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Electrotechnology

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General

——*Foreign Technology*——

Array Pre-Processing for the SESAM System: DOA Mean Square Minimization
P. Hyberg.
Swedish Defence Research Agency, Linkoeping. Command and Control Systems. May 2005, 34p, FOI-R-1297-SE. Summary in Swedish. Order this product from NTIS by: phone at 1-800-553-NTIS (U.S. customers); (703)605-6000 (other countries); fax at (703)605-6900; and email at orders@ntis.gov. NTIS is located at 5285 Port Royal Road, Springfield, VA, 22161, USA.
PB2005-106410WET Price code: PC A04

This report treats interpolation (mapping) of the output vector from an existing antenna array onto the output vector of another (virtual) array when the signal directions of arrival (DOAs) are known only to within a wide sector. In an earlier companion paper a first order condition for zero DOA bias under such mapping was derived, and also used to construct a design algorithm for the mapping matrix that minimized the DOA estimate bias. This bias minimizing theory is now extended to minimize not only bias, but DOA mean square error (MSE), i.e. bias squared plus variance. We first derive an analytical expression for mapped DOA MSE. Thereafter we propose a design algorithm for the transformation matrix that generates mapping errors minimizing this MSE. Generally, DOA MSE is not reduced by minimizing the size of the mapping errors, but instead by rotating these errors and the associated noise subspace into optimal directions relative to a certain gradient of the DOA estimator cost function. The analytical MSE expression and the design algorithm are supported by simulations that show not only conspicuous MSE improvements in relevant scenarios, but also a resulting pre-processing of better robustness for low SNRs as compared to the pure bias minimizing design described in the earlier paper.

Control of Structures & Properties in Ultrathin Films
P. S. Weiss.
Pennsylvania State Univ., University Park. Dept. of Chemistry. 31 May 2005, 38p, ARO-39209.3-MS.
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ADA436657WET Price code: PC A04/MF A01

We have deposited molecules that behave as molecular switches into alkanethiol and amide-containing alkanethiol monolayers and have followed their behavior as a function of time, chemical substitution, environment, matrix order, and matrix thickness. We have shown that we can control this switching and that we can stabilize the conductance states through interactions with the surrounding matrix (see ppt slides). This is done via hydrogen-bonding interactions. We have measured intermolecular interactions quantitatively by following the motion of adsorbed molecules. We have developed methodologies to record thousands of single molecule measurements using scanning tunneling microscopy that have enabled all the above measurements. We have designed monolayers that have weak intermolecular interactions and are thus labile with respect to displacement for use in patterning surfaces, and have demonstrated the utility of this approach.

Controlling High-Dimensional Chaos in Optical Devices
D. J. Gauthier.
Duke Univ., Durham, NC. Dept. of Physics. 22 Jul 2005, 14p, ARO-43758.8-PH. Product reproduced from digital image. Order this product from NTIS by: phone at 1-800-553-NTIS (U.S. customers); (703)605-6000 (other countries); fax at (703)605-6900; and email at orders@ntis.gov. NTIS is located at 5285 Port Royal Road, Springfield, VA, 22161, USA.
ADA436762WET Price code: PC A03/MF A01

The primary purpose of the proposed program is to develop methods for controlling and synchronizing the behavior of optical and electronic systems that display complicated behavior, such as high-dimensional chaos and turbulent-like behavior. The results of the program have the following potential applications: increasing the coherence of high-power lasers and nonlinear optical devices, developing an entirely new class of high-speed digital communications system based on chaotic elements, devising ultra-high speed methods for generating random numbers for distributed communications networks, and in new techniques for computing with chaotic systems. The authors are especially interested in determining techniques for controlling systems that show complexity in both space and time. Specifically, they are trying to understand whether the behavior of such systems can be controlled by applying perturbations to the system at one or a few control locations, rather than at every spatial point of the device. From the results of this experiment, the number of controllers needed to stabilize the entire pattern will be determined. In addition, these results will determine how information spreads and is lost as it is injected into a complex system, with potential implications for communication and computation with chaotic devices. This report summarizes the results of research in the following areas: ultra-low-light-level all-optical switching, high-speed chaotic electronic oscillators, bifurcation analysis of a time-delay system with band-limited feedback, high- speed chaos in an optical feedback system with flexible time scales, controlling fast chaos, and semiconductor lasers with controlled current inputs. A list of 18 research papers resulting from this contract is included.

High-Q Tunable Microwave Superconducting Strip-Line Filters

D. Anderson, P. Rehrig, M. Lanagan, E. Furman, and X. Xi.
TRS CERAMICS INC STATE COLLEGE PA. 8 Apr 2005, 23p, TRS0004Z. The original document contains color images. Product reproduced from digital image. Order this product from NTIS by: phone at 1-800-553-NTIS (U.S. customers); (703)605-6000 (other countries); fax at (703)605-6900; and email at orders@ntis.gov. NTIS is located at 5285 Port Royal Road, Springfield, VA, 22161, USA.
ADA436411WET Price code: PC A03/MF A01

The objective of the Phase II SBIR project was to develop high Q, tunable microwave filters by using a cryogenic piezoelectric actuator to mechanically tune a high temperature superconducting (HTS) resonator. The concept, designated piezotun-HTS, will enable a broad range of civilian and military applications that require precise band selectivity over a broad frequency range. In Phase I of this project, a 25% frequency tuning range was successfully demonstrated between 2 and 8 GHz by using a piezoelectric bending element to adjust the width of an air gap between a microstrip resonator and a dielectric or metal tuning plate. In Phase II, the piezotune-HTS and strip-line resonator concepts are applied to achieve large tuning range and low insertion loss.

High-Temperature Ferromagnetism in Transition Metal Implanted Wide- Bandgap Semiconductors

J. A. Raley.
Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering and Management. Jul 2005, 269p, AFIT/DS/ENP/05-04. The original document contains color images. Product reproduced from digital image. Order this product from NTIS by: phone at 1-800-553-NTIS (U.S. customers); (703)605-6000 (other countries); fax at (703)605-6900; and email at orders@ntis.gov. NTIS is located at 5285 Port Royal Road, Springfield, VA, 22161, USA.
ADA436455WET Price code: PC A13/MF A03

Material with both semiconductor and magnetic properties, which is commonly called a dilute magnetic semiconductor (DMS), will prove most useful in the fabrication of spintronic devices. In order to produce a DMS at above room temperature, transition metals (TMs) were implanted into host semiconductors of p-GaN, Al0:35Ga0:65N, or ZnO. Magnetic hysteresis measurements using a superconducting quantum interference device (SQUID) magnetometer show that some of the material combinations clearly exhibit ferromagnetism above room temperature. The most promising materials for creating spintronic devices using ion implantation are p-GaN:Mn, Al0:35Ga0:65N:Cr, and Fe-implanted ZnO nanotips on Al2O3. Temperature-dependent magnetization measurements con rm that indications of ferromagnetism are due to DMS behavior. Photo- and cathodoluminescence measurements show that implantation damage is recovered and the implanted TMs are incorporated into the semiconductor. As progress is made toward realizing practical spintronic devices, the work reported here will be useful for determining material combinations and implantation conditions that will yield the needed materials.

Microstructure of Laterally Overgrown Gan Layers

Z. Liliental-Weber, and D. Cherns.
Bristol Univ. (England). H.H. Wills Physics Lab. 2005, 32p. Sponsored by Department of Energy, Washington, DC. Product reproduced from digital image. Order this product from NTIS by: phone at 1-800-553-NTIS (U.S. customers); (703)605-6000 (other countries); fax at (703)605-6900; and email at orders@ntis.gov. NTIS is located at 5285 Port Royal Road, Springfield, VA, 22161, USA.
DE2005-835807WET Price code: PC A04/MF A01

Transmission electron microscopy study of plan-view and cross-section samples of epitaxial laterally overgrown (ELOG) GaN samples is described. Two types of dislocation with the same type of Burgers vector but different line direction have been observed. It is shown that threading edge dislocations bend to form dislocation segments in the c-plane as a result of shear stresses developed in the wing material along the stripe direction. It is shown that migration of these dislocations involves both glide and climb. Propagation of threading parts over the wing area is an indication of high density of point defects present in the wing areas on the ELOG samples. This finding might shed new light on the optical properties of such samples.

Nearly Optimal Solution of HJB Equation Using Neural Networks: Applications to Control of DoD Systems and MEMS Assembly

F. L. Lewis.
Texas Univ. at Arlington. 25 Jul 2005, 26p, ARO-43795.18-CI. Product reproduced from digital image. Order this product from NTIS by: phone at 1-800-553-NTIS (U.S. customers); (703)605-6000 (other countries); fax at (703)605-6900; and email at orders@ntis.gov. NTIS is located at 5285 Port Royal Road, Springfield, VA, 22161, USA.
ADA436807WET Price code: PC A03/MF A01

The goals of this grant were three. All have been accomplished. Goal 1 designed rigorous new nonlinear control schemes based on direct approximate solution of the Hamilton-Jacobi equations using neural networks (NN). On-line NN control techniques were developed that stabilize the system based on NN weight learning to approximate the optimal value function. Computational complexity was confronted using specialized structured NN controllers to provide efficient numerical solution algorithms for nonlinear optimal controllers. Optimal constrained controls were designed that satisfy actuator saturation limitations. Goal 2 proposed new information content and controllers for wireless networked systems. A new matrix-based discrete event controller was designed for wireless sensor networks with some mobile sentry nodes and some unattended ground sensors. The results were implemented on a mobile wireless sensor network testbed built at ARRI. Goal 3 built a prototype precision automated robotic microassembly system for future MEMS sensors and actuators for military networks. Novel control schemes and user interfaces were provided for tele-operated vision-guided microassembly.

Speech Articulator and User Gesture Measurements Using Micropower, Interferometric EM-Sensors
J. F. Holzrichter, and L. C. Ng.
Lawrence Livermore National Lab., CA. 6 Feb 2001, 12p. Sponsored by Department of Energy, Washington, DC. Order this product from NTIS by: phone at 1-800-553-NTIS (U.S. customers); (703)605-6000 (other countries); fax at (703)605-6900; and email at orders@ntis.gov. NTIS is located at 5285 Port Royal Road, Springfield, VA, 22161, USA.
DE2005-15013252WET Price code: PC A03/MF A01

Very low power, GHz frequency, 'radar-like' sensors can measure a variety of motions produced by a human user of machine interface devices. These data can be obtained 'at a distance' and can measure 'hidden' structures. Measurements range from acoustic induced, 10-micron amplitude vibrations of vocal tract tissues, to few centimeter human speech articulator motions, to meter-class motions of the head, hands, or entire body. These EM sensors measure 'fringe motions' as reflected EM waves are mixed with a local (homodyne) reference wave. These data, when processed using models of the system being measured, provide real time states of interface positions or other targets vs. time. An example is speech articulator positions vs. time in the user's body. This information appears to be useful for a surprisingly wide range of applications ranging from speech coding synthesis and recognition, speaker or object identification, noise cancellation, hand or head motions for cursor direction, and other applications.

Study to Uncover the Microstructural Basis for the Intrinsic Toughness of Interfaces and Its Relation to the Plastic Work That Accompanies Interface
V. Gupta.
California Univ., Los Angeles. Dept. of Mechanical and Aerospace Engineering. 20 Jul 2005, 30p, ARO-40925.1-MS. Product reproduced from digital image. Order this product from NTIS by: phone at 1-800-553-NTIS (U.S. customers); (703)605-6000 (other countries); fax at (703)605-6900; and email at orders@ntis.gov. NTIS is located at 5285 Port Royal Road, Springfield, VA, 22161, USA.
ADA436647WET Price code: PC A03/MF A01

A fundamental relationship between intrinsic and total toughness of tantalum/sapphire, Al/epoxy, and Si/epoxy joints is established using several novel interface characterization tools. The focus of research was to understand issues related to size effects, energy absorption capacity, and reliability, of joints. A double cantilever beam experiment equipped with a cryogenic cell, and a lasergenerated stress wave technique was used to measure the strength and toughness of interfaces, respectively. Although not part of the original proposal, experimental procedures to determine interfacial moisture content were established and then related to the measured interface strength. This was demonstrated for a polymer/nitride interface. This allows quantitative prediction of the durability of epoxy joints in service. The experimental procedures are general and applicable to epoxy/Al joints of direct interest to the Army. In addition, a novel application of laser-generated stress waves was developed which involved their use in releasing stiction in MEMS devices. Finally, during the execution of the above research objectives, discovery of glass modified stress waves with rarefaction shocks was made. The technological importance of such waves in measuring the interfacial tensile strength of ultrathin films was demonstrated. The ability of the glass to modify the rise time of the stress pulse from 1-2 ns to almost 50 ns points to an interesting effect that is worthy of further inquiry for defeating shock fronts for the purposes of designing armors.

System Dynamics Aviation Readiness Modeling Demonstration
M. E. McDevitt.
CONSOLIDATED ANALYSIS CENTER INC DYNAMIC SYSTEMS (CACI) SAN DIEGO CA. 31 Aug 2005, 64p. The original document contains color images. Product reproduced from digital image. Order this product from NTIS by: phone at 1-800-553-NTIS (U.S. customers); (703)605-6000 (other countries); fax at (703)605-6900; and email at orders@ntis.gov. NTIS is located at 5285 Port Royal Road, Springfield, VA, 22161, USA.
ADA436605WET Price code: PC A05/MF A01

A proof-of-concept demonstration of System Dynamics modeling was developed to determine the relative merit of the approach and then an experiment compared the results of the System Dynamics model with a traditional linear regression readiness model. This report documents the proof of concept model development and the experiment's results. An aviation readiness production model was formulated using system dynamics. The model was developed over a period of six months with participation from subject matter experts at Commander Naval Air Force and Commander Strike Fighter Wing Pacific. The model incorporates monthly flight hour execution taking into consideration aircraft mission capable rates and the location of a squadron relative to the Fleet Response Plan (FRP) training cycle to generate Primary Mission Area points in strike warfare that are accumulated to generate an Attack Index. Concurrently, a renewed Strike Warfare Proficiency (Strike PRO) analysis was conducted for comparison. Twenty-four Carrier Air Wing (CVW) events at NSAWC Fallon, NV were used to benchmark performance. The results of the Strike PRO algorithm and the results of the System Dynamics Model were each compared against the performance metric. Source code for the System Dynamics Model is included as an appendix to the report.

Antennas

Radiation Pattern Analysis of a Four-Element Linear Array
J. J. Lemmon.
National Telecommunications and Information Administration, Washington, DC. Jul 2005, 28p, NTIA-TM-05-426. Order this product from NTIS by: phone at 1-800-553-NTIS (U.S. customers); (703)605-6000 (other countries); fax at (703)605-6900; and email at orders@ntis.gov. NTIS is located at 5285 Port Royal Road, Springfield, VA, 22161,

USA.
PB2005-110101WET Price code: PC A03

The effects of mutual coupling on the radiation pattern of a four-element linear array were investigated. The objective was to improve the angular resolution of the array for direction-of-arrival estimation by compensating for mutual coupling. It is concluded that the effects of mutual coupling on the performance of the array are not significant, and that the angular resolution of the array is consistent with its theoretical radiation pattern in the absence of mutual coupling. However, it is recommended that the array be calibrated to compensate for systematic errors and any (small) mutual coupling effects that are present.

——*Foreign Technology*——

Stralningsdiagramsyntes foer Konforma Gruppantenner (Pattern Synthesis for Conformal Arrays)
L. Pettersson.
Swedish Defence Research Agency, Linkoeping. Sensor Technology. Dec 2004, 32p, FOI-R-1477-SE. Text in Swedish; summary in English. Order this product from NTIS by: phone at 1-800-553-NTIS (U.S. customers); (703)605-6000 (other countries); fax at (703)605-6900; and email at orders@ntis.gov. NTIS is located at 5285 Port Royal Road, Springfield, VA, 22161, USA.
PB2005-107415WET Price code: PC A04/MF A01

Pattern synthesis consists of finding weight coefficients, both in amplitude and phase, for the antenna element signals in a phased array so that the radiation pattern becomes as close, in some meaning, to the desired pattern as possible. Here the phase of the radiation is considered unimportant which affects both the methods used and the obtainable results. For conformal, i.e. non-planar arrays where no symmetry can be utilized, numerical methods must be used. Here we discuss this problem both generally but in particular the ‘Alternating projection’ method on sets consisting of desirable patterns and realizable patterns respectively. The application of this method on conformal arrays with full polarimetry is discussed. The method has been implemented in a Mat lab program and a simple example is given.

Optoelectronic Devices & Systems

Controlling High-Dimensional Chaos in Optical Devices
Duke Univ., Durham, NC. Dept. of Physics. 22 Jul 2005, 14p.
ADA436762WET Price code: PC A03/MF A01

For complete citation see General

Feasibility Study of Integrating IDELIX’s Pliable Display Technology into the COPlanS Technology Demonstration Software
IDELIX SOFTWARE INC VANCOUVER (BRITISHCOLUMBIA). 31 Mar 2005, 43p. The original document contains color images. Product reproduced from digital image. Order this product from NTIS by: phone at 1-800-553-NTIS (U.S. customers); (703)605-6000 (other countries); fax at (703)605-6900; and email at orders@ntis.gov. NTIS is located at 5285 Port Royal Road, Springfield, VA, 22161, USA.
ADA436384WET Price code: PC A04/MF A01

This document examines the potential for enhancement of Defence Research and Development Canada’s Collaborative OperationsPlanningSystem(COPlanS)technologydemonstration software in the areas of collaboration and data visualization using IDELIX’s Pliable Display Technology. In particular, it begins by outlining several possible forms of general collaboration that apply to the application and then defines a number of areas within the application with collaboration and data visualization improvement potential. Each of these areas is subsequently analyzed in depth with specific details of how enhanced collaboration and data visualization can be attained with PDT. Finally, rough orders of magnitude are provided for all defined features and potential implementation approaches.

——*Foreign Technology*——

Fotorefraktiva Skydd Jamfoerda med Olika Styrda Skydd mot Laser (Photorefractive Alternatives to Active Sensor Protection)
S. Svensson, A. Eriksson, C. Lopes, and B. Ericson.
Swedish Defence Research Agency, Linkoeping. Sensor Technology. Sep 2004, 40p, FOI-R-1329-SE. Text in Swedish; summary in English. Product reproduced from digital image. Order this product from NTIS by: phone at 1-800-553-NTIS (U.S. customers); (703)605-6000 (other countries); fax at (703)605-6900; and email at orders@ntis.gov. NTIS is located at 5285 Port Royal Road, Springfield, VA, 22161, USA.
PB2005-106461WET Price code: PC A04

Photorefractive materials are able to attenuate low power rays better than other passive non-linear optical devices. Compared to active protection the photorefractive need neither external energy source nor laser warning receiver. In 1990 photorefractive concepts for sensor protection were known. These ideas, however, were then considered not applicable in Sweden. The major drawback turned out to be that the physical process was too slow. Recently the interest in photorefractive materials seems to have grown among researchers. This report thus elaborates on the potential of photorefractive protection as an alternative to active protection concepts.

Simulations of CdSe Quantum Dots
A. Puzder, A. Williamson, F. Gygi, and G. Galli.
Lawrence Livermore National Lab., CA. 18 Mar 2004, 16p, UCRL-CONF-203007. Sponsored by Department of Energy, Washington, DC. Order this product from NTIS by: phone at 1-800-553-NTIS (U.S. customers); (703)605-6000 (other countries); fax at (703)605-6900; and email at orders@ntis.gov. NTIS is located at 5285 Port Royal Road, Springfield, VA, 22161, USA.
DE2005-15014048WET Price code: PC A03

No abstract available.

Semiconductor Devices

Controlled Synthesis of Metastable Oxides Utilizing Epitaxy and Epitaxial Stabilization. Final Report
M. P. Dvorscak.
Department of Energy, Argonne, IL. Chicago Operations Office. Jul 2003, 36p. Product reproduced from digital image. Order this product from NTIS by: phone at 1-800-553-NTIS (U.S. customers); (703)605-6000 (other countries); fax at (703)605-6900; and email at orders@ntis.gov. NTIS is located at 5285 Port Royal Road, Springfield, VA, 22161, USA.
DE2005-819922WET Price code: PC A04/MF A01

Molecular beam epitaxy (MBE) has achieved unparalleled control in the integration of semiconductors at the nanometer. These advances were made through the use of epitaxy, epitaxial stabilization, and a combination of composition-control techniques including adsorption-controlled growth and RHEED-based composition control that we have developed, understood, and utilized for the growth of oxides. Also key was extensive characterization (utilizing RHEED, four-circle x-ray diffraction, AFM, TEM, and electrical characterization techniques) in order to study growth modes, optimize growth conditions, and probe the structural, dielectric, and ferroelectric properties of the materials grown. The materials that we have successfully engineered include titanates (PbTiO3, Bi4Ti3O12), tantalates (SrBi2Ta2O9), and niobates (SrBi2Nb2O9); layered combinations of these perovskite-related materials (Bi4Ti3O12-SrTiO3 and Bi4Ti3O12-PbTiO3 Aurivillius phases and metastable PbTiO3/SrTiO3 and BaTiO3/SrTiO3 superlattices), and new metastable phases (Srn+1TinO3n+1 Ruddlesden-Popper phases). The films were grown by reactive MBE and pulsed laser deposition (PLD). Many of these materials are either new or have been synthesized with the highest perfection ever reported. The controlled synthesis of such layered oxide heterostructures offers great potential for tailoring the superconducting, ferroelectric, and dielectric properties of these materials. These properties are important for energy technologies.

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