finland; James Dekker, VTT Technical Research Centre of Finland; Tuomas Pensala, VTT Technical Research Centre of Finland; Lauri Lipiäinen, Aalto University; Kimmo Kokkonen, Aalto University</i>	
Characterization of CMOS-MEMS Resonator by Pulsed Mode Electrostatic Actuation	415
<i>J.L. Muñoz-Gamarra, Univ. Autònoma de Barcelona; E. Marigó, Univ. Autònoma de Barcelona; J. Giner, Univ. Autònoma de Barcelona; A. Uranga, Univ. Autònoma de Barcelona; F. Torres, Univ. Autònoma de Barcelona; N. Barniol, Univ. Autònoma de Barcelona</i>	
Passive Noise Analyses on Langatate Crystal Resonators	419
<i>J. Imbaud, FEMTO-ST Institute; G. Douchet, FEMTO-ST Institute; F. Sthal, FEMTO-ST Institute</i>	

Oscillators, Synthesizers, Noise & Circuit Techniques II

Examining Peculiarities of Crystal Oscillators using Computer Simulation	425
<i>Mike F. Wacker, Vectron International</i>	

A Novel Principle for PLL and its Application in Digital Innovation Experiment of Circuits in Active Hydrogen Maser	431
<i>Jiangtao Sun, Xidian University; Wei Zhou, Xidian University; Hainiu Zhou, Xidian University</i>	

A Novel Design of DTCXO with Low Phase Noise	435
<i>Faxi Chen, Xidian University; Wei Zhou, Xidian University; Jie Zhao, Xidian University</i>	

High Spectral Purity Oscillator at 40 GHz: Design using Air-Dielectric Cavity	437
<i>Archita Hati, National Institute of Standards and Technology; Craig W. Nelson, National Institute of Standards and Technology; Bill F. Riddle, National Institute of Standards and Technology; David A. Howe, National Institute of Standards and Technology</i>	

Phase Noise Suppression in Frequency Comb Generators	440
<i>C.W. Nelson, National Institute of Standards and Technology; A. Hati, National Institute of Standards and Technology; J.F.G. Nava, National Institute of Standards and Technology; D.A. Howe, National Institute of Standards and Technology</i>	

The Simulation and Accomplishment of 80MHz Low Phase Noise Crystal Oscillator	443
<i>Wei Fu, University of Electronic Science and Technology of China; Feng Tan, University of Electronic Science and Technology of China; Xianhe Huang, University of Electronic Science and Technology of China</i>	

Passive Dynamic Method and Measurements of Compressed Amplifiers to Determine Amplitude Noise Effects on System Noise Performance	446
<i>Patrick A. Green, Northrop Grumman Corporation; Matthew Facchine, Northrop Grumman Corporation; Jonathon Ulrey, Northrop Grumman Corporation</i>	

Digital Dual Mixer Time Difference for Sub-Nanosecond Time Synchronization in Ethernet	449
<i>Pedro Moreira, University College London; Pablo Alvarez, CERN; Javier Serrano, CERN; Izzat Darwezeh, University College London; Tomasz Wlostowski, CERN</i>	

Optical & Microwave Frequency Standards II

MOT-Based Continuous Cold Cs-Beam Atomic Clock	454
<i>H. Wang, The Aerospace Corporation; G. Iyanu, The Aerospace Corporation</i>	

A ⁸⁵Rb Coherent Population Trapping Atomic Clock	459
<i>Ke Deng, Peking University; Xuzong Chen, Peking University; Zhong Wang, Peking University</i>	

Performance Evaluation on Time and Frequency Transfer of Transponder Satellite Positioning System	462
<i>Fang Cheng, Chinese Academy of Sciences; Xiaochun Lu, Chinese Academy of Sciences; Tao Han, Chinese Academy of Sciences; Ji Wang, Ningbo University</i>	

Towards a Compact Cold Atom Frequency Standard based on Coherent Population Trapping	465
<i>Francois-Xavier Esnault, National Institute of Standards and Technology;</i>	
<i>Elizabeth Donley, National Institute of Standards and Technology;</i>	
<i>John Kitching, National Institute of Standards and Technology</i>	

Low-Thermal-Noise Optical Cavity	470
<i>Stephen Webster, National Physical Laboratory; Patrick Gill, National Physical Laboratory</i>	

Clock Monitoring and Control Units for Navigation Satellites	474
<i>Dirk Felbach, Astrium GmbH; Francis Soualle, Astrium GmbH; Lars Stopfkuchen, Astrium GmbH;</i>	
<i>Alexander Zenzinger, Astrium GmbH</i>	

Precise Monitoring of Ultra Low Expansion Fabry-Perot Cavity Length by the use of a Stabilized Optical Frequency Comb	480
<i>Radek Šmíd, Institute of Scientific Instruments of the ASCR, v.v.i.; Ondřej Číp, Institute of Scientific Instruments of the ASCR, v.v.i.; Zdeněk Buchta, Institute of Scientific Instruments of the ASCR, v.v.i.; Jan Ježek, Institute of Scientific Instruments of the ASCR, v.v.i.; Břetislav Mikel, Institute of Scientific Instruments of the ASCR, v.v.i.; Martin Čížek, Institute of Scientific Instruments of the ASCR, v.v.i.; Josef Lazar, Institute of Scientific Instruments of the ASCR, v.v.i.</i>	

Sensors & Transducers II

LiTaO₃ Ultrasonic Transducer Excited by Lateral Electric Field	485
<i>Zhitian Zhang, Tsinghua University; Chao Zhang, Tsinghua University; Wenyan Wang, Tsinghua University; Tingfeng Ma, Tsinghua University; Guanping Feng, Tsinghua University</i>	

Investigation of Lateral-Field-Excitation on LiTaO₃ Single Crystal	489
<i>Tingfeng Ma, Tsinghua University; Chao Zhang, Tsinghua University; Zhitian Zhang, Tsinghua University; Wenyan Wang, Tsinghua University; Guanping Feng, Tsinghua University</i>	

A Micromachined ZnO/Si₃N₄ Lamb Wave Device for Ultraviolet Sensing Application	493
<i>Wei-Shan Wang, National Taiwan University; Tsung-Tsong Wu, National Taiwan University</i>	

Investigations of SAW Delay Lines on C-Plane AlN/Sapphire at Elevated Temperatures	499
<i>Gudrun Bruckner, Carinthian Tech Research AG; Jochen Bardong, Carinthian Tech Research AG;</i>	
<i>David Eisele, University of Freiburg – IMTEK; Esko Forsén, Danish Technological Institute;</i>	
<i>René Fachberger, Carinthian Tech Research AG</i>	

Remote Control of SAW Resonators using a Frequency-Modulation-Based Interrogation Strategy	503
<i>C. Droit, SENSEOR SAS; G. Martin, FEMTO-ST; J.-M. Friedt, SENSEOR SAS; S. Ballandras, FEMTO-ST</i>	

Phase Noise Analysis and Performance of the Vibrating Beam Accelerometer	511
<i>R. Levy, ONERA; V. Gaudineau, ONERA</i>	

Novel Acoustic Devices

Band Gap Materials and Micro-Phononic Devices	515
<i>Tsung-Tsong Wu, National Taiwan University; Jia-Hong Sun, National Taiwan University</i>	

Support Loss-Free Micro/Nano-Mechanical Resonators using Phononic Crystal Slab Waveguides	521
<i>Saeed Mohammadi, Georgia Institute of Technology; Ali A. Eftekhar, Georgia Institute of Technology; Ali Adibi, Georgia Institute of Technology</i>	
Observation of the Acoustoelectric Effect in Gallium Nitride Micromechanical Bulk Acoustic Filters	524
<i>Vikrant J. Gokhale, University of Michigan, Ann Arbor; Yonghyun Shim, University of Michigan, Ann Arbor; Mina Rais-Zadeh, University of Michigan, Ann Arbor</i>	
Evidence of Acoustic Wave Focusing in a Microscale 630 MHz Aluminum Nitride Phononic Crystal Waveguide	530
<i>Nai-Kuei Kuo, University of Pennsylvania; Gianluca Piazza, University of Pennsylvania</i>	
Electrostatically Transduced Face-Shear Mode Silicon MEMS Microresonator	534
<i>Angel T-H. Lin, University of Cambridge; Jize Yan, University of Cambridge; Ashwin A. Seshia, University of Cambridge</i>	
Opto-Electronic & Photonic Oscillators	
Spurious-Mode Suppression in Optoelectronic Oscillators	539
<i>Olukayode Okusaga, U.S. Army Research Laboratory; Eric Adles, U.S. Army Research Laboratory; Etgar Levy, Technion Israel Institute of Technology; Moshe Horowitz, Technion Israel Institute of Technology; Curtis Menyuk, University of Maryland; Gary Carter, University of Maryland; Weimin Zhou, U.S. Army Research Laboratory</i>	
Theoretical and Experimental Study of the Phase Noise of Opto-Electronic Oscillators based on High Quality Factor Optical Resonators	544
<i>A. Bouchier, Université de Toulouse; K. Saleh, Université de Toulouse; P.-H. Merrer, Université de Toulouse; O. Llopis, Université de Toulouse; G. Cibié, CNES</i>	
Noise Analysis of the Opto-Electronic Microwave Oscillator (OEO)	549
<i>P. Salzenstein, FEMTO-ST Institute; R. Brendel, FEMTO-ST Institute; Y. Koumu Chembo, FEMTO-ST Institute; K. Volyanskiy, FEMTO-ST Institute; L. Larger, FEMTO-ST Institute; E. Rubiola, FEMTO-ST Institute</i>	
Loop-Length Dependent Sources of Phase Noise in Optoelectronic Oscillators	550
<i>Eric J. Adles, University of Maryland; Andrew Docherty, University of Maryland; Curtis Menyuk, University of Maryland; Gary Carter, University of Maryland; Olukayode Okusaga, U.S. Army Research Laboratory; Weimin Zhou, U.S. Army Research Laboratory; Etgar Levy, Technion – Israel Institute of Technology; Asaf David, Technion – Israel Institute of Technology; Moshe Horowitz, Technion – Israel Institute of Technology</i>	
Whispering-Gallery Mode based Opto-Electronic Oscillators	554
<i>A.A. Savchenkov, OEwaves Inc; V.S. Ilchenko, OEwaves Inc; J. Byrd, OEwaves Inc; W. Liang, OEwaves Inc; D. Eliyahu, OEwaves Inc; A.B. Matsko, OEwaves Inc; D. Seidel, OEwaves Inc; L. Maleki, OEwaves Inc</i>	
High Performance, Miniature Hyper-Parametric Microwave Photonic Oscillator	558
<i>L. Maleki, OEwaves Inc; V.S. Ilchenko, OEwaves Inc; A.A. Savchenkov, OEwaves Inc; W. Liang, OEwaves Inc; D. Seidel, OEwaves Inc; A.B. Matsko, OEwaves Inc</i>	

Clock Applications

Femtosecond Precision Timing Distribution for Accelerators and Light Sources	564
<i>Franz X. Kärtner, Massachusetts Institute of Technology; Jungwon Kim, Massachusetts Institute of Technology; Jonathan Cox, Massachusetts Institute of Technology; Jeff Chen, Massachusetts Institute of Technology; Amir H. Nejadmalayeri, Massachusetts Institute of Technology</i>	
Atacama Large Millimeter Array Photonic Local Oscillator: Femtosecond-Level Synchronization for Radio Astronomy	569
<i>Bill Shillue, National Radio Astronomy Observatory</i>	
GRAIL – A Microwave Ranging Instrument to Map Out the Lunar Gravity Field	572
<i>Daphna G. Enzer, Jet Propulsion Laboratory; Rabi T. Wang, Jet Propulsion Laboratory; William M. Klipstein, Jet Propulsion Laboratory</i>	

Characterization, Processes & Modeling

Study by Stroboscopic X-Ray Topography of the Effects of the Crystal Defects on the Vibration Modes of High Performance Resonators	578
<i>Bernard Capelle, Universités Pierre et Marie Curie (Paris VI); Yves Epelboin, Universités Pierre et Marie Curie (Paris VI); Jacques Detaint, Universités Pierre et Marie Curie (Paris VI)</i>	
Analytical Study of Anisimkin's (Quasilongitudinal) Modes in Piezoelectric Plate	584
<i>Morio Onoe, University of Tokyo; Shigetaka Kaga, Nihon Dempa Kogyo Co., Ltd.</i>	
Chemically Etched Resonant LGS Microsensors	590
<i>G. Douchet, FEMTO-ST Institute; T. Leblois, FEMTO-ST Institute; O. Medeira, FEMTO-ST Institute; F. Sthal, FEMTO-ST Institute</i>	
The Fifth-Order Overtone Vibrations of Crystal Plates with Corrected Higher-Order Mindlin Plate Equations	596
<i>Ji Wang, Ningbo University; Lijun Yang, Ningbo University; Jianke Du, Ningbo University; Dejin Huang, Ningbo University</i>	
Analytical Modeling of Electrical Potential Repartition on Piezoelectric Transformer	602
<i>Clément Nadal, Université de Toulouse; Francois Pigache, Université de Toulouse; Yvan Lefevre, Université de Toulouse</i>	

MEMS, FBAR & Minature Oscillators

A Wide-Tuning Digitally Controlled FBAR-Based Oscillator for Frequency Synthesis	608
<i>Julie Hu, University of Washington; Reed Parker, Avago Technologies; Rich Ruby, Avago Technologies; Brian Otis, University of Washington</i>	
Low Jitter Thin-Film Piezoelectric-on-Substrate Oscillators	613
<i>Mohsen Shahmohammadi, Oklahoma State University; Mohammad Jafar Modarres-Zadeh, Oklahoma State University; Reza Abdolvand, Oklahoma State University</i>	

1.5 GHz Voltage Controlled Oscillator with 3% Tuning Bandwidth using a Two-Pole DSBAR Filter	618
<i>I.D. Avramov, Georgy Nadjakov Institute of Solid State Physics; S.R. Gilbert, Avago Technologies; R. Ruby, Avago Technologies</i>	

Phase Noise Analysis of the Frequency Tracking Oscillator	624
<i>R. Levy, ONERA; A. Dupret, University Paris-Est; H. Mathias, University Paris 11</i>	

Optical Techniques

Prospects for Milli-Hertz Linewidth Lasers using Collective Emission	629
<i>D. Meiser, University of Colorado; Jun Ye, University of Colorado; M.J. Holland, University of Colorado</i>	

An Ultra-Low Frequency Noise Agile Laser	634
<i>A. Haboucha, LNE-SYRTE; H. Jiang, LNE-SYRTE; F. Kéfélian, Université Paris 13; P. Lemonde, LNE-SYRTE; A. Clairon, LNE-SYRTE; G. Santarelli, LNE-SYRTE</i>	

Multiplexed Optical Link for Ultra-Stable Frequency Dissemination	639
<i>O. Lopez, LPL-CNRS, Université Paris 13; B. Chanteau, LPL-CNRS, Université Paris 13; V. Roncin, LPL-CNRS, Université Paris 13; F. Kéfélian, LPL-CNRS, Université Paris 13; Ch. Chardonnet, LPL-CNRS, Université Paris 13; A. Amy-Klein, LPL-CNRS, Université Paris 13; H. Jiang, LNE-SYRTE; A. Haboucha, LNE-SYRTE; G. Santarelli, LNE-SYRTE</i>	

FBAR

Thickness Control by Ion Beam Milling in Acoustic Resonator Devices	642
<i>Sergey Mishin, AMSystems, Inc; Yury Oshmyansky, Avago Technologies; Frank Bi, Avago Technologies</i>	

High Coupling Coefficient Temperature Compensated FBAR Resonator for Oscillator Application with Wide Pulling Range	646
<i>Qiang Zou, Avago Technologies; Donald Lee, Avago Technologies; Frank Bi, Avago Technologies; Richard Ruby, Avago Technologies; Martha Small, Avago Technologies; Steven Ortiz, Avago Technologies; Jyrki Kaitila, Avago Technologies; Yury Oshmyansky, Avago Technologies</i>	

Temperature Compensated Radio-Frequency Harmonic Bulk Acoustic Resonators	652
<i>T. Baron, FEMTO-ST, Université de Franche-Comté; D. Gachon, FEMTO-ST, Université de Franche- Comté; G. Martin, FEMTO-ST, Université de Franche-Comté; S. Alzuaga, FEMTO-ST, Université de Franche-Comté; D. Hermelin, FEMTO-ST, Université de Franche-Comté; J.P. Romand, FEMTO-ST, Université de Franche-Comté; S. Ballandras, SENSEOR</i>	

Spurious Wave Suppression in BAW Resonators with Frame-Like Airgap	656
<i>Wenxia Yang, The Hong Kong Polytechnic University; Wai-Yip Tam, The Hong Kong Polytechnic University</i>	

LiNbO₃ Film Bulk Acoustic Resonator	661
<i>M. Pijolat, CEA, LETI, MINATEC; S. Loubriat, CEA, LETI, MINATEC; S. Queste, FEMTO-ST; D. Mercier, CEA, LETI, MINATEC; A. Reinhardt, CEA, LETI, MINATEC; E. Defaÿ, CEA, LETI, MINATEC; C. Deguet, CEA, LETI, MINATEC; M. Aïd, CEA, LETI, MINATEC; S. Ballandras, FEMTO-ST</i>	

Cryogenic Oscillators & Optical Frequency Combs

High Stability Cryocooled 10 GHz Oscillator for the European Space Agency	665
<i>S. Grop, FEMTO-ST Institute; P.Y. Bourgeois, FEMTO-ST Institute; N. Bazin, FEMTO-ST Institute; E. Rubiola, FEMTO-ST Institute; C. Langham, National Physical Laboratory; M. Oxborrow, National Physical Laboratory; W. Schäfer, TimeTech GmbH; J. De Vincente, European Space Agency ESA-ESOC; Y. Kersalé, FEMTO-ST Institute; V. Giordano, FEMTO-ST Institute</i>	

Frequency Stability and Phase Noise of an Improved X-Band Cryocooled Sapphire Oscillator	670
<i>Nitin R. Nand, University of Western Australia; John G. Hartnett, University of Western Australia</i>	

Accurate Phase Synchronization of a Cryogenic Microwave Oscillator	674
<i>E.N. Ivanov, University of Western Australia; D. Mouneyrac, University of Western Australia; J.-M. Le Floch, University of Western Australia; M.E. Tobar, University of Western Australia; D. Cros, University of Limoges</i>	

Gyrotropic Paramagnetic Properties of Fe³⁺ Ions in a High-Q Whispering Gallery Mode Sapphire Resonator	677
<i>Karim Benmessai, University of Western Australia; Michael Tobar, University of Western Australia; Nicolas Bazin, FEMTO-ST Institute; Pierre-Yves Bourgeois, FEMTO-ST Institute; Yann Kersalé, FEMTO-ST Institute; Vincent Giordano, FEMTO-ST Institute</i>	

Phase Noise in the Photodetection of Ultrashort Optical Pulses	684
<i>Jennifer A. Taylor, National Institute of Standards and Technology; Frank Quinlan, National Institute of Standards and Technology; Archita Hati, National Institute of Standards and Technology; Craig Nelson, National Institute of Standards and Technology; Shubhashish Datta, Discovery Semiconductors, Inc.; Abhay Joshi, Discovery Semiconductors, Inc.; Scott A. Diddams, National Institute of Standards and Technology</i>	

Parameter Optimization for Octave-Spanning Optical Frequency Comb Generation in Whispering-Gallery Mode Resonators	689
<i>Yanne K. Chembo, Jet Propulsion Laboratory; Nan Yu, Jet Propulsion Laboratory</i>	