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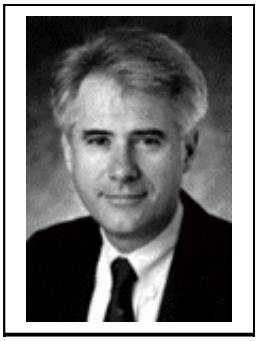
Autonomous and Robotic Vehicles Technologies

ABSTRACTS

VANGUARD MARKETING
INTERNATIONAL INC



JACOB E. BYERS
Chief Executive Officer
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Abstract:
Operations Iraqi Freedom and its counterpart in Afghanistan have fueled the demand for unmanned aircraft systems. Yet, with impending cuts in the 2005 defense budget, this emerging market may prove to be too tough to penetrate for traditional or nontraditional developers. For companies to succeed it is critical that they understand the characteristics of new and emerging markets, apply these principals to unmanned systems, and then see how and why the market is changing so that they may prepare for and potentially help shape the market to their advantage.

Biography:
Mr. Byers is the Chief Executive Officer of Vanguard Marketing International, Inc., a premier strategic marketing firm providing business-consulting services to companies in the commercial and defense sectors. Vanguard specializes in the exploration and design of new markets and revenue opportunities. In particular, over the last three years, the company has worked with a wide range of companies in evaluating unmanned systems markets and emerging technologies.
Mr. Byers and his team of consultants work with leading companies across a variety of industries, including Amgen, Boeing Company, Honeywell, Intel, L-3 Communications, Motorola, Northrop Grumman, QUALCOMM, Parker Bertea, Raytheon, Teledyne, Universal Avionics, ViaSat, and others. The company's cross-industry expertise enables Vanguard to bring critical insights to its client, especially with regard to how trends, business strategies and practices have played out in other industries.
Prior to establishing Vanguard Marketing, Mr. Byers was the General Manager of a $10 million high technology investment fund in Russia, and later the General Director of a personal computer joint venture in Byelorussia. During his tenure in Russia with JV Dialogue (JVD), the company became the country's exclusive distributor of Microsoft products and sought record setting first-round legislation for intellectual property right protection. He also helped pioneer one of the first commercially successful western-style banks and developed commercial opportunities for Russian products and alliances in the West. Mr. Byers launched and developed twenty-six distribution and support centers across the Soviet Union and Central Europe. In 1993, Harvard Business Review cited JV Dialogue as *the* most successful Russian joint ventures in history.

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GREG LARSON
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Boeing's Experience with DARPA's Grand Challenge

Abstract:
It was less than three years ago that DARPA attempted to address the difficulties of battlefield logistics and war fighter safety with a bold new initiative to develop autonomous ground vehicles capable of auto navigating across desert terrain. In DARPA like style, their procurement process was anything but the standard DoD approach. Rather, through Congressional Mandate, DARPA initiated a program challenging industry & academia to compete in fielding vehicles capable of auto navigating the Mojave Desert. The prize: $1,000,000. This presentation describes The Boeing Company's experience in this DARPA program and illuminates some of the approaches and innovations fielded through our sponsorship of two, very different teams. It also discusses how these technologies might be employed to field a class of autonomous and semi-autonomous ground vehicles that someday will save and protect American lives on the battlefield.

ASAD MADNI, Ph. D.
President & COO
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Full Circle Commercialization of a Dual-Use Micromachined Quartz Rate Sensor Technology

Abstract:
In early 1990s, BEI Systron Donner introduced a new MEMS tuning fork Quartz Rate Sensor (QRS) gyroscope technology (based on the Coriolis effect) that had been successfully utilized in several Aerospace and Defense (A&D) applications, including the guidance of the Maverick Missile. The technology had not captured significant market share beyond A&D and as the defense market contracted at the end of the Cold War, it caused a significant revenue reduction forcing the company to look at other markets.

An emerging application for low–cost rate sensors in automotive stability control brake systems was identified. The QRS exceeded automotive performance specifications and demonstrated potential for high volume, automated manufacturing techniques for lowering costs.

A massive culture and infrastructure change was implemented over the next 5 years to penetrate this market. Multi-discipline teams re-engineered every department to conform to automotive quality and ERP systems, statistical process controls, factory automation, engineering design/validation and technology road-mapping techniques for lowest unit cost and continuous cost reduction, exhaustive failure mode analysis and development of a global supplier and customer base.

Engineering re-designed production in three key areas: (1) quartz tuning fork fabrication, (2) fork balancing and hermetic packaging and (3) final assembly, calibration and test. Labor-intensive processes were eliminated by automation and proofed against human error. R&D Engineering achieved continuous cost reduction with 5 year technology roadmap plans including a unique design resulting in significant sensor size reduction while increasing performance, an outcome traditionally unexpected with size reduction in such mass based sensors. Primary customer needs of tight performance specifications and continuous fault detection for safety-critical applications were met, resulting in enthusiastic acceptance by the automotive industry with over 10 million sensors shipped to date.

With renewed Government emphasis on A&D budgets, this low-cost, high performance technology is being leveraged back into A&D applications (UAV's, low-cost missiles, smart munitions, guided bombs, avionics, etc) while simultaneously penetrating advanced automotive applications.

This full circle commercialization has produced unprecedented profitable growth for the company including revenue growth exceeding a factor of 6 since 1995.

DEREK BYE
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Morphing Aircraft Structures (MAS) activity

Abstract:
Morphing aircraft are seen as vital elements of an integrated air and space architecture that will fully support the warfighter in the future global battle space. Morphing vehicles will realize significant increases in platform endurance, maximum velocity and maneuver capability, maximizing time on-station, combat performance and operational payload flexibility. The ability to change the critical physical characteristics of a vehicle in flight would enable/allow a single vehicle to perform multiple missions that currently are conducted by dissimilar platform types. Lockheed Martin has completed Phase 1 of DARPA's Morphing Aircraft Structures (MAS) contract and is executing Phase 2. This presentation covers Lockheed Martin's work in Morphing that includes full-scale subcomponent models, technology demonstrations and vehicle concepts.

FREDRIC NEWBERG, Ph. D.
Lead System Architect
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Wireless Sensor Networks - Past, Present, and Future

Abstract:
Wireless sensor networks have the potential to provide unprecedented remote monitoring capabilities that can benefit applications such as industrial control, environmental monitoring, and defense. Simpler and cheaper to deploy than wired solutions, these networks will enable improved understanding of processes and environments through continual monitoring of a larger set of parameters than has been previously possible or cost effective.
In this talk the evolution of wireless sensor networks will be presented, starting with examples of early implementations, followed by the current state of technology in the field, and then looking ahead to the challenges and opportunities that are on the horizon for this technology.

Bio:
Dr. Fredric Newberg is the Lead System Architect at Sensoria Corporation in Culver City, CA. Since joining Sensoria in 1999, his focus has been on system and hardware architecture for embedded computing platforms with sensing and wireless networking capabilities. His work on such platforms at Sensoria has ranged from implementing extremely low-power, small form factor, wireless sensor devices with multihopping communication capabilities to architecting computationally powerful, modular, embedded computing platforms based around 32-bit processors. Dr. Newberg received his B.S. (1995), M.S. (1997), and Ph.D. (2002) degrees in electrical engineering from the University of California, Los Angeles, where his research was focused on RF and system design for wireless sensor networks.

RAJIT GADH, PhD
Professor, Henry Samueli School of Engineering and Applied Science
Director, UCLA Wireless Internet for the Mobile Enterprise Consortium
Director UCLA Wireless Media Lab

Internet of Artifacts – The next generation of Wireless

Abstract:
The last twenty-five years have marked the coming of the personal computing and communication industry. Result: Individuals now carrying devices that are personal, mobile and always connected to the Internet. It is my belief that in the next twenty-five years, such information carrying and disseminating capability will extend from the "computing/communication devices" to real-world non-computing artifacts that we use in every day life such as clothes, utensils, furniture, packages, etc. These artifacts will collectively form what I refer to as the "Internet of Artifacts", an idea whose time has come. Like with any grand challenge, these artifacts will need to be uniquely identified (using technologies such as RFID), they will need to communicate with each other (wirelessly) and will gradually have the ability to take intelligent decisions first individually and then collectively.
At UCLA's WINMEC (Wireless Internet for the Mobile Enterprise Consortium), the Wireless "Internet of Artifacts" notion is being explored via a project called WinRFID (http://winmec.ucla.edu/rfid) -- which is the first generation of our implementation of this idea. RFID or Radio Frequency Identification is a technology that can embody the identity and other related information of an artifact within a chip called a tag that has no power source and make such information available to an RFID transceiver when the tag receives the RF transmission and its coupled energy. RFID tags are expected to eventually be embedded into every daily-life artifact. At UCLA, we are developing the WinRFID Middleware that allows efficient, intelligent and optimized networking and management of RFID readers, tags and sensors at the edge of the network.
The WinRFID middleware is currently being applied to for research applications and industry-led projects at UCLA-WINMEC that include securing assets, asset tracking, managing object shipments in supply chains, factory wireless networks, etc.
The lecture will delve into the notion of the Wireless "Internet of Artifacts" and will present some of the real-world projects resulting from this research that's built up using WinRFID.

Bio:
Dr. Rajit Gadh is a Professor at the Henry Samueli School of Engineering and Applied Science at UCLA where he heads the Wireless Internet for Mobile Enterprise Consortium of which major companies including Intel, HP, Siemens, Computer Associates, Ericsson, Sprint, Northrop Grumman, Hughes Network Systems, Qualcomm, TCS, Satyam, Tata Infotech, ISMB-Italy and several others are sponsoring members. Dr. Gadh works in the areas of Mobile/Wireless Internet, multimedia/graphics, RFID Middleware and scalability, reconfigurable wireless sensor networks, wireless enterprise security, multi-media and DRM for content distribution over the internet, and multi-media over UWB, within the Wireless Media Lab. He has published over 100 papers in journals, conferences and technical magazines and 3 patents.
He has a Doctorate from Carnegie Mellon University, a Masters from Cornell University and a Bachelors' from IIT Kanpur. He has taught as a visiting researcher at UC Berkeley,

has been an Assistant, Associate and Full Professor at University of Wisconsin-Madison, and did his sabbatical as a visiting researcher at Stanford University for a year. Prior to his academic career, he has worked for two software startup companies. He has won several awards from NSF (CAREER award, Research Initiation Award, NSF-Lucent Industry Ecology Award, GOAL-I award), SAE (Ralph Teetor award), ASME (Kodak Best Technical Paper award), AT&T (Industrial ecology fellow award), Engineering Education Foundation (Research Initiation Award), etc., and other accolades in his career.

ROBERT H. MILLER, Ph.D.
Manager VMS & Flight Controls
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UAV Autonomy & Multi-Vehicle Control

Abstract:
The presenter will provide an overview of the major UAV programs at Northrop Grumman. He will discuss the recent Flight Test from the DARPA Software Enabled Control Program and the advanced UAV Autonomy technologies demonstrated in the flight Test. He will also discuss some other internally funded UAV autonomy technologies currently under development.

Bio:
Robert H. Miller is currently manager of VMS and Flight Controls at UnManned Systems part of the Integrated Systems Sector of Northrop Grumman. Before that he was the Mission Management and Control IPT lead on the Northrop Grumman UCAR program. Prior to that he lead several technology development programs for Northrop among those was the DARPA Software Enabled Control Program. He has a Ph.D. in Aerospace Engineering from the University of Michigan Ann Arbor and a BS and MS degree from Stanford.

REINHOLD BEHRINGER, Ph. D.
Program Manager, Rockwell Scientific Company
President, SciAutonics
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Technology Lessons from the DARPA Grand Challenge

Abstract:
The DARPA Grand Challenge 2004 was the first public large-scale attempt to organize a competition of autonomous ground vehicles. The distance of 142 miles was supposed to be mastered by vehicles that could follow a series of waypoints, stay within a given corridor, recognize obstacles and avoid collisions with them, and finish the course within 10 hours. Over 100 teams intended to participate, but only 15 teams qualified for participation in this competition. None of the teams' vehicles completed the course; the vehicle that came furthest stopped at 7.4 miles. There are lessons to be learned from these failures, but nevertheless, this event was a milestone in the development of autonomous vehicles.
There are numerous challenges to be overcome in order to have a completely autonomously driving system. While a robust hardware is a good basis for completing the rough terrain, the real challenges in building autonomous systems are in the intelligent information processing of data from sensors. Obstacles and path borders must be recognized in order to keep the vehicle out of harm, and path planning must assure to reach the goal with the fastest possible speed. In order to master the specific challenges, the teams employed various approaches.
SciAutonics, LLC, was founded specifically to participate in the DARPA Grand Challenge. It is the only sponsor that sent two teams into this competition. SciAutonics-2 reached 2nd place, SciAutonics-1 stopped after 0.75 miles. This presentation will give an overview on the DARPA Grand Challenge event, the software challenges and potential solutions, and the specific team efforts of the SciAutonics teams.

Bio:
Reinhold Behringer is Program Manager at Rockwell Scientific Company (RSC) in Thousand Oaks, CA. He has 15 years experience in technology and software development for intelligent systems and Human-Computer Interaction technology. After studying physics, he received his PhD at the "Universität der Bundeswehr, München" (Germany) in 1996 with a thesis on computer-vision-based road recognition for an autonomous road vehicle. In this work, he collaborated with Daimler-Chrysler (then Daimler-Benz) and DASA (then Dornier). Several experimental road vehicles were equipped with his visual lane-tracking software, which allows automatically keeping the vehicle in the lane. At RSC, he worked on computer-vision-based tracking approaches for Augmented Reality and environment sensing. His scientific work is documented in over 50 publications at conferences and journals.
As the DARPA Grand Challenge was announced in 2003, he and several RSC co-workers and external engineers decided to participate, and founded the company SciAutonics, LLC.
Reinhold Behringer also has degrees in physics (Diploma, University of Würzburg, 1990; MA, SUNY Buffalo, 1988).

H. PATRICK HALEY
Development Engineer and
Autonomous Systems Team Leader
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Full and partial autonomy: Air, Land, and Sea

Abstract:
The robotics division at PM&AM Research is working on several multiplatform autonomy programs, encompassing air, land, and sea. These programs will be briefly outlined, including platform-communication, coordination, and cooperation. The platforms are developed to carry sensors and/or deliver payloads. Some resulting capabilities will be indicated, as will various applications. An autonomous walking platform will be described, as will a corresponding air-delivery platform. The main focus of this presentation, will be on a semi-autonomous ocean vehicle, which was designed to track octopuses. Lessons learned will be presented, as will be follow-on modifications and ongoing development and applications.

Bio:
H. Patrick Haley received his BS in Mechanical Engineering from the University of Arizona and leads the autonomous systems group at PM&AM Research. Mr. Haley has worked extensively on Unmanned Air Vehicles (UAVs) and Autonomous Underwater Vehicles (AUVs), specializing in flow control, propulsion, and vehicle control/autonomy. His primary area of research and development has been in the area of autonomous systems and unmanned vehicles, having led multiple design teams in the development of UAV's (unmanned aerial vehicles), UUV's (unmanned underwater vehicles), and ULV's (unmanned land vehicles) for use in competitions, scientific research, and sensor development. Mr. Haley is a member of both the American Institute of Aeronautics and Astronautics (AIAA) and the Marine Technology Society (MTS).

TASSO POLITOPOULOS, Ph. D.
Chief Scientist
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Coremicro® Palm Navigator

Abstract:
The AGNC coremicro Palm Navigator is an advanced position/location tracking and communication device based on the AGNC coremicro AHRS/INS/DGPS Integration Unit. The coremicro Palm Navigator constitutes an interruption-free navigation and tracking system, carried by an air, land, marine or robotic vehicle and personnel, which includes a coremicro IMU, a positioning assistant, a navigation processor, a wireless communication device and optional automatic pilot implementation, cellular access, color display, map database and DGPS. Multi-tracking among vehicles is effected with or without a monitoring center. The user's position information can be exchanged with other users through the wireless communication device, and the location and surrounding information can be displayed on the display device by accessing a map database with the vehicle or personnel position information. The coremicro Palm Navigator is ideal for tracking and communication between multiple air, land, water/marine or robotic vehicles and personnel. The coremicro Palm Navigator allows vehicles and personnel to be provided with accurate positioning data continuously, in real time, anytime and anywhere. The tracking functions are executed without interruption in a variety of environments. The system possesses reasonable size, weight (about one lb) and power consumption for commercial operations and can be used in areas where GPS signals are not consistently available.

Bio:
Dr. Tasso Politopoulos is a Chief Scientist at AGNC. He is involved with multiple programs to develop and assess robot control techniques for various applications. Dr. Politopoulos has been involved with target tracking, navigation systems, image processing, target classification, control integration, flight control, GPS/INS, neural networks, fuzzy logic and system performance evaluations. Dr. Politopoulos received his Ph.D. degree in Electrical Engineering (with emphasis in Systems Engineering) from the University of Utah. At Logicon Dr. Politopoulos' responsibilities included GPS and INS navigation analysis studies. He was a Principal Engineer with Ford Aerospace and Communications Corporation where he performed navigation and control system analysis and imaging sensor data processing for aerospace systems and electro/optics pods.

TULLY FOOTE and HAMIAO HUANG
California Institute of Technology

Team Caltech: Racing to Win the DARPA Grand Challenge

Abstract:
The DARPA Grand Challenge is a desert road race from Los Angeles to Las Vegas that took place on March 13, 2004, with a grand prize of $1 million. Competing teams had to build a vehicle that could operate completely autonomously (no remote control allowed!) and drive along a 150 mile course---including trails, open desert, water crossings, and dirt roads---in 10 hours or less. The course was specified two hours before the race starts as a set of 2500 GPS waypoints, along with a corridor varying between 10 meters and 10 kilometers wide, that the vehicles must stay within. Caltech undergraduates worked for over one year to modify a 1996 Chevy Tahoe named "Bob" to compete in this competition, aided by researchers from Caltech, JPL, Northrop Grumman and other sponsors.