

ADVANCE PROGRAM

FORTY-FIRST ANNUAL PRECISE TIME AND TIME INTERVAL (PTTI) SYSTEMS AND APPLICATIONS MEETING



November 16 – 19, 2009

41 Years of Progress
1969 – 2009

Hyatt Regency Tamaya Resort
Santa Ana Pueblo, New Mexico

SCHEDULE

Monday, November 16, 2009

0800-1300	Exhibition setup of booth for Exhibitors
0730-0830	Tutorials Breakfast
0830-1715	Tutorials
1300-1700	Exhibitor Setup
1700-1830	Icebreaker - Exhibitor Area
1830-2100	Exhibitor Setup
1900-2100	Registration*

Tuesday, November 17, 2009

0700-1600	Registration*
0700-0800	Speakers' Breakfast
0700-1600	Speakers' Room
0700-0800	Attendees' Breakfast
0800-1700	Technical Exhibits**
0800-0805	Opening
0805-0825	Distinguished PTTI Award Presentation
0825-0845	Opening Remarks
0845-0850	Call to Session
0840-1010	Session I – Time from GNSS
1010-1040	Intermission - Exhibits Area
1040-1150	Session II – Vendor Presentations
1150-1300	Lunch
1300-1440	Session III – Time Transfer Techniques
1440-1500	Intermission - Exhibit Area
1500-1620	Session IV – Algorithms
1620-1730	Session V – Poster Session
1830-2000	Reception

Wednesday, November 18, 2009

0700-1600	Registration*
0700-0800	Speakers' Breakfast
0700-1600	Speakers' Room
0700-0800	Attendees' Breakfast
0800-1700	Technical Exhibits**
0800-0945	Session VI – National Lab Update (I)
0945-1015	Intermission
1015-1200	Session VII – National Lab Update (II)
1200-1320	Lunch
1320-1440	Session VIII – Calibration: Receivers & Systems
1440-1510	Intermission
1510-1700	Session IX – Future PTTI Workshop
1730-1830	Joint Executive and Advisory Board Meeting
1900-2030	Special Event

Thursday, November 19, 2009

0700-1200	Registration*
0700-0800	Speakers' Breakfast
0700-1600	Speakers' Room
0700-0800	Attendees' Breakfast
0800-0940	Session X – Time Transfer - Data Treatments
0940-1010	Intermission
1010-1200	Session XI - Space Clocks and Panel
1200-1320	Lunch
1320-1440	Session XII – Advanced Clocks
1440-1500	Intermission
1500-1620	Session XIII – Receiver Biases
1620-1640	General Discussion
1640	Close of Meeting

*Registration is available each day.

**Exhibits are open Tuesday and Wednesday only.

REGISTRATION FORM FOR PTTI 2009

Hyatt Regency Tamaya Resort, Santa Ana Pueblo, New Mexico
November 16 – 19, 2009

NAME: _____
First _____ Last _____

AGENCY: _____ Company or Organization _____

ADDRESS: _____ Street _____

TELEPHONE: _____ City, State and Country _____
FAX: _____

E-MAIL: _____
 Speaker Session Chairman Exhibitor

Full Registration fee - \$575; \$525, if payment received/postmarked on or before October 16. Includes entry to the sessions and exhibit hall, the Tuesday and Wednesday luncheons, the Monday evening Ice Breaker, the Tuesday evening Welcoming Reception and one copy of the Proceedings.

Retiree registration fee - \$75. The attendee must be fully retired to qualify for the reduced registration fee. Includes entry to the sessions and exhibit hall only.

Student registration fee - \$50. The attendee must be a full-time student to qualify for the reduced registration fee. Includes all Full Registration benefits.

One Day registration fee - \$200; includes entry to the sessions, exhibit hall and the offered luncheon for that day ONLY.

Tutorials Registration fee - \$300; \$250 if payment received/postmarked on or before October 16.

Registration Fee \$ _____
 One Day Registration (\$200) \$ _____
 Tutorials Registration \$ _____
 Extra Reception Tickets (\$55 each) No. _____ \$ _____
 Extra Lunch Tickets (\$25 each) No. _____ \$ _____
 Extra Proceedings (\$150.00) No. _____ \$ _____

TOTAL AMOUNT DUE \$ _____

Check Enclosed Will pay onsite (fax to 202-767-2845)
 Mark here if purchasing Proceedings only and not attending conference.

Make checks payable to **Treasurer, PTTI**. If paying in advance, mail the payment and a copy of the registration card to:

Treasurer, PTTI
c/o Mrs. Sheila Faulkner
3159 Patrick Henry Drive
Falls Church, VA 22044, USA

When paying by check, the envelope must be postmarked on or before **October 16** to receive all early discounts. All checks must be received no later than **October 30**.

To register online and/or pay by credit card, visit:

<http://pttimeeting.org/registration.html>

Online registration ends **October 30**. After that date, registration must be completed onsite.

Questions? Contact Ms. Jardine at 202-767-2595, DSN 297-2595, or nikki.jardine@nrl.navy.mil

ADVANCE PROGRAM

FORTY-FIRST 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
Defense Information Systems Agency
U.S. Coast Guard Navigation Center

November 16 – 19, 2009



Hyatt Regency Tamaya Resort
Santa Ana Pueblo, New Mexico

TABLE OF CONTENTS

Schedule	First Page
Registration Card	Second Page
Objectives.....	iii
Registration	iv
Cancellation Policy.....	iv
Registration Desk Hours	v
Questions	v
PTTI on the Web	v
PTTI 2009 Tutorials Sessions	vi
Hotel Reservations.....	vii
Messages.....	vii
Temperature.....	vii
Tours	vii
Transportation Information.....	vii
Parking	viii
Directions	viii
Speakers' Breakfast	ix
Presented Papers	ix
Exhibit Information	ix
List of Potential Exhibitors.....	ix
Student Poster Competition	x
PTTI 2009 Evening Activities	x
Proceedings	x
42 nd Annual PTTI Meeting	x
PTTI Executive Committee	xi
PTTI Advisory Board	xii
2009 Distinguished PTTI Service Award Committee	xiii
PTTI 2009 Meeting Officers	xiv
PTTI 2009 Session Chairs	xv
PTTI 2009 Agenda	xvi-xxiv
Hotel Reservation Card	Last Page

OBJECTIVES

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

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

- PTTI Vendor Presentations
- Time and Frequency Standards Laboratories: Activities and Updates
- Time & Frequency Transfer
- PTTI in Current Applications
- Advanced Clocks
- Clocks in Unique and Novel Systems
- PTTI in Future Systems
- Time Scales, Algorithms & Methods
- Timing Systems & Applications
- Military Applications
- Clock Modeling and Simulation
- Satellite Navigation
- Environmental Effects on Precision Clocks
- Student Poster Competition

WELCOME TO PTTI 2009

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Treasurer, PTTI
c/o Mrs. Sheila Faulkner
3159 Patrick Henry Drive
Falls Church, VA 22044 USA

When paying by check, the envelope must be postmarked on or before **October 16** to receive all early discounts. All checks must be received no later than **October 30**.

Register online: <http://pttimeeting.org/registration.html>. Online registration will be available until **October 30**. After that date, registration must be completed onsite.

If you are unable to register online, please fill out the enclosed Registration Card and send it to Ms. Nikki Jardine via fax (202-767-2845) or email (nikki.jardine@nrl.navy.mil).

PTTI accepts Visa, MasterCard, American Express and Discover via PayPal. A PayPal account **is not** required to complete the transaction. To pay with your credit card, please register online <http://pttimeeting.org/registration.html>. The resulting charge will appear on your statement as "PTTI Meeting."

The full registration fee is \$575 (early discounted fee is \$525). Full registration includes entry to the sessions and exhibit hall, the Tuesday and Thursday luncheons, the Monday evening Ice Breaker, the Tuesday evening Welcoming Reception and one copy of the Proceedings. **The fee increases on October 17.**

The registration fee for full-time students is \$50 and includes all Full Registration benefits. **The registration fee for full-time retirees is \$75** and includes entry to the sessions and exhibit area only. **The One Day registration fee is \$200** and includes entry to the sessions, exhibit hall and the offered lunch for **that day ONLY**.

The tutorials registration fee is \$300 (early discounted fee is \$250) and includes breakfast, lunch and a copy of the presentations. **The fee increases on October 17.** The tutorials will be held **Monday, November 16**.

Tickets for the luncheons (\$25 each) and the reception (\$55 each) can be purchased at the PTTI Registration Desk. Extra copies of the Proceedings are also available for purchase.

All attendees, including presenters and exhibitors, must register and receive a badge. The badge must be worn for admission to all sessions and functions and is not transferable. The exhibit area is open to everyone; visitor badges can be picked up at the registration desk.

If you have special dietary or physical requirements, please contact Mrs. Faulkner at 703-532-6411, FAX 703-532-6338 or bopenyan@aol.com.

Cancellation policy

All requests for cancellation must be received in writing before October 16, 2009. On or after October 16, there is a \$300 cancellation fee. Refunds are not given for "no shows"; however, substitutions are allowed.

Registration Desk Hours

The registration desk will be open during the following hours:

Monday, November 16, 1900 – 2100
Tuesday, November 17, 0700 – 1600
Wednesday, November 18, 0700 – 1600
Thursday, November 19, 0700 – 1200

Questions

Please contact the following people for information on matters concerning:

Technical questions: Joe White
202-767-5111
joe.white@nrl.navy.mil

Exhibits: Gary Geil
949-361-0212
gary@gmasales.com

Don Mitchell
928-474-1088
don@gmasales.com

General: Sheila Faulkner
703-532-6411, Cell: 703-244-6346
bopenyan@aol.com

Registration: Nikki Jardine
202-767-2595
nikki.jardine@nrl.navy.mil

PTTI on the Web
Access PTTI online: <http://www.pttimeeting.org>

PTTI 2009 Tutorials Session

The PTTI 2009 Tutorials Session will take place on **Monday, November 16**. The Tutorials are intended for engineers, mathematicians, scientists or anyone who is new to the field of PTTI, as well as those who have been a part of the PTTI community. For information regarding the Tutorials, please contact **Francine Vannicola** at francine.vannicola@nrl.navy.mil, 202-404-4015 (DSN 754-4015). Additional Information on the speakers and the presentations is also available on the PTTI website, <http://www.pttymeeting.org/tutorials.html>.

The registration fee for the PTTI 2009 Tutorials Session is **\$250 postmarked on or before October 16** and **\$300 after October 16**. The fee includes breakfast, lunch and a copy of the Tutorials presentations (notebook and CD). Also included in the fee are a Stable32 Student Version CD and the Handbook of Frequency Stability Analysis. Registration is available on-line at <http://www.pttymeeting.org/registration.html>. Or submit the PTTI 2009 Registration form at http://www.pttymeeting.org/ptti_advanceprogram.pdf.

Time	Subject	Presenter
0830 - 0930	Introduction to Time and Frequency	Joseph D. White U.S. Naval Research Lab (NRL)
0930 - 1030	Clock Stability Analysis	William J. Riley Hamilton Technical Services
1045 - 1145	Time Transfer Techniques	Judah Levine National Institute of Standards and Technology (NIST)
1300-1430	Global Navigation Satellite Systems (GNSS) I and II	Edward D. Powers Blair Fomville U.S. Naval Observatory (USNO)
1445 - 1545	IEEE 1588-2008: IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems – an Overview	John C. Eidson University of California, Berkeley
1545 - 1645	An Introduction to Atomic and Quartz Clock Hardware for Space Applications	Leo A. Mallette The Aerospace Corporation

Hotel Reservations

Mail or FAX the hotel reservation card (located on the last page) to:

Hyatt Regency Tamaya Resort & Spa
(PTTI 2009 Room Block)
1300 Tuyuna Trail
Santa Ana Pueblo, New Mexico, USA 87004
505-867-1234, Fax 505-771-6180

Or visit <https://resweb.passkey.com/go/ptti2009> to make your reservations online.

When making your reservations, be sure to mention PTTI 2009 to receive the group sleeping room rate. The PTTI rate is available November 11– 23. Check-in time is 1500 (3:00 PM) and checkout time is Noon. Rooms will only be held if guaranteed with a credit card. The block of reserved rooms will be released **October 20**, so reserve early. If you leave before your scheduled departure date without informing the Hyatt, you will be charged an early departure fee. Reston offers a wide range of restaurants and shops.

The PTTI 2009 room rate is the government per diem rate of \$93 for single occupancy. The rate increases to \$118 for double occupancy and \$143 for triple and quad occupancy.

Messages

Messages may be left for PTTI attendees through the hotel's telephone number:
505-867-1234.

Temperature

The climate during November in the Santa Ana Pueblo area will be cool (below 60 degrees) and dry with temperatures dropping below 40 degrees at night. Attendees are reminded to stay hydrated during their stay.

Tours

Tour information will be posted on the PTTI website, <http://pttymeeting.org>.

Transportation Information

Airline

American Airlines is the official airline for **PTTI 2009**. The Promotion Code is **35N9AI**.

U.S. and Canadian attendees: To make reservations, Please visit <http://www.AA.com> or call **800-433-1790** and refer to the Promotion Code.

International attendees: To make reservations, please call your local reservations number and refer to the Promotion Code (STARfile 35N9AI).

Please be advised that there is a separate ticketing charge of \$20.00 USD per ticket for tickets purchased via the phone or \$30.00 USD per ticket for tickets purchased at the airport (this amount is subject to change). At this time, there is no ticketing fee for reservations made and ticketed through the American Airlines website.

Rental Car

Avis is the official rental car agency for **PTTI 2009**. The Avis Worldwide Discount (AWD) Number is **G027999**. Please use this AWD number when calling Avis directly at **888-754-8878** to receive the best car rental rates available. The discount includes unlimited mileage and is available from seven days before to seven days after the meeting. To make your reservation online, visit <https://www.avis.com>.

Airport Shuttle

Service is offered between the Albuquerque airport and the hotel via vans or sedans. The cost is \$40 for the first person, \$10 each additional person within the same party.

For the Santa Fe airport, please contact the hotel.

Parking

Valet and self parking are available. Valet parking is \$15.00 overnight, with in/out privileges. Valet parking for the day only is complimentary. Self parking is available at no charge. The parking areas are large enough to accommodate vans.

Directions

From the Albuquerque Airport (Approximately 26 miles) and South from I-25:

Exit to the right as you leave Sunport Blvd. Stay towards the right as the on-ramp to I-25 North will be on your right. Enter and follow I-25 North towards Santa Fe to Exit #242. Turn left on to Hwy 550(44) West toward Bernalillo. Proceed 2.4 miles to the intersection of Tamaya Blvd. and Hwy 550 just past the Santa Ana Star Casino. Turn right at Tamaya Blvd. and proceed 1.2 miles to the 3-way stop (Tuyuna Trail). Turn right and proceed 1.3 miles to the Resort. Proceed to the front entrance courtyard. Approximate driving time: 30 minutes

From the Santa Fe Airport: (Approximately 42 miles)

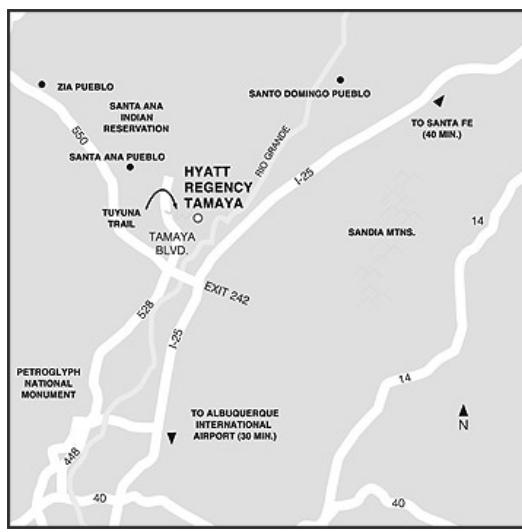
Travel East on Airport Blvd. to Cerrillos Road. Turn right on Cerrillos Road and follow to the entrance of I-25. Take I-25 South toward Albuquerque to Exit #242. Turn right on to Hwy 550(44) West toward Bernalillo. Proceed 2.4 miles to the intersection of Tamaya Blvd. and Hwy 550 just past the Santa Ana Star Casino. Turn right at Tamaya Blvd. and proceed 1.2 miles to the 3-way stop (Tuyuna Trail). Turn right and proceed 1.3 miles to the Resort. Proceed to the front entrance courtyard. Approximate driving time: 40 minutes

From North:

Take I-25 south to Exit #242 (US550). Go West on US550 to Tamaya Boulevard, approximately 2.4 miles). Turn right (north) on Tamaya Boulevard to Tuyuna Trail (approximately 1.4 miles). Turn right (east) on Tuyuna Trail.

From East or West I-40:

Exit North on I-25 toward Santa Fe to Exit #242. Turn left on to Hwy 550(44) West towards Bernalillo. Proceed 2.4 miles to the intersection of Tamaya Blvd. and Hwy 550 just past the Santa Ana Star Casino. Turn right at Tamaya Blvd. and proceed 1.2 miles to the 3-way stop (Tuyuna Trail). Turn right and proceed 1.3 miles to the Resort. Proceed to the front entrance courtyard. Approximate driving time: 30 minutes



viii

Speakers' Breakfast

The author giving the oral presentation must attend the Speakers' Breakfast on the morning of the presentation. Please ask at the PTTI Registration Desk for the location. The Speakers' Breakfast will be held from 0700-0800 on Tuesday, Wednesday and Thursday. The purpose of this breakfast is to allow the Session Chairs to meet each of the presenters and coordinate any last minute details. This is also the time when the audio-visual equipment and the timing lights will be demonstrated. The Speakers' Breakfast is a mandatory event for each author responsible for a scheduled Paper that day. If the presenter is not in attendance, the Session Chairs will not know if the presenter is prepared to present and may be forced to cancel the presentation.

Presented Papers

Presenters must send their presentations in PowerPoint 2003 format (versions XP or 2000 accepted) to presentations@pttimeeting.org by November 9. In the event this deadline cannot be met, you must hand-deliver a CD-ROM or flash drive containing the presentation to CWO David Holder by 1800 the day before the presentation.

Please provide a Microsoft Word electronic version of your Paper (e-mail, CD-ROM), formatted according to the PTTI Paper Preparation Instructions included in the Author's Kit, to Dr. Lee Breakiron, Editorial Chairman (lee.breakiron@usno.navy.mil) by November 19. If prior arrangements have not been made, the Paper will not be published in the Proceedings. The PTTI Author's Kit is available on the Web at:

http://www.pttimeeting.org/author_kit.pdf

Exhibit Information

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

Gary Geil and Don Mitchell
Geil Marketing Associates
934 Calle Negocio Suite B
San Clemente, CA 92673

Tel: 949-361-0212
Fax: 949-361-0312
E-mail: gmasales.com or don@gmasales.com

List of Potential Exhibitors for PTTI 2009

Astrogeodynamical Observatory	Lange-Electronic GmbH
AccuBeat, Ltd.	Locus
Brandywine Communications	Military University of Technology
Brilliant Instruments, Inc.	Mira Vista Technologies
Brilliant Telecommunications	Morion, Inc.
EndRun	NavTech GPS Supply
Evertz	OEWaves
Frequency Electronics, Inc.	Osborne Technologies
Furuno GPS OEM	Pendulum Instruments
GMV Aerospace and Defence, S.A.	PikTime Systems, LTD
GPS Networking	Poseidon Scientific Instruments
GPS World/Questex Media	Precise Time and Frequency, Inc.
GPS Source	Quartzlock
The Historical Electronics Museum	Sanders & Associates, Inc.
Inside GNSS	SigNav
The Institute of Navigation	Spectracom Corporation
ITT	SpectraDynamics, Inc.
Jackson Labs	SpectraTime
JTime! Meinberg USA	Spectrum Instruments, Inc.

Symmetricom Timing Test and Measurements
Synergy Systems
Time & Frequency Solutions
TimeTech, LLC GmbH

TRAK Microwave Corporation
Trimble Navigation
U.S. Naval Observatory
XECO, Inc

Student Poster Competition

The third annual PTTI Student Poster competition will take place at this year's PTTI. The goal is to get students thinking early in their careers about the engineering and scientific applications of precise timing (in the broadest sense) and in that way maintain the vitality of our field in the 21st century. The competition also offers an opportunity for students to meet future employers and for employers to get a better sense of what skills young engineers and scientists are bringing to the marketplace.

The competition has an undergraduate and graduate division and submitted abstracts will cover any area dealing with "precise" timekeeping systems or applications. In light of the competition's goal, there is a wide range of topics that students might address (i.e., biological to geophysical to astronomical). Consequently, the specific meaning of the word "precise" is taken in context. Abstracts can be submitted for posters dealing with literature reviews, laboratory work, or computational investigations.

Questions concerning the Student Poster Competition should be addressed to Mrs. Rachel Evans-Binfield, rachel.binfield@jhuapl.edu.

PTTI 2009 Evening Activities

On Monday, November 16 at 1700, the "Get Acquainted" Icebreaker function will be held in the Exhibits Hall. Refreshments will be served.

The Welcoming reception will be held Tuesday, November 17 at 1830. There will be a chuck wagon dinner under the stars (weather permitting). Boots, cowboy hats and jeans – Wear 'em if you have 'em!

On Wednesday, November 18 at 1900, PTTI 2009 is pleased to have Ms. Anna Sofaer present a program on the Solstice Project. Ms. Sofaer is the founder and president of The Solstice Project, a non-profit group organized in 1978 and dedicated to the study of ancient cultures of the American Southwest.

Proceedings

The Proceedings will be available on CD and mailed to the attendees in 2009. If you cannot attend, but wish to reserve a copy of the Proceedings, please return the Registration Card with a check for \$150 made out to **Treasurer, PTTI**. Please note on the card that you are not attending. Your reserved copy will be sent to you. If you wish extra copies, they will also be available at \$150.

Forty-second Annual PTTI Meeting

The 42nd Annual PTTI Systems and Applications Meeting (PTTI 2010) will be held November 15 – 18, 2010 at the Hyatt Regency, Reston, Virginia.

PTTI EXECUTIVE COMMITTEE

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

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Defense Information Systems Agency

MR. RONALD L. BEARD
U.S. Naval Research Laboratory

DR. LEE A. BREAKIRON
U.S. Naval Observatory

MR. RICHARD CAMP
Defense Information Systems Agency

CWO DAVID A. HOLDER
U.S. Coast Guard Navigation Center

DR. DENNIS D. MCCARTHY
U.S. Naval Observatory

CAPT ED THIEDEMAN
U.S. Coast Guard Navigation Center

DR. ROBERT L. TJOELKER
NASA Jet Propulsion Laboratory

MR. GEORGE SHATON
Department of Defense

MS. FRANCINE M. VANNICOLA
U.S. Naval Research Laboratory

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Frequency Electronics, Inc.

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Stanford University

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MR. PASCAL ROCHAT
SpectraTime

MR. RONALD C. ROLOFF
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The RAND Corporation

DR. SAMUEL R. STEIN
Symmetricom

PROFESSOR JACQUES VANIER
University of Montreal

DR. ANDY WU
The Aerospace Corporation

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DR. DENNIS D. MCCARTHY
U.S. Naval Observatory

MR. DON H. MITCHELL
Geil Marketing Associates

DR. LARA SCHMIDT
RAND Corporation

DR. JACQUES VANIER
University of Montreal

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 Technologies

2000
MR. ROGER EASTON
U.S. Naval Research Laboratory (Retired)

2001
DR. ROBERT F. C. VESSOT
Smithsonian Astrophysical Observatory
(Retired)

2002
MR. HARRY PETERS
Sigma Tau, Incorporated (Retired)

2003
MR. S. CLARK WARDRIP
National Aeronautics and Space
Administration (Retired)

2005
DR. NORMAN F. RAMSEY
Harvard University

2006
PROFESSOR DAVID L. MILLS
University of Delaware

2007
DR. R. MICHAEL GARVEY
Symmetricom

2008
DR. PATRIZIA TAVELLA
Istituto Nazionale di Ricerca Metrologica

PTTI 2009 MEETING OFFICERS

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MR. WARREN WALLS
U.S. Naval Observatory

TECHNICAL PROGRAM COMMITTEE CHAIRMAN
DR. LEO A. MALLETTE
The Aerospace Corporation

TECHNICAL PROGRAM COMMITTEE CO-CHAIRMAN
MRS. RACHEL EVANS-BINFIELD
Johns Hopkins University/Applied Physics Laboratory

TUTORIALS CHAIRMAN
MS. FRANCINE VANNICOLA
U.S. Naval Research Laboratory

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Global Strategies Group (North America), Inc.

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U.S. Naval Observatory

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U.S. Coast Guard Navigation Center

MEETING ARRANGEMENTS
MRS. SHEILA FAULKNER
Global Strategies Group (North America), Inc.

REGISTRATION
MS. NICOLETTE JARDINE
U.S. Naval Research Laboratory

PTTI 2009 SESSION CHAIRS

SESSION I – Time from GNSS
RACHEL EVANS-BINFIELD
JHU/APL

SESSION II – Vendor Presentations
TONY DIFLORIO
Spectracom

SESSION III – Time Transfer Techniques
KIRK MONTGOMERY
Symmetricom

SESSION IV – Algorithms
GEORGE SHATON
Department of Defense

SESSION V – Poster Session
RACHEL EVANS-BINFIELD
JHU/APL

SESSION VI – National Lab Update (I)
EDOARDO DETOMA
SEPA S.p.A

SESSION VII – National Lab Update (II)
GILDA FATHI
The Aerospace Corporation

SESSION VIII – Calibration: Receivers & Systems
SAM STEIN
Symmetricom

SESSION IX – Future PTTI Workshop
JAMES CAMPARO
The Aerospace Corporation

SESSION X – Time Transfer – Data Treatments
STEVEN JEFFERTS
National Institute of Standards and Technology

SESSION XI – Space Clocks and Panel
KEN SENIOR
U.S. Naval Research Laboratory

SESSION XII – Advanced Clocks
RYAN DUPUIS
PerkinElmer

SESSION XIII – Receiver Biases
S. CLARK WARDRIP
Global Strategies Group (North America), Inc.

PTTI 2009
FORTY-FIRST ANNUAL
PRECISE TIME AND TIME INTERVAL (PTTI)
SYSTEMS AND APPLICATIONS MEETING

TUESDAY, NOVEMBER 17, 2009

0800 – 0805	OPENING Warren Walls, <i>U.S. Naval Observatory</i>
0805 – 0825	DISTINGUISHED PTTI SERVICE AWARD Presented by Joe White, <i>U.S. Naval Research Laboratory</i>
0825 – 0845	OPENING REMARKS CAPT R. Scott Steadley, <i>U.S. Naval Observatory</i>
0845 – 0850	CALL TO SESSION Leo Mallette, <i>The Aerospace Corporation</i>
SESSION I	TIME FROM GNSS Chairman: Rachel Evans-Binfield, <i>JHU/APL</i>
0850 – 0910	Paper 1: USE OF GLONASS AT THE BIPM W. Lewandowski and Z. Jiang, <i>Bureau International des Poids et Mesures, France</i>
0910 – 0930	Paper 2: IMPLEMENTATION STATUS OF THE GPS TO GALILEO TIME OFFSET (GGTO) E. Powers, B. Fonville, <i>U.S. Naval Observatory</i> ; J. H. Hahn, A. Mudrak, and S. Binda, <i>European Space Agency/ESTEC, The Netherlands</i>
0930 – 0950	Paper 3: EGNOS NETWORK TIME AND ITS RELATIONSHIPS TO UTC AND GPS TIME J. Delporte, N. Suard, <i>CNES-French Space Agency</i> ; D. Sidorov, <i>University Paul Sabatier</i> , and P. Uhrich, <i>Observatoire de Paris</i>
0950 – 1010	Paper 4: THE COMMON TIME MODULE, A ROBUST TIME MAINTENANCE SYSTEM A. Dowd and R. M. Garvey, <i>Symmetricom, Inc.</i>
1010 – 1040	INTERMISSION
SESSION II	VENDOR PRESENTATIONS Chairman: Tony DiFlorio, <i>Spectracom</i>
1040 – 1150	LUNCH

TUESDAY, NOVEMBER 17, 2009

SESSION III	TIME TRANSFER TECHNIQUES Chairman: Kirk Montgomery, <i>Symmetricom</i>
1300 – 1320	Paper 5: IMPLEMENTATION AND COMPARISON OF TIME AND FREQUENCY TRANSFER METHODS BY GPS CARRIER PHASE K. Liang and A. Zhang, <i>National Institute of Metrology, China</i>
1320 – 1340	Paper 6: STUDY OF FREQUENCY TRANSFER VIA OPTICAL FIBER IN MICROWAVE DOMAIN M. Amemiya, M. Imae, Y. Fujii, T. Suzuyama, K. Watabe, T. Ikegami, and H. Tsuchida, <i>National Institute of Advanced Industrial Science and Technologies (AIST), Japan</i>
1340 – 1400	Paper 7: FIBER BASED FREQUENCY DISTRIBUTION BASED ON LONG HAUL COMMUNICATION LASERS S.-C. Ebenhag, P. Hedekvist, H. Skoogh, and K. Jaldehag, <i>SP Technical Research Institute of Sweden, Sweden</i>
1400 – 1420	Paper 8: TIME TRANSFER BY LASER LINK - T2L2: RESULTS OF THE FIRST YEAR OF OPERATION Ph. Guillemot, S. Leon, <i>CNES-French Space Agency, France</i> ; P. Exertier, E. Samain, F. Pierron, D. Albanese, J. Paris, J.-M. Torre, <i>Observatoire de la Côte d'Azur, France</i> ; Ph. Laurent, J. Achkar and D. Rovera, <i>Observatoire de Paris, France</i>
1420 – 1440	Paper 9: HIGH PERFORMANCE RF OPTICAL LINKS S. Crane, C. R. Ekstrom, P. A. Koppang and W. F. Walls, <i>U.S. Naval Observatory</i>
1440 – 1500	INTERMISSION
SESSION IV	ALGORITHMS Chairman: George Shaton, <i>Department of Defense</i>
1500 – 1520	Paper 10: ANOMALY CLOCK DETECTION ALGORITHM FOR ROBUST CLOCK ENSEMBLE Q. Wang and P. Rochat, <i>SpectraTime, Switzerland</i>
1520 – 1540	Paper 11: NEGATIVE POWER LAW NOISE; REALITY VS MYTH V. S. Reinhardt, <i>Raytheon Space and Airborne Systems</i>
1540 – 1600	Paper 12: IMPROVEMENT STUDY OF THE ALGOS ALGORITHM L. Bian, Q. Lili and G. Yuping, <i>Chinese Academy of Sciences, China</i>
1600 – 1620	Paper 13: NEW ALGORITHMS AND NEW RESULTS OF DATABASE FOR TA(PL) AND UTC(PL) M. Marszalec, <i>National Institute of Telecommunications, Poland</i>

TUESDAY, NOVEMBER 17, 2009

1620 – 1630 **INTRODUCTION OF STUDENT PAPERS**

Rachel Evans-Binfield, JHU/APL

SESSION V POSTER SESSION

1630 – 1730 **Chairman:** Rachel Evans-Binfield, JHU/APL

Poster 1: DESIGN AND IMPLEMENTATION OF A TIME SOURCE SELECTING AND MONITORING SYSTEM FOR THE TELEPHONE SPEAKING CLOCK

C. C. Lin, P. C. Chang and J. L. Wang, *National Standard Time & Frequency Laboratory, Taiwan*

Poster 2: OUTLIER DETECTION IN TWSTFT LINKS USED IN TAI

A. Harmegnies and G. Panfilo, *Bureau International des Poids et Mesures, France*

Poster 3: PROGRESS ON A PORTABLE ATOMIC FOUNTAIN FREQUENCY STANDARD (*Student Paper*)

P. Kunz, T. P. Heavner and S. R. Jefferts, *National Institute of Standards and Technology*

Poster 4: PERFORMANCE EVALUATION OF THE SYMMETRICOM ATS-6502 TIME TRANSFER MODEM

J. Hirschauer, E. Powers, R. Bumgarner, *U.S. Naval Observatory*; J. Warriner and C. Anderson, *Symmetricom*

Poster 5: BREAK DETECTION AND CORRECTION (*Student Paper*)

S. Czopek, *U.S. Naval Research Laboratory*

Poster 6: INVESTIGATIONS INTO THE RB CLOCK'S 2ND HARMONIC SIGNAL: A STATUS REPORT (*Student Paper*)

G. Fathi, C. Klimcak, and J. Campano, *The Aerospace Corporation*

Poster 7: CHARACTERIZATION OF NOISE PROPERTIES IN PHOTODETECTORS: A STEP TOWARD ULTRA-LOW NOISE MICROWAVES (*Student Paper*)

J. Taylor and S. Diddams, *National Institute of Standards and Technology*

Poster 8: TIME TRANSFER THROUGH OPTICAL FIBERS: A CONCEPT STUDY AND FIRST RESULTS FOR CALIBRATED CLOCK COMPARISONS

D. Piester, M. Rost, *Physikalisch-Technische Bundesanstalt, Germany*, and M. Fujieda, *National Institute for Information and Communications Technology, Japan*

TUESDAY, NOVEMBER 17, 2009

SESSION V POSTER SESSION (cont.)

Poster 9: PROTOTYPE OF THE DLR OPERATIONAL COMPOSITE CLOCK: METHODS AND TEST CASES

M. Suess and J. Hammesfahr, *German Aerospace Center*

1830 – 2000 **RECEPTION – Chuck Wagon Dinner!**

WEDNESDAY, NOVEMBER 18, 2009**SESSION VI NATIONAL LAB UPDATE (I)**

Chairman: Edoardo Detoma, SEPA S.p.A.

- 0800 – 0815 **Paper 14:** ACTIVITIES AND UPDATES AT THE STATE TIME AND FREQUENCY STANDARD OF RUSSIA
Y. Domnin, N. Koschelyaevsky, V. Kostromin, P. Krasovsky, and V. Palchikov, *FGUP "VNIIIFTRI," Russia*
- 0815 – 0830 **Paper 15:** BIPM TIME SECTION UPDATE
G. Panfilo, A. Harmegnies and F. Arias, *Bureau International des Poids et Mesures, France*
- 0830 – 0845 **Paper 16:** CURRENT STATUS AND FUTURE PLANS OF TIME AND FREQUENCY ACTIVITIES OF NPLI
P. Banerjee, A. Sen Gupta, G. M. Saxena, A. Chatterjee, A. K. Suri, A. Agarwal and P. P. Thorat, *National Physical Laboratory, India*
- 0845 – 0900 **Paper 17:** METAS TIME & FREQUENCY METROLOGY REPORT
L. G. Bernier, A. Stefanov and C. Schlunegger, *METAS, Switzerland*
- 0900 – 0915 **Paper 18:** PTB'S TIME AND FREQUENCY ACTIVITIES IN 2008 AND 2009
M. Rost, D. Piester, A. Bauch, J. Becker, T. Polewka, D. Sibold and E. Staliuniene, *Physikalisch-Technische Bundesanstalt, Germany*
- 0915 – 0930 **Paper 19:** STATUS AND DEVELOPMENTS OF THE TIME & FREQUENCY LABORATORY AT VSL
E. Dierikx and L. Jol, *VSL, The Netherlands*
- 0930 – 0945 **Paper 20:** THE TIMING ACTIVITIES OF THE NATIONAL TIME AND FREQUENCY STANDARD LABORATORY OF THE TELECOMMUNICATION LABORATORIES, CHT CO. LTD., TAIWAN
P. C. Chang, J. L. Wang, H. T. Lin, S. Y. Lin, W. H. Tseng, C. C. Lin, F. D. Chu and C. S. Liao, *National Time and Frequency Standard Laboratory, Taiwan*
- 0945 – 1015 **INTERMISSION**
- SESSION VII NATIONAL LAB UPDATE (II)**
Chairman: Gilda Fathi, *The Aerospace Corporation*
- 1015 – 1030 **Paper 21:** TIME ACTIVITIES AT NTSC
H. Yuan, S. Dong and Z. Wang, *Chinese Academy of Sciences, China*
- 1030 – 1045 **Paper 22:** TIME AND FREQUENCY ACTIVITIES AT NICT, JAPAN
Y. Koyama, K. Imamura, T. Iwama, S. Hama, J. Amagai, R. Ichikawa, and M. Hosokawa, *National Institute of Information and Communications Technology, Japan*

WEDNESDAY, NOVEMBER 18, 2009**SESSION VII NATIONAL LAB UPDATE (II) (cont.)**

- 1045 – 1100 **Paper 23:** TIME AND FREQUENCY ACTIVITIES AT ROA
F. J. Galindo, J. Palacio and H. Esteban, *Real Instituto y Observatorio de la Armada, Spain*
- 1100 – 1115 **Paper 24:** TIME AND FREQUENCY ACTIVITIES AT SP IN SWEDEN
K. Jaldehag and C. Rieck, *SP Technical Research Institute of Sweden, Sweden*
- 1115 – 1130 **Paper 25:** TIME AND FREQUENCY ACTIVITIES AT THE JHU APPLIED PHYSICS LABORATORY
M. Miranian, G. L. Weaver, M. J. Reinhart and R. A. Dragonette, *JHU/Applied Physics Laboratory*
- 1130 – 1145 **Paper 26:** TIME AND FREQUENCY ACTIVITIES AT THE U.S. NAVAL OBSERVATORY
D. Matsakis, *U.S. Naval Observatory*
- 1145 – 1200 **Paper 27:** TIMING ACTIVITIES AT THE U.S. NAVAL RESEARCH LABORATORY
R. Beard, O. Oaks, K. Senior and J. White, *U.S. Naval Research Laboratory*
- 1200 – 1210 **ANNOUNCEMENT OF STUDENT PAPER WINNERS**
Warren Walls, *U.S. Naval Observatory*
- 1210 – 1320 **LUNCH**
- SESSION VIII CALIBRATION: RECEIVERS & SYSTEMS**
Chairman: Sam Stein, *Symmetricom*
- 1320 – 1340 **Paper 28:** TVAR AND ELECTRICAL DELAY COMPARISON OF DUAL FREQUENCY GPS RECEIVERS
A. Proia, G. Cibiel, *Centre National d'Etudes Spatiales, France*; and L. Yaigre, *Sogethi High Tech, France*
- 1340 – 1400 **Paper 29:** PHASE-LOCK LOOPS IN VIBRATION ENVIRONMENTS
A. Hati, C. W. Nelson, and D. A. Howe, *National Institute of Standards and Technology*
- 1400 – 1420 **Paper 30:** PROFICIENCY TESTING ACTIVITIES OF FREQUENCY CALIBRATION LABORATORIES IN TAIWAN, 2009
H. T. Lin, P. C. Chang, J. L. Wang and C. S. Liao, *Chunghwa Telecom Co., Ltd., Taiwan*

WEDNESDAY, NOVEMBER 18, 2009**SESSION VIII CALIBRATION: RECEIVERS & SYSTEMS (cont.)**

- 1420 – 1440 **Paper 31:** CLOCK COMPARISON USING DIGITAL TELEVISION SIGNALS
D. Boehm, J. White, *U.S. Naval Research Laboratory*; S. Mitchell and E. Powers, *U.S. Naval Observatory*

1440 – 1510 INTERMISSION**SESSION IX FUTURE PTTI WORKSHOP**

Chairman: James Camparo, *The Aerospace Corporation*

- 1510 – 1700 **Paper 33:** AGENDA: 62ND ANNUAL PTTI SYSTEMS AND APPLICATIONS MEETING, NOVEMBER 2030
J. C. Camparo and L. A. Mallette, *The Aerospace Company*

1730 – 1830 JOINT EXECUTIVE AND ADVISORY BOARD MEETING

- 1830 – 2030 **SPECIAL EVENT – “The Solstice Project”** presented by Ms. Anna Sofaer, founder and president of The Solstice Project.

THURSDAY, NOVEMBER 19, 2009**SESSION X TIME TRANSFER – DATA TREATMENTS**

Chairman: Steven Jefferts, *National Institute of Standards and Technology*

- 0800 – 0820 **Paper 34:** OPTIMAL TIME TRANSFER
J. R. Wright and J. Woodburn, *Analytical Graphics, Inc.*

0820 – 0840 Paper 35: TWO-WAY TIME AND FREQUENCY TRANSFER USING 1 MCHIP/S CODES

V. Zhang, T. E. Parker, *National Institute of Standards and Technology*; Demetrios Matsakis, *U.S. Naval Observatory*; J. Achkar, D. Rovera, *Observatoire de Paris, France*; and D Piester, *Physikalisch-Technische Bundesanstalt, Germany*

- 0840 – 0900 **Paper 36:** TIME AND FREQUENCY TRANSFER USING ASYNCHRONOUS FIBER-OPTICAL NETWORKS: PROGRESS REPORT
S.-C. Ebenhag, P. O. Hedekvist, C. Rieck, K. Jaldehag, *SP Technical Research Institute of Sweden, Sweden*; and P. Löthberg, *STUPI LLC*

- 0900 – 0920 **Paper 37:** NOVEL, ALL-DIGITAL PHASE MEASUREMENT SYSTEM FOR TIME SCALES
S. Römisch, S. R. Jefferts and T. E. Parker, *National Institute of Standards and Technology*

- 0920 – 0940 **Paper 38:** TWSTFT DATA TREATMENT FOR UTC TIME TRANSFER
Z. Jiang, W. Lewandowski and H. Konaté, *Bureau International des Poids et Mesures, France*

0940 – 1010 INTERMISSION**SESSION XI SPACE CLOCKS AND PANEL**

Chairman: Ken Senior, *U.S. Naval Research Laboratory*

- 1010 – 1030 **Paper 39:** RESSOX CONTROL OF QZSS DURING COMMUNICATION INTERRUPTION
T. Iwata, T. Matsuzawa, *National Institute of Advanced Industrial Science and Technology, Japan*; and A. Abei, *Cosmo Research Corporation, Japan*

- 1030 – 1050 **Paper 40:** ESTIMATION AND PREDICTION PERFORMANCES OF GIOVE CLOCKS
P. Waller, F. Gonzalez, S. Binda, *European Space Agency, ESA-ESTEC, The Netherlands*; I. Hidalgo, G. Tobias, *GMV S.A., Spain*; I. Sesia and P. Tavella, *Istituto Nazionale di Ricerca Metrologica, Italy*

THURSDAY, NOVEMBER 19, 2009**SESSION XI SPACE CLOCKS AND PANEL (cont.)**

- 1050 – 1110 **Paper 41:** GPS BLOCK IIF RUBIDIUM ATOMIC FREQUENCY STANDARD LIFE TEST
F. Vannicola, R. Beard, J. White, K. Senior, A. Kubik, D. Wilson, *U.S. Naval Research Laboratory*; and J. Buisson, *Antoine Enterprises*
- 1110 – 1130 **Paper 42:** WHAT WE DON'T KNOW ABOUT QUARTZ CLOCKS IN SPACE
M. Bloch, O. Mancini and T. McClelland, *Frequency Electronics, Inc.*
- 1130 – 1200 **PANEL DISCUSSION**
- 1200 – 1320 **LUNCH**
- SESSION XII ADVANCED CLOCKS**
Chairman: Ryan Dupuis, *PerkinElmer*
- 1320 – 1340 **Paper 43:** TCMO™: A VERSATILE MEMS OSCILLATOR TIMING PLATFORM
K. J. Schoepf, D. M. Chen, R. Rebel, G. Zolfagharkhani, A. Gaidarzhy, J. H. Kuypers, P. Mohanty, and M. Crowley, *Sand 9, Inc.*
- 1340 – 1400 **Paper 44:** SPACE PASSIVE HYDROGEN MASER - PERFORMANCES, LIFETIME DATA AND GIOVE-B RELATED TELEMETRIES
M. Belloni, M. Gioia, S. Beretta, *Selex Galileo, Italy*; F. Droz, P. Mosset, Q. Wang, *SpectraTime, Switzerland*; A. Resti, P. Waller and A. Ostillio, *European Space Agency (ESTEC), The Netherlands*
- 1400 – 1420 **Paper 45:** MICRO ION FREQUENCY STANDARD
P. D.D. Schwindt, D. Stick, G. Biedermann, M. Blain, T. Statom, D. Serkland, R. Olssen, T. Swiler, R. Manginell, *Sandia National Laboratories*
- 1420 – 1440 **Paper 46:** MASER POP: A SPACE RB PULSED OPTICAL PUMPED CLOCK - CURRENT STATUS, RESULTS AND FUTURE ACTIVITIES
M. Belloni, A. Battisti, A. Cosentino, A. Sapia, A. Borella, *Selex Galileo, Italy*; S. Micalizio, A. Godone, F. Levi, C. Calosso, *INRiM, Italy*; L. Zuliani and F. Longo, *ASI, Italy*
- 1440 – 1500 **INTERMISSION**

THURSDAY, NOVEMBER 19, 2009**SESSION XIII RECEIVER BIASES**

Chairman: S. Clark Wardrip, *Global Strategies Group (North America), Inc.*

- 1500 – 1520 **Paper 47:** LOCAL OSCILLATOR CONTRIBUTION TO CARRIER PHASE MEASUREMENTS IN A GNSS RECEIVER
E. Detoma, P. Capetti and L. Bonafede, *SEPA S.p.A., Italy*
- 1520 – 1540 **Paper 48:** CODE-TRACKING TIMING ERRORS IN A BANDLIMITED MODERNIZED GPS RECEIVER
B. Fonville and E. Powers, *U.S. Naval Observatory*
- 1540 – 1600 **Paper 49:** TRACKING BIASES CAUSED BY IMPERFECTIONS IN DLL RECEIVERS
G. Hejc and W. Schäfer, *TimeTech GmbH, Germany*
- 1600 – 1620 **Paper 50:** EVALUATION OF THE TIME AND FREQUENCY TRANSFER CAPABILITIES OF A NETWORK OF GNSS RECEIVERS LOCATED IN TIMING LABORATORIES
R. Píriz, *GMV, Spain*; G. Cerretto, A. Perucca and P. Tavella, *INRiM, Italy*
- 1620 – 1640 **GENERAL DISCUSSION**
Joe White, *U.S. Naval Research Laboratory*
- 1640 **CLOSE OF MEETING**

TYPE, PRINT AND FAX (see number below)

HOTEL RESERVATION CARD

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