MINIATURE AND MICRO-DOPPLER SENSORS

by

D. Modarress, D. Fourguette, F. Taugwalder
M. Gharib[1], S. Forouhar[2], D. Wilson[2], and J. Scalf[2]

VioSense Corporation
2400 Lincoln Ave., Altadena, California 91001, USA

Abstract

Recent advancement has resulted in the miniaturization of laser Doppler sensors for the measurement of flow velocity and wall shear stress. In particular, the design and the performance of a Miniature laser Doppler anemometer, a miniature particle sizing sensor, and an optical shear stress sensor based on micro-optical electromechanical systems (MOEMS) is reviewed.

The Miniature LDA (See Figure 1) uses a diode laser, diffractive optical element and miniature optics resulting in a rugged, small and self- contained backscatter LDA with frequency shifting. It has a fixed probe distance, and except for a rotating diffraction grating, has no moving or adjustable parts. It has a dimension of 50 mm in length and 25 mm in diameter. Sensors with different fringe sizes and sensor f-numbers have been fabricated.

By incorporating a second laser and modifying the collection optics of the miniature LDA, a miniature particle sizing probe for spherical and non-spherical particles was fabricated. The particle sizing is achieved by the "IMAX" technique. The sensor is capable of sizing particles from a micron to 100's of microns. The dynamic range is limited by the dynamic range of the linear or log detector. Addition of a second detector allows the sensor to measure droplet size using the "Phase Doppler" technique.

Further miniaturization of the laser Doppler sensor was achieved by the fabrication of integrated optics on a single substrate. Micro-Devices technology was used for the integration of curved diffractive optical elements on a single substrate. As an initial demonstration of the technology, an optical shear stress sensor was fabricated. In this sensor, four optical elements were printed on a single silicone substrate. Using a diode laser, an optical fiber, and the substrate, an optical shear sensor was fabricated. The sensor has a dimension of 15 mm in diameter and 20 mm in length.

Figure 1. Photograph of a miniature laser Doppler anemometer.

[1] California Institute of Technology, Pasadena, California, USA
[2] NASA Jet Propulsion Laboratory, Altadena, California, USA

Miniature And Micro Doppler Sensors

Theodore S. Gold,Donald C. Latham

Miniature And Micro Doppler Sensors:

Micro-Doppler Characteristics of Radar Targets Qun Zhang,Ying Luo,Yong-an Chen,2016-10-31 Micro Doppler Characteristics of Radar Targets is a monograph on radar target s micro Doppler effect theory and micro Doppler feature extraction techniques The micro Doppler effect is presented from two aspects including micro Doppler effect analysis and micro Doppler feature extraction with micro Doppler effects induced by different micro motional targets in different radar systems analyzed and several methods of micro Doppler feature extraction and three dimensional micro motion feature reconstruction presented The main contents of this book include micro Doppler effect in narrowband radar micro Doppler effect in wideband radar micro Doppler effect in bistatic radar micro Doppler feature analysis and extraction and three dimensional micro motion feature reconstruction etc This book can be used as a reference for scientific and technical personnel engaged in radar signal processing and automatic target recognition etc It is especially suitable for beginners who are interested in research on micro Doppler effect in radar Presents new views on micro Doppler effects analyzing and discussing micro Doppler effect in wideband radar rather than focusing on narrowband Provides several new methods for micro Doppler feature extraction which are very helpful and practical for readers Includes practical cases that align with main MATLAB codes in each chapter with detailed program annotations **International Conference on Intelligent Data Communication Technologies and Internet of Things (ICICI) 2018** Jude Hemanth,Xavier Fernando,Pavel Lafata,Zubair Baig,2018-12-20 This book discusses data communication and computer networking communication technologies and the applications of IoT Internet of Things big data cloud computing and healthcare informatics It explores examines and critiques intelligent data communications and presents inventive methodologies in communication technologies and IoT Aimed at researchers and academicians who need to understand the importance of data communication and advanced technologies in IoT it offers different perspectives to help readers increase their knowledge and motivates them to conduct research in the area highlighting various innovative ideas for future research **Neuromorphic Solutions for Sensor Fusion and Continual Learning Systems** Ali Safa,Lars Keuninckx,Georges Gielen,Francky Catthoor,2024-07-17 This book provides novel theoretical foundations and experimental demonstrations of Spiking Neural Networks SNNs in tasks such as radar gesture recognition for IoT devices and autonomous drone navigation using a fusion of retina inspired event based camera and radar sensing The authors describe important new findings about the Spike Timing Dependent Plasticity STDP learning rule which is widely believed to be one of the key learning mechanisms taking place in the brain Readers will be enabled to create novel classes of edge AI and robotics applications using highly energy and area efficient SNNs Optimization of Spiking Neural Networks for Radar Applications Muhammad Arsalan,2024-09-01 This book offers a comprehensive exploration of the transformative role that edge devices play in advancing Internet of Things IoT applications By providing real time processing reduced latency increased efficiency improved security and scalability edge

devices are at the forefront of enabling IoT growth and success As the adoption of AI on the edge continues to surge the demand for real time data processing is escalating driving innovation in AI and fostering the development of cutting edge applications and use cases Delving into the intricacies of traditional deep neural network deepNet approaches the book addresses concerns about their energy efficiency during inference particularly for edge devices The energy consumption of deepNets largely attributed to Multiply accumulate MAC operations between layers is scrutinized Researchers are actively working on reducing energy consumption through strategies such as tiny networks pruning approaches and weight quantization Additionally the book sheds light on the challenges posed by the physical size of AI accelerators for edge devices The central focus of the book is an in depth examination of SNNs capabilities in radar data processing featuring the development of optimized algorithms **Sensors** Bruno Andò,Francesco Baldini,Corrado Di Natale,Vittorio Ferrari,Vincenzo Marletta,Giovanna Marrazza,Valeria Militello,Giorgia Miolo,Marco Rossi,Lorenzo Scalise,Pietro Siciliano,2019-01-17 This book gathers the best papers presented at the Fourth Italian National Conference on Sensors held in Catania Italy from 21 to 23 February 2018 The book represents an invaluable and up to the minute tool providing an essential overview of recent findings strategies and new directions in the area of sensor research Further it addresses various aspects based on the development of new chemical physical or biological sensors assembling and characterization signal treatment and data handling Lastly the book applies electrochemical optical and other detection strategies to relevant issues in the food and clinical environmental areas as well as industry oriented applications *Microsensors and Catheter-based Imaging Technology* Alan I. West,1988 *Sensors in Medicine and Health Care* P. Ake Oberg,Tatsuo Togawa,Francis A. Spelman,2006-03-06 Taken as a whole this series covers all major fields of application for commercial sensors as well as their manufacturing techniques and major types As such the series does not treat bulk sensors but rather places strong emphasis on microsensors microsystems and integrated electronic sensor packages Each of the individual volumes is tailored to the needs and queries of readers from the relevant branch of industry A review of applications for point of care diagnostics their integration into portable systems and the comfortable easy to use sensors that allow patients to monitor themselves at home The book covers such advanced topics as minimal invasive surgery implantable sensors and prostheses as well as biocompatible sensing **40th AIAA Aerospace Sciences Meeting & Exhibit** ,2002 *Multi-User Gesture Recognition with Radar Technology* Ninos, Alexandros,2022-10-27 The aim of this work is the development of a Radar system for consumer applications It is capable of tracking multiple people in a room and offers a touchless human machine interface for purposes that range from entertainment to hygiene BioMEMS and Biomedical Nanotechnology Rashid Bashir,Steven T. Wereley,2007-04-03 Annotation Volume 4 is a balanced review of key aspects of BioMEMS sensors including i BioMEMS sensors and materials ii means of manipulating biological entities at the microscale and iii micro fluidics and characterization These three sections provide a succinct review of important topics within one volume of this series **Pattern Recognition**

Apostolos Antonacopoulos,Subhasis Chaudhuri,Rama Chellappa,Cheng-Lin Liu,Saumik Bhattacharya,Umapada Pal,2024-12-01 The multi volume set of LNCS books with volume numbers 15301 15333 constitutes the refereed proceedings of the 27th International Conference on Pattern Recognition ICPR 2024 held in Kolkata India during December 1 5 2024 The 963 papers presented in these proceedings were carefully reviewed and selected from a total of 2106 submissions They deal with topics such as Pattern Recognition Artificial Intelligence Machine Learning Computer Vision Robot Vision Machine Vision Image Processing Speech Processing Signal Processing Video Processing Biometrics Human Computer Interaction HCI Document Analysis Document Recognition Biomedical Imaging Bioinformatics **Biomedical Sensors and Instruments** Tatsuo Tagawa,Toshiyo Tamura,P. Ake Oberg,2011-03-22 The living body is a difficult object to measure accurate measurements of physiological signals require sensors and instruments capable of high specificity and selectivity that do not interfere with the systems under study As a result detailed knowledge of sensor and instrument properties is required to be able to select the best sensor from o *Phigix ... ⬜ - A Crank's Perspective ...... ⬜ ⬜ ⬜ - High Voltage ... ⬜ - With Coffee ... ⬜, Milk ... ⬜, Sugar ... ⬜ and Some Common Sense ... ⬜* Abhijeet Madhukar Deshpande ... ⬜⬜,2020-06-01 Phigix P other than the fact that I have cursed everyone to buy it or else Is that I have explained the entire subject of physics and particle matter in such an elucidative manner and style that even an ordinary person even without any or zero or even a minus knowledge of the subject matter of physics and particle physics can very well and easily understand the same Including children right from kindergarten itself So that everyone can now become an Expert on Physics My book contains the entire factual information on physics and its theories It also outlines the principles of particle physics which factually prove that infinite speeds in infinite exponential speeds in excess of the speed of light itself are possible for light and matter to travel anywhere in the universe or creation itself Now My Role as me being myself and since being the unusual personality that I am Created this EMRFC processor which can utilize and create and store energy and particle RF transfer state as infinite informational perpetual processing system Can store infinite information in parallel random and sequential processing each within one another about the entire information of all of creation right from its start to its end Within a single processing chip the size less than the tip of my fingernail Further more My book details the factual creation the engineering and the developmental structure of the process of the system and the mechanism and of particle physics Of Time Travel Itself So you can have the opportunity of a life time to become a Time Traveler And I am the factual creator and developer of The Time Machine This book reveals how to make one and become a Time Traveler Itself Reality is now bent The Adventure of a Life time *Tactics and Technology for 21st Century Military Superiority* Theodore S. Gold,Donald C. Latham,1998-06 Explores new ways to make rapidly deployable forces much more effective than they are today The report states that substantial possibly revolutionary improvements in the effectiveness of rapidly deployable forces are feasible The essence is an ability to mass fire rather than forces it relies on remote sensors processors and weapons Also discusses how to

achieve new capabilities as well as meet other challenges including command force insertion and training Describes how this new force concept could operate to perform various missions in different environments Illustrated **Introduction to Wireless Communications and Networks** Krishnamurthy Raghunandan,2022-03-31 This book provides an intuitive and accessible introduction to the fundamentals of wireless communications and their tremendous impact on nearly every aspect of our lives The author starts with basic information on physics and mathematics and then expands on it helping readers understand fundamental concepts of RF systems and how they are designed Covering diverse topics in wireless communication systems including cellular and personal devices satellite and space communication networks telecommunication regulation standardization and safety the book combines theory and practice using problems from industry and includes examples of day to day work in the field It is divided into two parts basic fundamentals and advanced elected topics Drawing on the author s extensive training and industry experience in standards public safety and regulations the book includes information on what checks and balances are used by wireless engineers around the globe and address questions concerning safety reliability and long term operation A full suite of classroom information is included *Motion Compensation for Near-Range Synthetic Aperture Radar Applications* Huaming Wu,2014-07-30 The work focuses on the analysis of influences of motion errors on near range SAR applications and design of specific motion measuring and compensation algorithms First a novel metric to determine the optimum antenna beamwidth is proposed Then a comprehensive investigation of influences of motion errors on the SAR image is provided On this ground new algorithms for motion measuring and compensation using low cost inertial measurement units IMU are developed and successfully demonstrated **Microsensors** Oleg Minin,2011-06-09 This book is planned to publish with an objective to provide a state of art reference book in the area of microsensors for engineers scientists applied physicists and post graduate students Also the aim of the book is the continuous and timely dissemination of new and innovative research and developments in microsensors This reference book is a collection of 13 chapters characterized in 4 parts magnetic sensors chemical optical microsensors and applications This book provides an overview of resonant magnetic field microsensors based on MEMS optical microsensors the main design and fabrication problems of miniature sensors of physical chemical and biochemical microsensors chemical microsensors with ordered nanostructures surface enhanced Raman scattering microsensors based on hybrid nanoparticles etc Several interesting applications area are also discusses in the book like MEMS gyroscopes for consumer and industrial applications microsensors for non invasive imaging in experimental biology a heat flux microsensor for direct measurements in plasma surface interactions and so on **ICCWS 2021 16th International Conference on Cyber Warfare and Security** Dr Juan Lopez Jr,Dr Kalyan Perumalla,Dr Ambareen Siraj,2021-02-25 These proceedings represent the work of contributors to the 16th International Conference on Cyber Warfare and Security ICCWS 2021 hosted by joint collaboration of Tennessee Tech Cybersecurity Education Research and Outreach Center CEROC Computer Science

department and the Oak Ridge National Laboratory Tennessee on 25 26 February 2021 The Conference Co Chairs are Dr Juan Lopez Jr Oak Ridge National Laboratory Tennessee and Dr Ambareen Siraj Tennessee Tech s Cybersecurity Education Research and Outreach Center CEROC and the Program Chair is Dr Kalyan Perumalla from Oak Ridge National Laboratory Tennessee *Advances in Guidance, Navigation and Control* Liang Yan,Haibin Duan,Xiang Yu,2021-11-12 This book features the latest theoretical results and techniques in the field of guidance navigation and control GNC of vehicles and aircraft It covers a range of topics including but not limited to intelligent computing communication and control new methods of navigation estimation and tracking control of multiple moving objects manned and autonomous unmanned systems guidance navigation and control of miniature aircraft and sensor systems for guidance navigation and control Presenting recent advances in the form of illustrations tables and text it also provides detailed information of a number of the studies to offer readers insights for their own research In addition the book addresses fundamental concepts and studies in the development of GNC making it a valuable resource for both beginners and researchers wanting to further their understanding of guidance navigation and control **Soft Computing: Theories and Applications** Rajesh Kumar,Ajit Kumar Verma,Om Prakash Verma,Jitendra Rajpurohit,2025-10-02 The book is a collection of high quality papers presented at the International Conference on Soft Computing Theories and Applications SoCTA 2024 held at Malaviya National Institute of Technology MNIT Jaipur Rajasthan India during 27 29 December 2024 This book focuses on soft computing and how it can be applied to solve real world problems arising in various domains ranging from medicine and healthcare to supply chain management image processing and cryptanalysis The book offers valuable insights into soft computing for teachers and researchers alike the book inspires further research in this dynamic field

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