

**ADVANCE PROGRAM**

**THIRTY-SECOND ANNUAL  
PRECISE TIME AND TIME INTERVAL (PTTI)  
SYSTEMS AND APPLICATIONS MEETING**

November 28-30, 2000



32 Years of Progress  
1969-2000

Hyatt Regency Hotel  
Reston, Virginia

## The Schedule

### Monday, November 27, 2000

0800-1300	Pipe and Drape Set-Up for Exhibitors
0830-1600	Navtech Seminars Tutorials
1300-2000	Exhibitor Set-Up
1900-2100	Registration - PTTI Meeting*
1900-2100	Committee on GPS and GLONASS Time Transfer Standards

### Tuesday, November 28, 2000

0700-0800	Speakers' Breakfast
0700-1500	Speakers' Room Open
0700-0800	Attendees' Breakfast
0715-1600	Registration - Grand Ballroom Foyer
0800-1700	Technical Exhibits
0800-0900	Opening Session and Keynote
0900-1030	Session I
1030-1050	Intermission - Exhibits Area
1050-1150	Session II
1150-1320	Attendees' Lunch
1320-1440	Session III
1440-1500	Intermission - Exhibits Area
1500-1620	Session III (con't)
1620-1720	Session IV
1830-2030	Reception

### Wednesday, November 29, 2000

0700-0800	Speakers' Breakfast
0700-1600	Speakers' Room
0700-0800	Attendees' Breakfast
0800-1600	Registration
0800-1700	Technical Exhibits
0800-0920	Session V
0920-1020	Session VI
1020-1040	Intermission - Exhibits Area
1040-1140	Session VII
1140-1300	Attendees' Lunch
1300-1420	Session VIII
1420-1440	Intermission - Exhibits Area
1440-1640	Poster Session
1730-1830	Joint PTTI Executive Board and Advisory Board Meeting
1900-2030	Evening Speaker

### Thursday, November 30, 2000

0700-0800	Speakers' Breakfast
0700-1200	Speakers' Room
0700-0800	Breakfast
0800-1000	Registration
0800-1000	Session IX
1000-1020	Intermission - Pre-Function Area
1020-1140	Session X
1140-1150	Closing Session
1150-1200	Close of Meeting

\*Registration for the PTTI Meeting is available each day. Exhibits will be open Tuesday and Wednesday only.

**REGISTRATION CARD  
32<sup>nd</sup> ANNUAL  
PRECISE TIME AND TIME INTERVAL  
SYSTEMS AND APPLICATIONS  
NOVEMBER 28-30, 2000**

NAME \_\_\_\_\_  
First Name \_\_\_\_\_ Initial \_\_\_\_\_ Last Name \_\_\_\_\_

AGENCY \_\_\_\_\_  
Company or Organization \_\_\_\_\_

ADDRESS \_\_\_\_\_  
Street \_\_\_\_\_  
City, State or Country \_\_\_\_\_

TELEPHONE \_\_\_\_\_ FAX \_\_\_\_\_

E-MAIL \_\_\_\_\_  
\_\_\_\_\_

Registration (will pay on-site)

Registration – Amount Enclosed \$ \_\_\_\_\_

† \$250.00 if postmarked on or before November 1, \$275.00 thereafter;

‡ Student/Retiree fee - \$50.00

Hardcopy of Proceedings (\$35.00) - Amount Enclosed \$ \_\_\_\_\_

Will attend Reception      Additional Reception Tickets (\$30 each)

Guest Breakfast Tickets (\$20 ea.)      Guest Lunch Tickets (\$25 ea.)

No. \_\_\_\_\_ Amount Enclosed \$.\_\_\_\_\_

Additional copies of the Proceedings (\$100 each)

Amount Enclosed \$ \_\_\_\_\_

(Mark here if purchasing Proceedings only)

† Covers entry to all sessions, one Reception ticket, and one copy of the Proceedings on CD in Adobe Acrobat (pdf) format

‡ Must be fully retired or full-time student to qualify for the reduced registration fee. Covers entry to sessions and exhibits only.

Make checks payable to Treasurer, PTTI; This year PTTI will accept credit card payments only through the PTTI website. Please see the website for details. Credit cards cannot be accepted at the registration desk.

Speaker \_\_\_\_\_  
Session Chairman \_\_\_\_\_  
Exhibitor \_\_\_\_\_

Questions? Contact Ms. Jardine at 202-762-1414 or  
[nikki@spica.usno.navy.mil](mailto:nikki@spica.usno.navy.mil)

**Ms. Nicolette Jardine**  
PTTI Registration  
U.S. Naval Observatory  
Time Service Department  
3450 Massachusetts Avenue, NW  
Washington, D.C. 20392-5420

Place  
Stamp  
Here

**ADVANCE PROGRAM**

**THIRTY-SECOND ANNUAL  
PRECISE TIME AND TIME INTERVAL (PTTI)  
SYSTEMS AND APPLICATIONS MEETING**

Sponsored by

U.S. Naval Observatory  
U.S. Naval Research Laboratory  
NASA Jet Propulsion Laboratory  
U.S. Air Force Office of Scientific Research  
Defense Information Systems Agency  
U.S. Coast Guard Navigation Center  
U.S. Army Research Office

November 28-30, 2000



Hyatt Regency Hotel  
Reston, Virginia

## TABLE OF CONTENTS

Schedule.....	Inside Front Cover
Objectives.....	iii
Meeting Information: .....	iv
Registration.....	iv
Registration Card.....	Front of Book
Cancellation Policy .....	iv
PTTI Home Page .....	v
Tutorials .....	v
Hotel Reservations and Information .....	vi
Hotel Reservation Card ( <b>Reserve early</b> ) .....	Back of Book
Transportation (air, rental cars, airport transportation) .....	vii
Parking.....	vii
Map and Directions.....	viii
Messages .....	ix
Exhibit Information .....	ix
List of Potential Exhibitors for PTTI 2000.....	ix
Speakers' Room .....	x
Presented Papers .....	x
Proceedings .....	x
Temperature .....	x
33rd Annual Meeting.....	x
PTTI Executive Committee .....	xi
PTTI Meeting Officers .....	xii
PTTI Award Committee.....	xiii
PTTI Advisory Board.....	xiv
PTTI Session Chairs.....	xv
Agenda .....	xvi

## OBJECTIVES

The objectives of the PTTI Systems and Applications Meetings are to:

- Disseminate and coordinate PTTI information at the user level
  - Review present and future PTTI requirements
  - Inform Government and Industry engineers, technicians, and managers of precise time and frequency technology and its problems
  - Provide an opportunity for an active exchange of new technology associated with PTTI
- 

This year, PTTI 2000 addresses:

- Advances in Frequency and Timing Systems
- Telecommunications, Utilities, Internet Protocol, and Network Timing
- GPS, GLONASS and Two-Way Satellite Time Transfer
- WAAS, EGNOS and MSAS GPS Augmentation Systems
- Time Scales
- Panel Discussion: Leap Second and Future Considerations
- Future Timing and Frequency Applications
- PTTI Vendor Presentations

## **WELCOME TO PTTI 2000**

### **MEETING INFORMATION**

#### **Registration**

Please send the PTTI registration form to:

Ms. Nicolette Jardine  
PTTI Registration  
U.S. Naval Observatory  
Time Service Department  
3450 Massachusetts Avenue, N.W.  
Washington, D.C. 20393-5420  
202-762-1414 FAX 202-762-1511  
e-mail: jardine.nicolette@usno.navy.mil

**The registration fee is \$275.00. Note: If payment is received postmarked before November 1, 2000 the cost is \$250.00.**

The full registration fee includes entry to all the sessions, the exhibit area, a copy of the Proceedings, the welcoming reception, breakfast and lunch on Tuesday and Wednesday, breakfast Thursday, and a special presentation on Wednesday evening. Guest tickets are \$30.00 for the reception, \$20.00 for breakfast and \$25.00 for lunch.

The registration fee for students and full-time retirees is \$50.00 and includes entry to the scientific sessions and the exhibit area only. It does not include a copy of the Proceedings, entry to breakfasts, lunches, the reception, or the Wednesday evening special presentation.

Please make checks payable to: Treasurer, PTTI. This year PTTI will accept credit card payments only through the PTTI website. Please see the website for details. Credit cards cannot be accepted at the registration desk. Attendees, including presenters and exhibitors, must register and receive a badge and badges must be worn for admission to all sessions and functions. Badges for registered attendees are not transferable.

Visitor badges for the exhibit area only may be obtained at the registration desk. The exhibit area is open to everyone.

PTTI 2000 proceedings will be provided on a CD in Adobe Acrobat (pdf) format. For those wishing to have a hardcopy version instead, a printed copy may be requested for an additional \$35 at the time of registration.

#### **Cancellation Policy**

All requests for cancellation must be received in writing before November 8, 2000. On or after November 8th there is a \$140.00 cancellation fee. Refunds are not given for "no shows"; however, substitutions are allowed.

## PTTI 2000 Home Page

Access the PTTI 2000 Home Page from the World Wide Web at:

<http://tycho.usno.navy.mil/ptti.html>

PTTI 2000 on-line registration is also available via the PTTI Home Page.

<http://tycho.usno.navy.mil/pttiregform.html>

Please remember to take advantage of the early registration fee. Payment has to be received postmarked on or before November 1, 2000.

## PTTI 2000 Tutorials

Navtech Seminars will offer tutorials prior to the PTTI 2000 technical sessions on Monday, November 27, 2000.

The tutorial sessions planned are:

### Morning Session

#### **Time and Time Transfer with GPS (D. Matsakis)**

- What is Time? (definitions and concepts)
- Description and performance of physical clocks
- Clock Characterization
- Time Scales and Clock Steering
- Time Transfer Techniques
- Future Accuracy Requirements and Technologies

### Afternoon Session

#### **GPS Carrier Phase Techniques for Timing Applications (J. Levine)**

Who should attend:

- Those who are implementing or considering implementing timing systems for their applications.
- Professionals wanting background information on recent developments in the PTTI field.
- Conference attendees wishing to enhance their understanding of the technical sessions and exhibits at the PTTI meeting.

Full details will be available on the Navtech Seminars website <http://navtechgps.com>. Please register directly with Navtech Seminars. Cost \$575 for full day, \$295 for half day.

Navtech Seminars and GPS Supply  
6121 Lincolnia Road, Suite 400  
Alexandria, VA 22312-2707 USA

Tel: 703-256-8900

Fax: 703-256-8988

Toll free Canada and US: 1-800-628-0885

E-mail: [courses@navtechgps.com](mailto:courses@navtechgps.com)

Web: <http://navtechgps.com/>

## Questions

Please contact the following people for:

Technical/Scientific: Dr. Joseph White, 202-767-5111 or  
white@juno.nrl.navy.mil

Exhibits: Mr. Don Mitchell, 707-528-1230 x118 or  
dmitchell@trueitime.com

General: Mrs. Sheila Faulkner, 703-532-6411 or  
bopenyan@aol.com

Registration: Ms. Nikki Jardine, 202-762-1414 or  
jardine.nicolette@usno.navy.mil

## Registration Desk Hours

The registration desk will be open during the following hours:

27 November, Monday	- 1900 - 2100
28 November, Tuesday	- 0715 - 1600
29 November, Wednesday	- 0800 - 1600
30 November, Thursday	- 0800 - 1000

## Hotel Reservations

Mail or fax the hotel reservation card (found in the back of the book) to:

The Hyatt Regency Hotel at Reston Town Center  
(PTTI 2000 Meeting Room Block)  
1800 Presidents Street  
Reston Town Center  
Reston, Virginia 20190  
703-709-1234  
Fax 703-709-2291

If reservations are made by telephone, mention PTTI 2000 to receive the special sleeping room rate. The PTTI rate is available from November 24 through December 2, 2000.

**Check-in time is 1500 and check-out time is Noon. Rooms are held until 1600 (4:00 p.m. EST if not guaranteed for late arrival by a credit card or one night's deposit). The block of reserved rooms will be released November 13 so register early.** If rooms are available after that date, reservations will be accepted at the group rate. If you leave before your scheduled departure date without informing the Hyatt, you will be charged an early departure fee. The area offers a wide range of restaurants and shops.

## Transportation Airlines

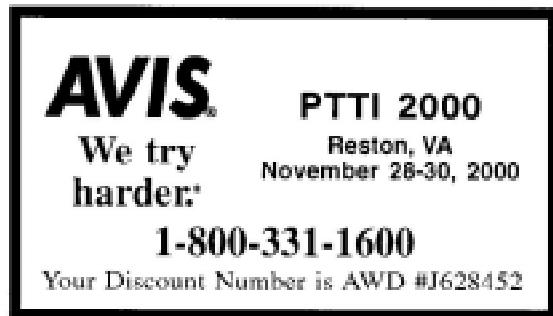
**United Airlines** has been chosen as the official carrier for **PTTI 2000** and is pleased to offer the best available airfares and schedules that fit your travel needs.

To obtain the best fares or schedule information, please call United's Meeting Desk at 1-800-521-4041. Reservationists are on duty 7 days a week from 0700 to Midnight EST. Please be sure to reference ID number 543ZO. The fares are available from November 25 through December 3, 2000. You or your travel agent should call without delay, as seats may be limited.

An additional 5% discount is available if you book and purchase a ticket at least 60 days in advance of the contracted travel dates. This increases the discount to 5% plus 5% off the lowest applicable fare or 10% plus 5% off the unrestricted coach fare.

## Rental Car

**Avis** has been chosen as the official rent-a-car company for **PTTI 2000**. To receive a reduced rate, call **1-800-331-1600** to book your reservation and give the Avis Meeting Sales Agent the Avis Worldwide Discount (AWD) number for PTTI 2000 - **J628452**. Special meeting rates are available one week before and one week after the meeting and include unlimited free mileage.



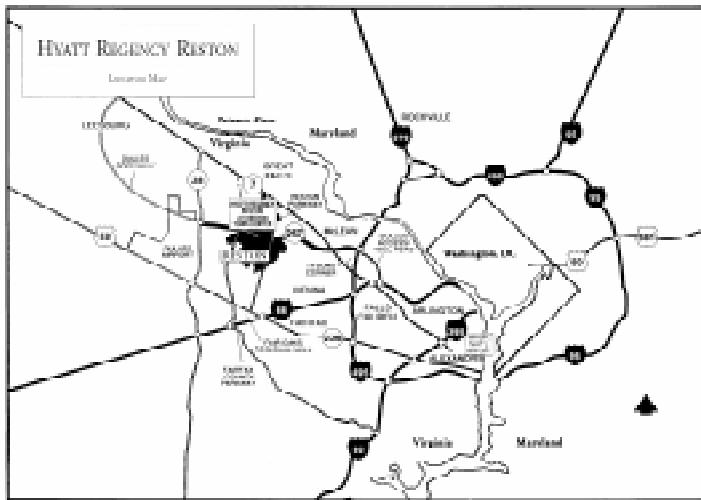
## Airport Shuttle

Complimentary hotel shuttle service is available from Dulles airport.

## Parking

Self and valet parking is available at the hotel. Parking for overnight guests; Self Parking is complimentary; valet parking is \$7.00 (day only) and \$14.00 overnight and includes unlimited in and out privileges

## Directions



### **DIRECTIONS TO HYATT REGENCY RESTON FROM:**

#### **Washington National Airport & Washington, DC —**

Follow signs to 1-66 West. (Be alert to late afternoon HOV restrictions.) From 1-66 West, take Exit 67, Dulles Airport Toll Road and follow it west to Exit 12, Reston Parkway. Turn right and continue  $\frac{1}{4}$  mile to second stop light. Hotel is on the left.

#### **Baltimore/New York —**

Follow 1-95 South to Washington DC beltway then exit right (west) onto 1-495. Follow 1-495 across the Potomac River into Virginia and exit right onto Rt. 267, Dulles Toll Road. At Reston, use Exit 12, Reston Parkway; turn right and proceed  $\frac{1}{4}$  mile to second stoplight. Hotel is on the left.

#### **Fredericksburg/Richmond —**

Follow 1-95 North to Washington, DC beltway (at Springfield), then exit onto 1-495 (north). Follow 1-495 to Rt. 267, Dulles Toll Road. At Reston, use Exit 12, Reston Parkway; turn right and proceed  $\frac{1}{4}$  mile to second stoplight. Hotel is on the left.

#### **Dulles International Airport —**

From airport take Dulles Access Road East toward Washington, DC. At Reston, take Exit 12, then left onto Reston Parkway and follow it north  $\frac{1}{4}$  mile to third stoplight. The hotel is on the left.

#### **Leesburg/Loudoun County —**

Two choices: (A) Follow Rt. 7 East to Dranesville and turn right onto Reston Parkway (Rt. 602). Proceed south approximately 3 miles. Hotel will be on the right. (B) Take Dulles Greenway Toll Road East past Dulles International Airport to Exit 12, Reston Parkway. Turn left onto Reston Parkway and follow it north  $\frac{1}{4}$  mile to third stoplight. Hotel is on the left.

#### **I-81 Corridor (North) — Hagerstown, Winchester —**

Follow 1-81 South to Winchester and exit onto Rt. 7 East. Follow Rt. 7 eastbound for approximately 50 miles to Dranesville and then turn right onto Reston Parkway (Rt. 602). Proceed south for approximately 3 miles. Hotel will be on the right.

#### **I-81 Corridor (South) — Roanoke, Harrisonburg —**

Follow 1-81 North to the Strasburg area then exit onto 1-66 East and go approximately 58 miles. After passing Rt. 28, look for and exit onto the Fairfax County Parkway and follow it north to the end. Exit right onto Sunset Hills Rd. East and proceed 1 mile to Reston Parkway. Turn left and hotel will be one block on the left.

## Messages

Messages may be left for PTTI attendees through the hotel's telephone number of 1-703-709-1234.

## Exhibit Information

The exhibit area is adjacent to the general session. For exhibit information, please contact:

Don Mitchell  
TrueTime, Inc.  
2835 Duke Court  
Santa Rosa, California 95407  
707-528-1230  
Fax 707-527-6640  
email: dmitchell@trutime.com

## List of Potential Exhibitors for PTTI 2000

Absolute Time  
Agilent Technologies  
Allen Osborne Associates  
Arbiter Systems, Inc.  
Brandywine Communications  
Datum  
Femtosecond Systems  
Frequency Electronics, Inc.  
GPS World  
Guide Technology  
Magellan Ashtech Products  
Motorola  
Oscilloquartz  
Perkin Elmer  
Composants Quartz & Electronique  
Quartzlock, U.K., Ltd.  
Septentrio Satellite Navigation  
SpectraDynamics, Inc.  
Spectrum Geophysical Instruments  
Stanford Research Systems  
Syntomics LLC  
Techtrol Cyclonetics, Inc.  
Temex Electronics  
3S Navigation  
Timing Solutions Corp.  
TIMEtech GmbH  
TRAK  
Trimble  
TrueTime, Inc.  
Zyfer, Inc. (Odetics Telecom)

### **Speakers' Room**

Please check the PTTI Registration Desk or the hotel's Function Board for the location of the Speakers' Room. Session chairs should alert their sessions' members to meet them in the Speakers' Room for the Speakers' Breakfast that is served each day. Beverages and speaker supplies are available during the day.

### **Presented Papers**

Papers in camera-ready form must be submitted to Dr. Lee A. Breakiron, Editorial Chairman, by November 28, 2000, unless prior arrangements have been made with him. If prior arrangements have not been made, the paper will not be published in the Proceedings.

### **Proceedings**

The proceedings will be mailed to the attendees in 2001. If you cannot attend, but wish to reserve a copy of the Proceedings, please return the Registration Card with a check for \$275.00 made out to Treasurer, PTTI. Please note on the card that you are not attending. Your reserved copy will be then sent to you. If you wish extra copies, they will also be available at \$100.00.

### **Temperature**

The climate during late November and early December in the Washington, DC area could be cool. A light coat or raincoat is recommended.

### **Thirty-third Annual PTTI Meeting**

The 33rd Annual PTTI Meeting will be held at the Hyatt Regency Hotel, Long Beach, California, November 27-29, 2001.

## **PTTI EXECUTIVE COMMITTEE**

**Dr. Joseph D. White**, Chairman  
U.S. Naval Research Laboratory

**Mr. Ronald L. Beard**  
U.S. Naval Research Laboratory

**Dr. Lee A. Breakiron**  
U.S. Naval Observatory

**Lieutenant David Fowler**  
U.S. Coast Guard

**Dr. Dennis D. McCarthy**  
U.S. Naval Observatory

**Captain Thomas R. Rice**  
U.S. Coast Guard

**Mr. William J. Ryan**  
Defense Information Systems Agency

**Dr. Howard Schlossberg**  
Deputy Assistant Secretary Air Force/AQR

**Dr. Robert L. Tjoelker**  
NASA Jet Propulsion Laboratory

**Ms. Francine M. Vannicola**  
U.S. Naval Observatory

**PTTI 2000 MEETING OFFICERS**

**GENERAL CHAIRMAN**

**MR. HUGO FRUEHAUF**

Zyfer, Inc.

**TECHNICAL PROGRAM COMMITTEE CHAIRMAN**

**DR. PAUL KOPPANG**

Datum, Timing -Test & Measurement

**TECHNICAL PROGRAM COMMITTEE CO-CHAIRMAN**

**DR. ANDY WU**

The Aerospace Corporation

**TECHNICAL PROGRAM COMMITTEE**

**DR. LEONARD S. CUTLER**

Agilent Laboratories

**MR. PAUL F. KUHNLE**

NASA Jet Propulsion Laboratory

**MR. DONALD MITCHELL**

TrueTime, Inc.

**DR. RICHARD L. SYDNOR**

NASA Jet Propulsion Laboratory

**MS. FRANCINE M. VANNICOLA**

U.S. Naval Observatory

**MR. S. CLARK WARDRIP**

SFA, Inc.

**EDITORIAL COMMITTEE CHAIRMAN**

**DR. LEE A. BREAKIRON**

U.S. Naval Observatory

**EXHIBITS AND PUBLICITY CHAIRMAN**

**MR. DON H. MITCHELL**

TrueTime, Inc.

**TECHNICAL ASSISTANCE**

**MR. HAROLD CHADSEY**

U.S. Naval Observatory

**MR. PAUL KUHNLE**

NASA Jet Propulsion Laboratory

**MEETING ARRANGEMENTS**

**MRS. SHEILA FAULKNER**

SFA, Inc.

**SUPPORT ASSISTANCE**

**Ms. Nicolette Jardine**

U.S. Naval Observatory

**DISTINGUISHED PTTI SERVICE AWARD COMMITTEE**

**DR. JOSEPH D. WHITE, CHAIRMAN**  
U.S. Naval Research Laboratory

**DR. LEONARD S. CUTLER**  
Agilent Laboratories

**DR. DENNIS McCARTHY**  
U.S. Naval Observatory

**MR. DON H. MITCHELL**  
TrueTime, Inc.

**DR. RICHARD L. SYDNOR**  
NASA Jet Propulsion Laboratory

*RECIPIENTS  
OF THE  
DISTINGUISHED PTTI SERVICE AWARD*

1994

**DR. GERNOT M. R. WINKLER**  
U.S. Naval Observatory (Retired)

1995

**DR. JAMES A. BARNES**

National Institute of Standards and Technology (Retired)

1996

**PROFESSOR SIGFRIDO M. LESCHIUTTA**

Politecnico di Torino  
and

Istituto Elettrotecnico Nazionale Galileo Ferraris

1997

**PROFESSOR BERNARD RENE GUINOT**

Honorary Astronomer  
Paris Observatory

1998

**DR. JACQUES VANIER**

National Research Counsel (Retired)

1999

**DR. LEONARD S. CUTLER**  
Agilent Laboratories

## **2000 ADVISORY BOARD MEMBERS**

**Mr. S. Clark Wardrip, Chairman**  
SFA, Incorporated

**Professor Carroll O. Alley**  
University of Maryland

**Mr. Martin B. Bloch**  
Frequency Electronics,  
Incorporated

**Mrs. Mary Chiu**  
Applied Physics Laboratory

**Dr. Leonard Cutler**  
Agilent Laboratories

**Mrs. Sheila Faulkner**  
SFA, Incorporated

**Mr. Hugo Fruehauf**  
Zyfer, Incorporated

**Mr. Robert H. Kern**  
KERNCO, Incorporated

**Dr. William J. Klepczynski**  
Innovative Solutions  
International

**Dr. Paul A. Koppang**  
Datum, Timing – Test &  
Measurement

**Mr. Paul F. Kuhnle**  
NASA Jet Propulsion  
Laboratory

**Mr. Donald H. Mitchell**  
TrueTime, Incorporated

**Mr. Jerry Norton**  
The Johns Hopkins University  
Applied Physics Laboratory

**Dr. Bradford W. Parkinson**  
Stanford University

**Dr. Victor S. Reinhardt**  
Hughes Space and  
Communications

**Mr. William J. Riley**  
Datum, Timing – Test &  
Measurement

**Dr. Henry Robinson**  
Duke University

**Mr. Ronald C. Roloff**  
Geil Marketing Associates

**Dr. Samuel R. Stein**  
Timing Solutions Corporation

**Dr. Richard L. Sydnor,**  
NASA Jet Propulsion  
Laboratory

**Dr. Andy Wu**  
The Aerospace Corporation

**PTTI 2000 SESSION CHAIRS**

**SESSION I- Vendor Presentations**

MR. ALECK HOLCOMB  
TrueTime, Inc.

**SESSION II- GPS Augmentation**

DR. WILLIAM KLEPCZYNSKI  
Innovative Solutions International

**SESSION III- GPS and GLONASS Time Transfer**

MS. LISA NELSON  
National Institute of Standards and Technology

**SESSION IV- Time Scales I**

DR. DEMETRIOS MATSAKIS  
U.S. Naval Observatory

**SESSION V – Two-way Satellite Time Transfer**

DR. FRANÇOISE BAUMONT  
Observatoire de Besançon

**SESSION VI- Leap Seconds**

DR. DENNIS McCARTHY  
U.S. Naval Observatory

**SESSION VII – Time Scales II**

DR. DEMETRIOS MATSAKIS  
U.S. Naval Observatory

**SESSION VIII – Advanced Frequency and Time Systems**

DR. ROBERT TJOELKER  
NASA Jet Propulsion Laboratory

**SESSION IX – Future Applications**

COMMANDER CHRIS GREGERSON  
U.S. Naval Observatory

**SESSION X - Telecommunications and Network Timing**

MR. ED BUTTERLINE  
Symmetricom

**POSTER SESSION**

DR. ANDY WU  
The Aerospace Corporation

**PTTI 2000**

**THIRTY-SECOND ANNUAL  
PRECISE TIME AND TIME INTERVAL (PTTI)  
SYSTEMS AND APPLICATIONS MEETING**

**TUESDAY, NOVEMBER 28, 2000**

**0800-0805      OPENING**  
Hugo Fruehauf, Zyfer, Inc.

**0805-0815      OPENING REMARKS**  
Captain B.J. Jaramillo, U.S. Naval Observatory

**0815-0830      DISTINGUISHED PTTI SERVICE**  
**AWARD** Presented by: Joe White, U.S. Naval Research Laboratory

**0830-0835      CALL TO SESSION**  
Paul Koppang, Datum-Timing, Test & Measurement

**0835-0900      KEYNOTE SPEAKER, IN THE BEGINNING OF GPS**, Roger Easton, U.S. Naval Research Laboratory (retired)

**SESSION I**      **PTTI VENDOR PRESENTATIONS,**  
**0900-1030**      Chairman: Aleck Holcomb, TrueTime, Inc.

**1030-1050      INTERMISSION**

**SESSION II**      **GPS AUGMENTATION**  
Chairman: William Klepczynski Innovative Solutions International

**1050-1110      Paper 1: CAPABILITIES OF THE WAAS AND EGNOS FOR TIME DISTRIBUTION AND TIME TRANSFER,**  
W. Klepczynski, Innovative Solutions International; E. Powers, U.S. Naval Observatory; P. Fenton, NovAtel, Canada; M. Brunet, CNES, France and R. Douglas, NRC, Canada

**1110-1130      Paper 2: WAAS, EGNOS, MSAS FOR TELECOM SYNC**, H. Fruehauf, Zyfer, Inc.

**TUESDAY, NOVEMBER 28, 2000**

1130-1150	<b>Paper 3: MODELISATION AND EXTRAPOLATION OF TIME DEVIATION OF USO AND ATOMIC CLOCKS IN GNSS-2 CONTEXT</b> J. Delporte, M. Brunet and Thierry Tournier, Centre National d'Etudes Spatiales, France; and F. Vernotte, Observatoire de Besancon, France
1150-1320	<b>ATTENDEES LUNCH (Provided)</b>
SESSION III	<b>GPS AND GLONASS TIME TRANSFER</b> , Chairman: Lisa Nelson, National Institute of Standards and Technology
1320-1340	<b>Paper 4: EVALUATING THE ACCURACY OF GPS CARRIER-PHASE FREQUENCY TRANSFER USING DATA FROM NIST AND PTB</b> , L. Nelson and J. Levine, National Institute of Standards and Technology
1340-1400	<b>Paper 5: A TRANSATLANTIC GeTT TIME TRANSFER EXPERIMENT - LATEST RESULTS</b> , R. Dach, T. Schildknecht and T. Springer, Astronomical Institute, University of Berne, Switzerland; and G. Dudle and L. Prost, Swiss Federal Office of Metrology, Switzerland
1400-1420	<b>Paper 6: EVALUATION AND PRELIMINARY RESULTS OF THE NEW USNO GPS PPS TIMING RECEIVER</b> , M. Miranian, E. Powers, L. Schmidt and F. Vannicola, U.S. Naval Observatory
1420-1440	<b>Paper 7: ABSOLUTE AND RELATIVE CALIBRATION OF CARRIER PHASE GPS RECEIVERS</b> , E. Powers, U.S. Naval Observatory
1440-1500	<b>INTERMISSION</b>

**TUESDAY, NOVEMBER 28, 2000**

- 1500-1520 **Paper 8: RESULTS FROM TIME TRANSFER EXPERIMENTS BASED ON GLONASS P-CODES MEASUREMENTS FROM RINEX FILES**, F. Roosbeek, P. Defraigne and C. Bruyninx, Royal Observatory of Belgium
- 1520-1540 **Paper 9: RECOVERING UTC(USNO,MC) WITH INCREASED ACCURACY USING A FIXED L1-CA CODE GPS RECEIVER**, R. Giffard, Agilent Laboratories
- 1540-1600 **Paper 10: PROGRESS ON A NEW GPS COMMON-VIEW RECEIVER**, M. Weiss, National Institute of Standards and Technology
- 1600-1620 **Paper 11: THE INFUSION OF MCS KALMAN FILTER DATA INTO GPS BLOCK II/IIA FREQUENCY STANDARD ANALYSIS TECHNIQUES**, G. Dieter, G. Hatten and J. Taylor, Boeing Space and Communication Services
- SESSION IV** **TIME SCALES I**  
Chairman: Demetrios Matsakis, U.S. Naval Observatory
- 1620-1640 **Paper 12: TIME LINKS FOR THE CONSTRUCTION OF TAI**, J. Azoubib and W. Lewandowski, Bureau International des Poids et Mesures, France
- 1640-1700 **Paper 13: TOWARDS A METHOD FOR COMBINING A GROUP OF TIME TRANSFER LINKS TO FORM AN OPTIMAL COMPOSITE**, J. Davis, S. Shemar, J. Clarke, P. Harris and M. Cox, National Physical Laboratory, United Kingdom
- 1700-1720 **PAPER 14: A REVISED WAY OF FIXING AN UPPER LIMIT TO CLOCK WEIGHTS IN TAI COMPUTATION**, J. Azoubib, Bureau International des Poids et Mesures, France
- 1830-2030 **RECEPTION**

**WEDNESDAY, NOVEMBER 29, 2000**

**SESSION V TWO-WAY SATELLITE TIME**

**TRANSFER, Chairman: Françoise  
Baumont, Observatoire de  
Besançon, France**

**0800-0820 Paper 15: RESULTS OF A  
CONTINUOUS TRANSATLANTIC TWO-  
WAY SATELLITE TIME TRANSFER  
TEST USING COMMERCIAL SATELLITE**

**MODEMS,** T. Celano, Timing Solutions  
Corporation; S. Francis, Zeta Associates;  
A. Gifford, National Institute of Standards  
and Technology

**0820-0840 Paper 16: TWO-WAY FREQUENCY  
TRANSFER VIA SATELLITE USING  
CARRIER PHASE,** W. Schafer,  
T. Kuhn and A. Pawlitzki, TimeTech,  
Germany

**0840-0900 Paper 17: TWSTFT NETWORK STATUS  
IN THE PACIFIC RIM REGION AND  
DEVELOPMENT OF A NEW TIME  
TRANSFER MODEM FOR TWSTFT,**  
M. Imae, M. Hosokawa and Y. Hanado,  
Communications Research Laboratory,  
Japan; L. Zhigang, Shaanxi Astronomical  
Observatory, China; P. Fisk, National  
Measurement Laboratory, Australia;  
Y. Nakadan, National Research Institute of  
Metrology, Japan; and C. Liao,  
Telecommunication Laboratories, Taiwan

**0900-0920 Paper 18: REPORT ON THE 8TH  
MEETING OF THE BIPM WORKING  
GROUP ON TWO WAY SATELLITE  
TIME AND FREQUENCY TRANSFER,**  
W. Klepczynski, Innovative Solutions  
International; and W. Lewandowski,  
Bureau International des Poids et  
Mesures, France

WEDNESDAY, NOVEMBER 29, 2000

**SESSION VI LEAP SECONDS: PANEL**

**DISCUSSION**

**Chairman: Dennis McCarthy, U.S.  
Naval Observatory**

**0920-0930 Paper 19: RELATING TIME TO THE  
EARTH'S VARIABLE ROTATION, H.  
Chadsey and D. McCarthy, U.S. Naval  
Observatory**

**0930-0940 REASONS FOR A CHANGE,  
D. McCarthy, U.S. Naval Observatory**

**0940-0950 REASONS NOT TO CHANGE,  
S. Malys, National Imagery and  
Mapping Agency**

**0950-1020 OPEN DISCUSSION**

**1020-1040 INTERMISSION**

**SESSION VII TIME SCALES II**

**Chairman: Demetrios Matsakis, U.S.  
Naval Observatory**

**1040-1100 Paper 20: A TOTAL ESTIMATOR OF  
THE HADAMARD FUNCTION USED  
FOR GPS OPERATIONS, D. Howe,  
National Institute of Standards and  
Technology; R. Beard, U.S. Naval  
Research Laboratory; C. Greenhall, Jet  
Propulsion Laboratory; F. Vernotte,  
Observatoire de Besancon, France**

**1100-1120 Paper 21: ON DEVELOPING AN  
INTEGRATED IGS FREQUENCY SCALE,  
K. Senior and D. Matsakis, U.S. Naval  
Observatory**

**1120-1140 Paper 22: PERFORMANCE AND  
CHARACTERIZATION OF U.S. NAVAL  
OBSERVATORY CLOCKS, L. Breakiron  
and D. Matsakis, U.S. Naval Observatory**

**1140-1300 ATTENDEES LUNCH (Provided)**

**WEDNESDAY, NOVEMBER 29, 2000**

**SESSION VIII ADVANCED FREQUENCY AND TIME SYSTEMS**  
Chairman: Robert Tjoelker, NASA Jet Propulsion Laboratory

- 1300-1320     **Paper 23: THEOREICAL AND EXPERIMENTAL STUDY OF LIGHT SHIFT IN CPT-BASED RB VAPOR CELL FREQUENCY STANDARD**, M. Zhu and L. Cutler, Agilent Laboratories
- 1320-1340     **Paper 24: PRELIMINARY RESULTS FROM THE USNO ATOMIC FOUNTAIN DEVELOPMENT PROJECT**, T. Swanson, E. Burt, and C. Ekstrom, U.S. Naval Observatory
- 1340-1400     **Paper 25: STABILIZED REFERENCE FREQUENCY DISTRIBUTION FOR RADIO SCIENCE WITH THE CASSINI SPACECRAFT AND THE DEEP SPACE NETWORK**, M. Calhoun, R. Wang, A. Kirk, G. Dick, and R. Tjoelker, NASA Jet Propulsion Laboratory
- 1400-1420     **Paper 26: A 100 GHZ LOW PHASE NOISE CLOCK BASED UPON SUPERCONDUCTING ELECTRONICS**, J. Luine, D. Durand, R. Sandell, A. Smith, J. Ostrick, and M. Wire, TRW Space and Electronics Group
- 1420-1440     **INTERMISSION**
- 1440-1640     **POSTER SESSION**  
Chairman: Andy Wu, The Aerospace Corporation  
  
**Poster 1: THE TIME LINKS BETWEEN CSAO AND CRL — TWSTFT AND GPS COMMON VIEW**, L. Huanxin and W. Zhengming, Shaanxi Astronomical Observatory, China

WEDNESDAY, NOVEMBER 29, 2000

**Poster 2: DISCRIMINATING A  
GRAVITATIONAL WAVE  
BACKGROUND FROM INSTRUMENTAL  
NOISE IN THE LISA  
INTERFEROMETRIC DETECTOR,**  
M. Tinto, J. Armstrong, and F. Estabrook,  
NASA Jet Propulsion Laboratory

**Poster 3: TIME AND FREQUENCY  
ACTIVITIES AT THE CSIR - NATIONAL  
METROLOGY LABORATORY,** E. Marais,  
CSIR - National Metrology Laboratory,  
South Africa

**Poster 4: THE DEVELOPMENT OF  
MULTI-CHANNEL GPS RECEIVERS AT  
THE CSIR - NATIONAL METROLOGY  
LABORATORY,** E. Marais, CSIR -  
National Metrology Laboratory, South  
Africa

**Poster 5: USNO ALTERNATE MASTER  
CLOCK (AMC) STEERING,** S. Hutsell,  
USNO Alternate Master Clock; and  
P. Koppang, Datum-Timing, Test &  
Measurement

**Poster 6: ONE-WAY GPS TIME  
TRANSFER 2000,** S. Hutsell, USNO  
Alternate Master Clock; Captain M. Rivers  
and 1 Lt T. Kelkenberg, U.S. Air Force

**Poster 7: OVERVIEW OF RESEARCH  
ACTIVITIES ON TIME AND FREQUENCY  
AT COMMUNICATIONS RESEARCH  
LABORATORY,** M. Hosokawa, N. Kotake,  
K. Imamura and N. Kurihara,  
Communications Research Laboratory,  
Japan

**WEDNESDAY, NOVEMBER 29, 2000**

**Poster 8: MULTI-PURPOSE TIME  
ANALYZER AND MONITOR FOR DEEP  
SPACE NETWORK TIME  
SYNCHRONIZATION,** J. Gonzalez, Jr.,  
M. Calhoun, S. Cole, and R. Tjoelker,  
NASA Jet Propulsion Laboratory

**Poster 9: ON-ORBIT FRACTIONAL  
FREQUENCY SHIFTS OF PRECISION  
CRYSTAL OSCILLATORS,** W. Stapor,  
B. Henson, M. Frank and P. McDonald,  
Innovative Concepts Inc.; and  
G. Snyder, U.S. Naval Research  
Laboratory

**Poster 10: CURRENT STATUS OF  
MILLISECOND PULSAR OBSERVATION  
AT CRL,** Y. Hanado, Y. Shibuya, M.  
Hosokawa, M. Sekido, and M. Imae,  
Communications Research Laboratory,  
Japan

**Poster 11: GPS COMMON-VIEW AND  
MELTING-POT TIME TRANSFER USING  
ONCORE UT+ RECEIVERS,** F. Meyer,  
Observatoire de Besancon, France

**Poster 12: GPS-BASED TIME ERROR  
ESTIMATES PROVIDED BY  
SMOOTHING, WIENER AND KALMAN  
FILTERS: A COMPARATIVE STUDY,**  
Y. Shmaliy, Guanajuato University,  
Salamanca, Mexico; A. Marienko,  
"Sichron" Center, Kharikiv, Ukraine; and  
O. Ibarra-Manzano, Guanajuato  
University, Salamanca, Mexico

**Poster 13: ROA TWSTFT STATION.  
SET-UP AND FIRST RESULTS,**  
J. Palacio and F. Galindo, Real Instituto y  
Observatorio de la Armada, Spain

**Poster 14: CLOCK SYNCHRONIZATION  
USING GPS/GLONASS CARRIER  
PHASE,** K. Tu, H. Peng and C. Liao,  
Chunghwa Telecom, Taiwan; and  
F. Chang, National Taiwan University

WEDNESDAY, NOVEMBER 29, 2000

- 1730-1830 Joint PTTI Executive Board and Advisory Board Meeting
- 1900-2030 **Evening Speaker, SELLING THE TRUE TIME IN 19TH CENTURY AMERICA**, Ian Bartky

THURSDAY, NOVEMBER 30, 2000

- SESSION IX FUTURE APPLICATIONS**  
Chairman: Chris Gregerson, U.S. Naval Observatory
- 0800-0820 **Paper 27: ISSUES NECESSITATING A COMMON TIME REFERENCE IN THE U.S. NAVY**, S. Linsenmeyer, U.S. Naval Sea System Command, C. Gregerson, U.S. Naval Observatory; and R. Beard, U.S. Naval Research Laboratory
- 0820-0840 **Paper 28: COMMON TIME REFERENCE TECHNOLOGY FOR SYSTEMS INTEROPERABILITY**, R. Beard and J. White, U.S. Naval Research Laboratory
- 0840-0900 **Paper 29: OVERVIEW AND COMPARISON OF EMERGING CLOCK TECHNOLOGIES**, C. Ekstrom and E. Burt, U.S. Naval Observatory
- 0900-0920 **Paper 30: DEVELOPMENT AND EVALUATION OF GPS SPACE CLOCKS FOR GPS III AND BEYOND**, B. Feess and A. Wu, The Aerospace Corporation
- 0920-0940 **Paper 31: INNOVATIVE APPLICATION OF QUANTUM CASCADE LASER TECHNOLOGY AS PRECISION CLOCKS**, T. Gates, W. Stapor, B. Henson, and P. McDonald, Innovative Concepts Inc.; and J. Schultz, Battelle
- 0940-1000 **Paper 32: FREQUENCY STABILITY REQUIREMENTS FOR NARROW BAND RECEIVERS**, W. Klepczynski, Innovative Solutions International; and P. Ward, Navward Systems
- 1000-1020 **INTERMISSION**

THURSDAY, NOVEMBER 30, 2000

SESSION XI    **TELECOM AND NETWORK TIMING**  
Chairman: ED BUTTERLINE,  
Symmetricom

- 1020-1040    **Paper 33: THE NANOKERNEL**  
D. Mills, University of Delaware; and  
P. Kamp, The FreeBSD Project
- 1040-1100    **Paper 34: USING THE NETWORK TIME  
PROTOCOL (NTP) TO TRANSMIT  
INTERNATIONAL ATOMIC TIME (TAI),**  
J. Levine, National Institute of Standards  
and Technology; and D. Mills, University of  
Delaware
- 1100-1120    **Paper 35: USNO GPS/ATOMIC NTP  
STRATUM-1 SERVERS,** R. Schmidt,  
U.S. Naval Observatory
- 1120-1140    **Paper 36: PRIMARY REFERENCE  
CLOCKS USING INDOOR  
ANTENNAS,** G. Zampetti,  
Symmetricom
- 1140-1150    **CLOSING SESSION**
- 1150-1200    **CLOSE OF MEETING**

## Notes

## Notes

## HOTEL RESERVATION CARD

Please mail in an appropriate envelope or fax to:

**The Hyatt Regency Hotel at Reston Town Center**  
(PTTI 2000 Meeting Room Block)  
1800 Presidents Street  
Reston Town Center  
Reston, Virginia  
703-709-1234 Fax 703-709-229

Name: \_\_\_\_\_

Company: \_\_\_\_\_

Address: \_\_\_\_\_

City: \_\_\_\_\_

State: \_\_\_\_\_

Country: \_\_\_\_\_

Postal Code: \_\_\_\_\_

Phone Number: \_\_\_\_\_

Arrival Date: \_\_\_\_\_

Departure Date: \_\_\_\_\_

Smoking/Non-Smoking: \_\_\_\_\_

Number in Party: \_\_\_\_\_

Credit Card Type (American Express, Diners Club,  
Discover, Master Card, Visa)

Number and Expiration Date:

\_\_\_\_\_ - \_\_\_\_\_

PRESORTED  
FIRST-CLASS MAIL  
U.S. POSTAGE PAID  
WASHINGTON DC  
PERMIT NO. 6184

DEPARTMENT OF THE NAVY  
NAVAL RESEARCH LABORATORY  
ATTN: CODE 8150.1  
4555 OVERLOOK AVE SW  
WASHINGTON DC 20375-5354

OFFICIAL BUSINESS