7th US/Russian Space Surveillance Workshop

Naval Postgraduate School
Monterey, California

29 October – 2 November 2007

P. Kenneth Seidelmann
General Chair

Kyle T. Alfriend
US Technical Chair

Stanislav Veniaminov
Russian Technical Chair

7th US/Russian Space Surveillance Workshop

Development of a More Complete Catalog

In this workshop we turn our attention toward the future of space surveillance and how to best meet the challenges ahead. In recent years there have been confirmed inadvertent collisions between resident space objects. Furthermore, potential collision with small, uncataloged debris continues to be a concern for both manned space flight as well as resident satellites. Finally, some nations have proposed or have experimented with "micro-satellites". Because of their small size, such satellites may not be easily tracked and cataloged.

Perhaps the most important direction for future space surveillance should be to expand the tracking and cataloging capability to include objects smaller than currently maintained. Such an objective has implications not only for observation technology, but also for satellite cataloging and characterization processes, both theory and practice being subject to further development. It has been estimated that there are over 100,000 satellites of size 5 cm or larger in current Earth orbit. Thus, presentations in this workshop will focus on theories, technologies and algorithms necessary to develop a satellite catalog more inclusive of smaller objects.

Information

Directions to the NPS Conference Center

The NPS conference center is about a 5-minute walk from the Hyatt. Go down the hill exiting from the Hyatt. Cross the street (Mark Thomas Drive) at the light. Be on the right side. The street you will be on is Sloat. Go through the underpass and you will see the Naval Postgraduate School on your right. Turn right into NPS, walk on the right and go to the guard house. The guard will have a list of participants. **Have an ID, drivers license for US, passport for foreign.** I will have some one there to help if there is a problem. When approved to enter continue on the sidewalk through the gate and then go left immediately. As soon as you cross the street after turning left the small building closest to the parking lot in front of you will be the conference center.

Final Banquet

The final banquet will be held in the Cypress Room in the Hyatt Conference Center. This room is on the lower level. There will be a reception with a cash bar from 6:00-7:00 and dinner at 7:00. We will have a talk after dinner by Dan Bursch, a former astronauts who is at NPS. Dan has been an astronaut since 1991 and has four space flights. He spent 6.5 months on the Space Station in 2002.

SCHEDULE

Monday, October 29
08:00 - 08:30 Breakfast
08:30 - 09:30 Opening Remarks
09:30 - 12:15 Session 1
12:15 - 13:30 Lunch
13:30 - 16:45 Session 2

Tuesday, October 30
08:00 - 08:30 Breakfast
08:30 - 12:00 Session 3
12:00 - 13:15 Lunch
13:15 – 16:45 Session 4

Wednesday, October 31
08:00 - 08:30 Breakfast
08:30 - 12:00 Session 5
12:00 - 13:15 Lunch
13:15 – 16:45 Session 6

Thursday, November 1
08:00 -08:30 Breakfast
08:30 - 12:00 Session 7
12:00 - 13:15 Lunch
13:15 – 16:45 Session 8

18:00 – Closing Banquet, Hyatt

Friday, 2 November
08:00 - 08:30 Breakfast
08:30 - 10:30 Session 9
10:30 - 12:00 Closing Remarks

Opening Remarks

08:30 – 09:30

Kenneth Seidelmann, General Chair
NPS Welcome -
Stanislav Veniaminov – Russia Technical Chair
Terry Alfriend – US Technical Chair

Session 1 ***Future Space Surveillance***
9:30 - 12:15
Chair ***Felix Hoots***

09:30 – 10:15
S1.1 **The U.S. Naval Space Surveillance Upgrade Program: 1999-2003**
P. Schumacher

10:15 – 10:45 **Break**

10:45 – 11:30
S1.2 **Investigations of the Feasibility of a European Space Surveillance System**
H. Klinkrad, T. Donath and T. Schildknecht

Session 2 ***Orbital Debris***
11:30 – 17:00
Chair ***Vasiliy Yurasov***

11:30 – 12:15
S2.1 **Space Surveillance Network for a More Complete Catalog**
N. Johnson and G. Stansbery

12:15 – 13:30 **Lunch**

13:30 – 14:15
S2.2 **On the Probability of Collisions of Interplanetary Space Vehicles With Meteors-CANCELLED**
R.I. Kiladze

14:15 – 15:00
S2.3 **Detection of Small-Size Space Debris with the FGAN and EISCAT Radars**
H. Krag, H. Klinkrad, R. Jehn, R. Leushacke and J. Markkanen

15:00 – 15:30 **Break**

15:30 – 16:15

S2.4 **On Some Difficulties of Planning the Search for a Space Object by Narrow-Beam Sensors**
S. Veniaminov, V. Lapukhin and Yu. Tretyakov

16:15 – 17:00 **Discussion on a Future Catalog**

Session 3 ***Orbit Determination 1***
8:30 - 12:00
Chair ***Andrey Nazarenko***

08:30 – 09:15
S3.1 **Technique for Operative Detection and Orbit Determination of Uncatalogued Space Objects**
V.S. Yurasov, V.G. Vygon and V.D. Schargorodskiy

09:15 – 10:00
S3.2 **Correlation of Optical Observations of Objects in Earth Orbit**
D.J. Scheeres, J.M. Maruskin and K.T. Alfriend

10:00 – 10:30 **Break**

10:30 – 11:15
S3.3 **Orbit Determination of LEO Space Objects Using a Single Pass of Observation Data: Methods Comparison**
Z.N. Khutorovskiy, S. Kamenskiy, N.N. Sbytov and K.T. Alfriend

11:15 – 12:00
S3.4 **Accurate Tracking of Space Objects via the Fokker-Planck Equation**
S. Chakravorty and M. Kumar

12:00 – 13:15 **Lunch**

Session 4 ***Optical Systems 1***
13:15 – 16:45
Chair ***Eric Pearce***

13:15 – 14:00
S4.1 **A Survey of Wide Field of View Optical Telescopes**
P.W. Kervin

14:00 – 14:45
S4.2 **Methods of CCD-Frame Processing In Case of Wide Field of View Containing Faint Objects-CANCELLED**
V.V. Koupriyanov

14:45 – 15:15 **Break**

15:15 – 16:00

S4.3 **Astrometric Calibration for Wide-Area Space Surveillance Sensors**
E.C. Pearce, R. Lambour and J.S. Stuart

16:00 **Discussion**

Session 5	***Catalog Maintenance and Development***
	8:30 - 12:00
Chair	***Zakhary Khutorovsky***
08:30 – 09:15	
S5.1	**Cataloging With An Upgraded Space Surveillance Fence** F.R. Hoots, G.S. Pierce, L. Ford and H. Hadley
09:15 – 10:00	
S5.2	**The SVD and Least Squares Orbit Determination** V.F. Boikov, Z.N. Khutorovskiy and K. T. Alfriend
10:00 – 10:30	**Break**
10:30 – 11:15	
S5.3	**A Review of Data Correlation Methods for Space Surveillance** R. Hujsak
11:15 – 12:00	
S5.4	**The Characteristics and Consequences of the Break-up of the Fengyun-C Spacecraft** N.L. Johnson, E. Stanbery, J.-C. Liou, M. Horstman, S. Stokely and D. Whitlock
12:00 – 13:15	**Lunch**
Session 6	***Orbit Prediction Accuracy***
	13:15 – 16:45
Chair	***Heiner Klinkrad***
13:15 – 14:00	
S6.1	**An Analysis of State Vector Propagation Accuracy** D.A. Vallado
14:00 – 14:45	
S6.2	**Force Models, Orbit Propagators, And Estimation Algorithms For The Future Space Catalog** P.J. Cefola and Z.J. Folcik
14:45 – 15:15	**Break**

15:15 – 16:00

S6.3 **Accuracy of Determination and Prediction Orbits in LEO. Estimation Errors Depending on Accuracy and Amount of Measurements**
A.I. Nazarenko

16:00 – 16:45

S6.4 **Discourse on Corrections to the NRLMSISE-00 Atmospheric Density Model**
M.P. Wilkins, C. Sabol, P.J. Cefola and K.T. Alfriend

Session 7 ***Orbit Estimation***
8:30 - 12:00
Chair ***Chris Sabol***

08:30 – 09:15
S7.1 **An Application of Optimal Sequential Estimation Toward Maintaining the Space Object Catalog**
J.H. Seago and J.W. Woodburn

09:15 – 10:00
S7.2 **Optimum Measurement Filtration and Motion Prediction Taking into Account the Atmosphere Distributions**
A.I. Nazarenko, V.S. Yurasov, K.T. Alfriend and P.J. Cefola

10:00 – 10:30 **Break**

10:30 – 11:15
S7.3 **Challenges Related to Discovery, Follow-up, And Study of Small High Area-to-Mass Ratio Objects at GEO**
T. Schildknecht, R. Musci, T. Flohrer and H. Klinkrad

11:15 – 12:00
S7.4 **Enhancing Multi-payload Launch Support with Netcentric Operations**
S.E. Andrews, W.C. Bougas, T.A. Cott, S.M. Hunt, J.M. Kadish, C.V. Solodyna

12:00 – 13:15 **Lunch**

Session 8 ***Characterization***
13:15 – 16:45
Chair ***Paul Schumacher***

13:15 – 14:00
S8.1 **Improving the Hyperspectral Linear Unmixing Problem With Unsupervised Cluster and Covariance Estimates**
E. Brevdo and K.K. Luu

14:00 – 14:45
S8.2 **Potentialities of Passive-RF Sensors for Characterization of Satellites**
S. Veniaminov, O.Ryazanov and Yu. Tretyakov

14:45 – 15:15 **Break**

15:15 – 16:00

S8.3 **Photometric Techniques for Wide Field of View Space Surveillance Applications**
J.S. Stuart, E.C. Pearce and R. Lambour

16:00 – 16:45

S8.4 **Can Photometrical Data Help To Maintain a Catalogue of Small-sized Space Objects?**
P. Papushev

Session 9 ***Reference Stars***
8:30 - 10:00
Chair ***Stanislav Veniaminov***

08:30 – 09:15
S9.1 **Optical Reference Star Catalogs for Space Surveillance: Current Status and Future Plans**
R. Gaume, P. K. Seidelmann, K. Johnston, N. Zacharias, and B. Dorland

09:15 – 10:00
S9.2 **Choosing Star Platforms When Measuring Angular Data Of Space Objects With Relative Method**
V.I. Kolinko, S.E. Zdor, V.V. Titenko and N.G. Yatskevich

10:00 – 10:30 **Break**

10:30 – 12:00 **Closing Remarks**
Stanislav Veniaminov, Russian Technical Chair
Terry Alfriend, US Technical Chair
Kenneth Seidelmann, General Chair