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ION GPS 2002 Show Daily

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Running Interference

Panel Tackles Compatibility, Interoperability

Panel Members (from left to right): Dr. Chris Hegarty, *The Mitre Corporation;* Per Enge, *Stanford University;* Ralph Braibanti, Director of Space and Advanced Technology, *U.S. State Department*; Karl Kovach, *ARINC Research Corporation*; Dr. Terry McGurn, panel moderator; Olivier Onidi, *European Commission;* and Dr. Günter Hein, *University of Munich, Germany.*

Last night's distinguished plenary panel kicked the ION off in high gear by tackling some of the most pressing issues facing the GNSS community — compatibility, interoperability, and interference. Panelists discussed the concept of system compatibility and three distinct types of interference of concern in the GNSS frequency band: intrasystem interference, which is caused by other GPS signals and satellites; intersystem concerns that center on mutual interference between Galileo and GPS; and external interference that could be caused by proposed Ultra-Wide-Band (UWB) technology.

Panel members were selected for their specific expertise in GNSS signal compatibility and interoperability and included Dr. Chris Hegarty of The Mitre Corporation; Dr. Günter Hein from the University of Munich, who also represents the European Commission Galileo Signal Task Force; Karl Kovach from ARINC Research Corporation; Stanford University's Per Enge; Ralph Braibanti, director of Space and Advanced Technology from the U.S. State Department; and Olivier Onidi, Head of Unit, Satellite Navigation System (Galileo), European Commission.

Bumping Into Galileo

Before the session kicked off, Panel Moderator Dr. Terry McGurn shared his thoughts on compatibility and interoperability between Galileo and GPS.

"If we can first ensure that Galileo and GPS will not interfere with each other's operation — that they're compatible — then ensuring interoperability should not be that difficult," McGurn said.

Obviously, he continued, for interoperability, the coordinate system and time base of each system should either be identical, nearly identical, or be offset from each other by some known and stable difference so that user equipment can provide composite position/navigation/time solutions.

McGurn's concerns went beyond the technical issue of compatibility and into the area of policy compatibility.

"Technical compatibility involves the

Plenary, *continued on page 3*

Raise a Glass To Lewis & Clark!

"We set out early and proceeded to the top of the mountain ... From this point, I beheld the grandest and most pleasing prospects which my eyes ever surveyed."

—William Clark, January 1806, on seeing the Pacific Ocean

Famed explorer William Clark uttered these words as he crested Tillamook Head, a 1,000-foot promontory overlooking the Pacific Ocean, less than 80 miles west of downtown Portland. It seems only seems fitting that, as the United States prepares to celebrate the bicentennial of Lewis and Clark's intrepid Corps of Discovery expedition (which took place from 1803–1806), the world's foremost navigators should converge near the end of the Lewis & Clark Trail.

Thankfully, we can celebrate their accomplishments — and the great art of navigation — in comfort and style. Today's Columbia River Basin is significantly more hospitable than the one Lewis and Clark visited.

No need to portage a canoe — getting around Portland today is a breeze using the city's "Max" light rail system. The cuisine has come a long way too. Head to the waterfront to enjoy some of the world's best fresh local oysters or travel downtown to sip an espresso. And don't forget the beer — Portland is home to the nation's largest variety of microbrews. Plan on sticking around through the weekend? Drive east to the historic Multnomah Falls Lodge, head west to the beautiful Oregon coast, or take the Max to Portland's classical Chinese gardens.

If Lewis & Clark were alive today, they'd marvel at the changes in Oregon. But what would impress them even more is how far navigation technologies have come since their grueling expedition.

So remember this week to raise your glass to Lewis & Clark; and enjoy your stay in the Pacific Northwest.

The Satellite Division

Welcomes You to the Great Northwest

From left to right: Dr. Rudy Kalafus, ION president; John Clark, Satellite Division treasurer; Dr. Penina Axelrad, Satellite Division chair; John Lavrakas, Satellite Division vice chair; Lyn Dutton, European technical advisor. Not pictured: Dr. Boris Pervan, secretary; Ron Hatch, immediate past chair; and SQNLDR Robert Bunton, Asian technical advisor.

The Institute of Navigation's Satellite Division is your host for ION GPS 2002, the largest single GNSS and positioning conference in the world. The Satellite Division was founded in 1987 by a group of longtime ION members who, anticipating GPS's immense potential, wished to both focus attention on this emerging technology and provide a forum for the exchange of technical information. The first ION GPS meeting was held in 1987 in Colorado Springs, Colo.

Since then, worldwide interest in the group's activities has made the Satellite Division the ION's most active and drawn worldwide recognition as the forum for the world's largest, and most prominent, positioning meeting. No other conference so adeptly illustrates the breadth and depth of GNSS technology or the marketplace.

As the conference has grown, the Satellite Division has clarified its mission: to encourage the development, operation, and use of satellite-based navigation and position determination systems. This mission is being achieved through the organization and execution of the annual international technical meeting, the sponsorship of student travel grants to present worthy technical papers at the annual meeting, and, more recently, through a newly organized endowment program that provides for the development of navigation curricula.

Current Satellite Division Officers include Dr. Penina Axel-

Satellite Division, *continued on page 3*

Navtech Seminars

A Tradition of Excellence

Navtech Seminars and GPS Supply continued its 16-year tradition of offering leading-edge tutorials in conjunction with the annual ION GPS series of meetings. More than 340 people chose among 35 short courses that were presented Monday and Tuesday at the Oregon Convention Center. This represents an increase of about 10 percent over last year. About 28 percent of the tutorial attendees came from outside the United States — a decrease from last year when 36 percent of attendees were from outside the United States. This shift in domestic/international ratio could be due to the many changes in GPS, Galileo, and world conditions since last year's Sept. 10–11 tutorials.

Twenty-four internationally recognized GPS experts taught the courses, which were designed to help attendees better comprehend the ION GPS 2002 conference presentations. This year's new sessions addressed the new military and civil GPS signals, relativistic timing effects, and a redesigned Galileo course. The signals and fundamentals classes were the best attended in the two-day period.

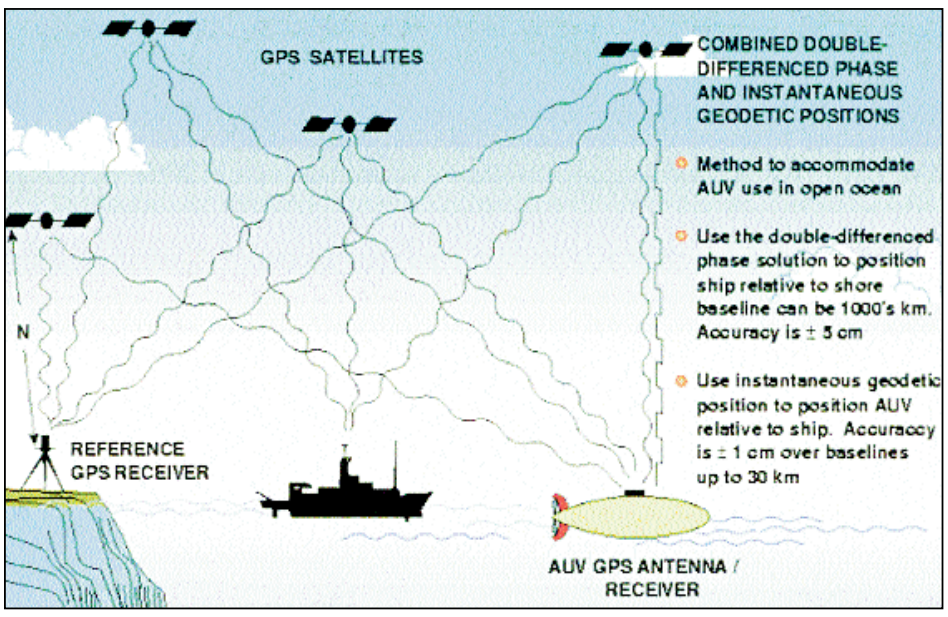
The new signals course detailed the structure, receiver processing, and jamming performance of signals that will become operational in the near future. The practical relativistic timing effects course

discussed time dilation and redshift effects errors that create systematic errors over a period of time on the order of tens of meters. This course was of interest to those concerned with GPS intersatellite links and for interoperability among other systems and networks. The Galileo course redesign shifted its emphasis from policy and program to a discussion of design options since the system has officially entered the development phase.

This was the first year that all presentations were in electronic format. Navtech wishes to publicly thank the instructors — all who designed technical graphics that so colorfully enhanced their teaching materials for this format. The management of Navtech also wishes to thank its highly accomplished technical production staff for its outstanding achievement in coordinating and producing this year's courses.

—Navtech Seminars & GPS Supply presents its tutorials as a contractor to the ION Satellite Division, paying a fee and commission to participate.

Geodetics Locates AUV



Using its Epoch by Epoch technology, Geodetics (Booth 426) has successfully completed a precision location experiment in which an Autonomous Underwater Vehicle (AUV) acquired simultaneous, dual-frequency data from three GPS receivers.

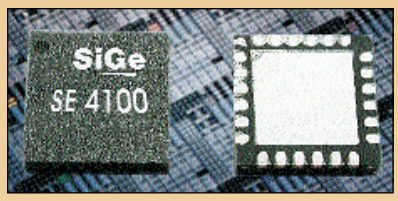
The first receiver was installed in the AUV's forward section in a vacuumed glass sphere. This receiver was connected to a line amplifier inside the glass sphere then to a dual-frequency GPS antenna modified for underwater use. A second GPS receiver with a choke-ring antenna was mounted aboard the surface ship tending the AUV, and a third was operated ashore. Data at the shore site were collected at a 1-Hz rate. The receivers aboard the ship and the AUV (while it sat on the surface) collected data at 10 Hz (see Figure).

Data were processed in two separate modes: from shore to ship to determine the location of the shipboard antenna relative to geographic coordinates, and from ship to AUV by using the independent epoch approach to measure the relative position between the AUV and ship. Combined, these solutions reportedly enabled the location of the AUV in geographic coordinates at the 10-centimeter level.

Founded in 1999, Geodetics is a privately held company with headquarters in San Diego, Calif. Its Epoch-by-Epoch technology provides instant positioning relative to one or multiple reference stations and autonomous heading and attitude determination. This method enables applications such as sports tracking, airborne navigation and landing, fleet tracking, intelligent transportation, environmental and structural monitoring, and machine control. Geodetics' technology and products can be used for wireless devices such as PDAs and smart phones.

RANDOM FIXES

SiGe Semiconductor Enters GPS Market with IC for AVL



SiGe Semiconductor **(Booth 1115)** has entered the GPS market with the launch of its PointCharger family of GPS devices. The first product from the line of components is the PointCharger SE4100, an integrated receiver IC that integrates an IF filter, VCO, tank circuitry, and LNA into a 4 square millimeter package that is said to draw only 10mA from a 2.7V supply.

The receiver IC incorporates an on-chip, switchable-gain LNA that delivers a low-noise figure of around 1.3dB, as well as quick recovery from either power-saving mode or from an RF overload from a local transmitter. The device reportedly delivers a digital 4.092 Mhz output suitable for industry-standard GPS baseband solutions. When paired with many leading baseband circuits, the whole system consumes less than 120mW in continuous operation, the company says. The SE4100 also supports further power-saving modes offered by its companion baseband chips.

The PointCharger SE4100 is designed specifically to meet the requirements of covert and always-on applications, in which power must be supplied or backed up from a source separate from the main battery. In aftermarket automotive devices, such as tracking systems or alarms, the GPS radio can be switched off completely or left with just its oscillator running to provide a clock for the baseband chip. An antenna detect function included in the design can alert a user to a missing or shorted antenna. The SE4100 is suited to railway or other transport applications in which the only power source is a solar cell and re-chargeable battery. The device is priced at U.S. $3.50 in quantities of 10,000, packaged in a 24-pin LPCC package.

Honeywell's Digital Compass

Honeywell **(Booth 503/505)** is debuting a two-axis, electronic compass circuit board that can be integrated into new or existing navigation applications. Engineers can integrate the HMR3100 digital compass into their own systems by way of a USART communication interface. The product is ready for use in vehicle compasses, navigation systems, handheld electronics, and telescopes with positioning functionality. The unit contains Honeywell's HMC 1022 magnetic sensors and includes electronics to provide digital readouts of heading measurements.

Applanix Automates Calibration and Post-processing

Applanix **(Booth Q)** has announced the release of POSPac 4.0, the latest update to the company's aided inertial post-processing software. In addition to the capabilities found in the previous release, POSPac 4.0 incorporates a Position and Orientation System Calibration (POSCal) capability into the POSEO (Exterior Orientation) module. This enhancement computes the camera/IMU boresight angles and camera calibration parameters directly, eliminating the need for third-party aerotriangulation. In addition, the new batch-processing mode allows automated post-processing of multiple data sets. After specifying the location of raw data files and base station coordinates, the user can leave the computer unattended and perform other functions. POSPac will automatically compute the smoothed solutions, optimizing filter settings for each data set without user intervention.

San Jose Navigation's Mobile GPS Data Logger

San Jose Navigation's **(Booth 213)** GL-50 is an integrated GPS logger, receiver, and antenna designed with AVL, fleet management, and marine navigation in mind. The unit connects to a computing device — such as a PC, PDA, or palmtop — by way of an RS-232 communication port shipped with the product and can provide real-time GPS position as an NMEA-0183 string, as well as speed, distance traveled, and heading information.

Pacific Crest Modems Worldwide

Pacific Crest Corporation **(Booth 333)** has announced that its Positioning Data Link Low Power Base unit (PDL LPB) modems are now available worldwide, complying with North American and European standards to offer reliable communication for GPS RTK surveying. Most recently, Pacific Crest gained approval from the Australian Compliance Commission to distribute its kits in Australia.

The PDL LPB features a 19,200 bps data rate, flexible transparent or packet-based protocol, and adapts to most survey applications. Its design boasts a lightweight, dust-proof all-weather enclosure and built-in antenna and pole mounts. The company also announced the addition of a 410-430 MHz frequency band for its PDL LPB radio modems.

Cast Contracts with USAF

CAST Navigation **(Booth 421/423/425/427)** has announced an initial contract award from the United States Air Force for the company's EMT3500 system. CAST's EMT3500 product line provides field support and trouble shooting tools for both the LN100G and H764G EGI (embedded GPS inertial). The EMT3500-1 flight line support product performs tasks such as uploading Operational Flight Program and GPS Embedded Module software, reading or writing an almanac, and supporting Built In Test operations. The EMT 3500-3 includes these capabilities and also enables testing of both the GPS module and the inertial sensor.

Plenary, *continued from page 1*

ability of the user equipment to acquire, track, and demodulate signals from specific satellites in the presence of ambient noise as well as the presence of other satellite and non-satellite signals operating in the RNSS band," he said. "Policy compatibility addresses the issue of whether the operation of one system interferes with the policy of the other country or region."

A case in point, McGurn said, might be the overlay of civil signals of one system on military frequencies of the other.

"The challenge, and the promise," he continued, "is to get this right."

UWB Threatens from the Sideline

Perhaps of most concern when it comes to interference is the threat from UWB.

Radio signals, whether they are used for communications, location determination, remote sensing, or some other purpose, are almost all generated by modulating a sinusoidal carrier wave. This signal energy is concentrated in a fairly narrow band, permitting a large number of signals to share the frequency real estate. But UWB is different. Its signals are generated as a sequence of very short pulses, spreading the signal energy over a large swath of the radio spectrum.

The threat of UWB interference to the GPS signal first came to light in 1998 when the FCC initiated an inquiry to investigate permitting operation of unlicensed UWB radio systems under Part 15 of its regulations. Proponents of the proposal want to use UWB for a wide range of mobile devices that could image objects behind walls or underground; permit short-range, high-speed data transmission for broadband Internet access; and enable secure, covert communications. Some argue that these devices could operate in the radio spectrum already occupied without causing interference. Others contend, though, that GPS, with its relatively weak signals, could be disabled by such actions.

In 2000, FCC issued a notice of proposed rulemaking on the issue, which set off a flurry of filings by both advocates and proponents. Vigorous lobbying by civil and military agencies led the FCC to set emission limits on UWB devices (which must remain above 1.99 GHz or below 960 MHz) in a February ruling. However, the commission intends to revisit these standards in the next several months. The panel, and the U.S. GPS Industry Council, urge continued vigilance on behalf of GPS as this issue continues to be debated. ◆

Need More Interference?

Want to learn more about the interference issue? Then you will want to Attend Session B2 from 2 p.m. to 5:30 p.m. in room C123/124. Led by moderators Robert Erlandson of Rockwell Collins and Dana Howell from Air Force Research Labs/SNAR, the "Jamming and Unintentional Interference" track will provide an update on the assessment of the GNSS L1 radio frequency interference environment and provide research results from a variety of interference investigations.

PROGRAM CHANGES: SEPTEMBER 25, 2002

Session F1: Paper #1, On the Calibration of Site Dependent Absolute Carrier-Phase Multipath, withdrawn. Replaced with Alternate Paper #1, A GPS C/A Code Tracking Loop Based on Extended Kalman Filter with Multipath Mitigation.

Session D2: Paper #4, GEO Signals Interoperability Critical to GNSS Use for Aeronautical Applications, withdrawn. Replaced with Alternate Paper #1, GRAS Applications: EGNOS TRAN.

Session E2: Paper #5, Intelligent Skyscraper Monitoring System Based on GPS and Optical Fibre Sensors, moved to Alternate Paper #3.

Session E2: Alternate Paper #1, Indoor and Outdoor Navigation for the Blind: An Integrated Approach for a New Product, moved to Paper #5.

TODAY'S SPECIAL EVENTS

SPOUSES TOUR
Portland City Tour and High Tea; 9 a.m. – 5 p.m., $70
A wonderful way to acquaint you with all the charm of Portland.

SPEAKER LUNCHEON
"Out of Africa" With Andrew Mallory; noon – 2 p.m., Oregon Ballroom
Included in a full registration. Partial registrant and guest tickets are $40 at the registration desk.

ICE CREAM BREAK
Sponsored by Northrup Grumman, Exhibit Hall, Booth 323/325, 3:35 p.m.

EXHIBITOR HOSTED RECEPTION
7 – 9 p.m., Exhibit Hall
Join this year's exhibitors for an evening of information and cuisine. All the exhibit booths will be open. Included with any type of registration. Spouses welcome.

CHECK IT OUT

The ION Business Center. The ION Business Center will be in **Room A103/104,** on the second floor of the Oregon Convention Center. Hours are Wednesday, 8 a.m. – 5:30 p.m.; Thursday, 8 a.m. – 5:30 p.m.; and Friday, 8 a.m.–noon.

Advance copies of technical papers presented at the conference will be available for $3 each. (This fee helps offset the cost of this service and does not result in a profit to the Institute or the meeting.) Only papers submitted by the author will be available. If a desired paper is not available, we suggest you contact the author directly.

The CD-ROM version of the proceedings will be mailed approximately 12 weeks after the conference.

Job Board. A self-service styled job board will be available outside the Business Center. Please use the space provided to post any openings your organization may have.

Fax Service. Need to receive a fax? Tell your office to send it to the Business Center at (503) 963-5700. For a small fee, the center will receive the fax and post your name on the message board asking you to retrieve your document. We recommend you also leave your host hotel's phone number and send messages there as well.

Need Internet Access? Feel free to use the computer stations in the registration area to log-on and check your e-mail, or simply use the connection with a personal computer. Please limit your time on-line if others are waiting. A special thanks goes to Applanix for providing these stations.

Satellite Division, *continued from page 1*

rad of The University of Colorado, chair; John Lavrakas of Overlook Systems Technologies, vice chair; Dr. Boris Pervan of The Illinois Institute of Technology, secretary; John Clark of Aerospace Corp., treasurer; Ron Hatch of Navcom Technology, immediate past chair; SQNLDR Robert Bunton of the Australian Air Force, Asian technical advisor; and Lyn Dutton of Thales, European technical advisor.

Meet Professor Lachapelle

This year's Program Chair is Dr. Gérard Lachapelle from the University of Calgary. Professor Lachapelle holds a research chair in navigation, positioning, and wireless location in the Department of Geomatics Engineering, University of Calgary. Prior to 1988, he was responsible for various industrial GPS R&D programs. He is well known for his contributions to GPS methods and software. He is also co-inventor of a cellular telephone positioning technique. He has been involved in the ION in various capacities for the past 15 years, including chair of the ION Alberta Chapter, and is currently the Western Region Vice-President. He has received numerous awards for his work, including the ION Satellite Division's Johannes Kepler Award in 1997.

About Dr. Van Dierendonck

This year's Program Chair is Dr. A.J. Van Dierendonck, an international consultant at AJ Systems and a general partner of GPS Silicon Valley. He has worked on the NAVSTAR Global Positioning System for over 28 years. AJ is an ION Fellow and has received numerous awards from the ION — the Burka Award (twice), the Kepler Award, and the Thurlow Award. He is also an IEEE Fellow and is in the U.S. Air Force's GPS Hall of Fame. AJ's current activities include such subjects as ionospheric scintillation effects on GPS, GPS and SBAS intrasystem interference, GPS spectrum protection, and future GPS and SBAS civil signal structures and their compatibility with Galileo.

Additionally, GPS 2002 has six track chairs: Marie Lage, ARINC; Dr. Gary McGraw, Rockwell Collins; Dr. John Studenny, CMC Electronics; Alan Schuster Bruce, Thales Avionics, Prof. Bernd Eissfeller, University of Munich; and Bryan Townsend, Roberton Enterprises.

The meeting and division are successful because of you. Division officers, the GPS 2002 organizing committee, ION members and volunteers show their appreciation each year by presenting a technical program that is relevant, current, and educational. Enjoy the week! ◆

WAAS/LAAS Receivers

dependability for safety critical navigation

NovAtel supplies receivers to national satellite-based augmentation systems (SBAS) around the world: the U.S. WAAS, the European EGNOS, Japanese MSAS and Chinese SNAS. These complex receivers incorporate NovAtel's Narrow Correlator® tracking technology and MEDLL® multipath reduction technology, process WAAS signals from geostationary satellites and include dual frequency L1/L2 signal reception.

NovAtel's LGF4 receiver is designed for LAAS ground reference sites. The receiver provides extremely high accuracy and integrity for Category I precision approaches. The LGF4 includes an L1/L1 RF front-end, GPS Satellite Quality Monitoring and tracking for up to 19 GPS and 4 GEO satellites.

OEM4 with API

performance for universal integration

NovAtel's OEM4 receiver now comes with a unique new feature – Application Programming Interface (API). This feature allows for the addition of your specialized application software to the OEM4 hardware platform. What this means to the system developer is that they can now focus exclusively on their application development rather than peripheral hardware development and maintenance. And ultimately, NovAtel's OEM4 with API will result in end-user positioning system products that are smaller, less expensive, more reliable and easier to upgrade.

Accuracy is the name of the game.

ProPak®-LB

flexibility for yield maximization

NovAtel's newest product, the ProPak-LB, is the first GPS receiver integrated with OmniSTAR-HP satellite-based correction services. The ProPak-LB delivers new levels of precise positioning without the need for a base station. This product also features 3 bi-directional COM ports, access to strobe signals and field-upgradeable software.

Pinwheel™ Technology

precision for unmanned systems

NovAtel's GPS-600 antenna features its patent pending Pinwheel aperture coupled slot array technology. It is the industry's first GPS dual-frequency antenna to achieve less than 1-millimeter offset between L1 and L2 phase centers without the aid of a choke ring. Intended for kinematic positioning, its compact size enables portability while the sealed randome allows the antenna to be used in severe weather, marine applications and hostile environments.

Visit NovAtel's exhibit and learn more about its leading edge, precise positioning technologies. You can believe anything is possible again.

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Now, what's tomorrow's challenge?