



NAVAL
POSTGRADUATE
SCHOOL

RESEARCH AND SPONSORED PROGRAMS OFFICE
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NPS (41)
29 August 2013

David W. Richardson
AVCR/Director
University of Illinois at Urbana-Champaign
1901 S. First Street, Suite A
Champaign, IL 61820

Dear Mr. Richardson,

The Naval Postgraduate School has been contacted by University of Illinois at Urbana-Champaign (UIUC) in reference to participation in solicitation NNH13ZEA001N, Subtopic AFCS-1.5: "Analysis of Separation Assurance in the Presence of Communication Failures." The Naval Postgraduate School (NPS) does have the in-house expertise and facilities to complete the proposed work.

NPS team of researchers will collaborate with UIUC PIs, Dr. Hovakimyan and Dr. Xargay. In the first year of the project, the proposed work by NPS will include focusing on the analysis of existing communication links available onboard of airplanes and the analytical description of their performance limitations in the form suitable for the formal analytical analysis of separation assurance. During the second year of research the NPS team will specify a set of communication failures based on the performance characteristics of existing ground and airborne ATC solutions: ADS-B, GPS, TIS-B, and CPDLC. During the last year of a set of representative scenarios will be developed that can be tested using high-fidelity hardware-in-the-loop simulations and flight tests utilizing advanced capabilities which are available at NPS and NASA facilities. We are requesting funding in the amount of \$149,206.12 per year for the total amount of \$448,518.36 for the entire project. I awarded the estimated period of performance for the project is 7/1/2014 through 6/30/2017.

NPS, however, as a federal university must not provide any organization with an unfair advantage in the competitive solicitation process. To meet this requirement, NPS will entertain additional inquiries from other organizations on this request. If an award is made to UIUC NPS will execute the appropriate agreement with NASA in order for NPS to accept funding for the proposed work.

For information relating to the technical portions of this project, you may contact Dr. Vladimir Dobrokhodov at vndobrok@nps.edu or (831) 656-7714. Administrative and budgetary matters, as well as award and post-award matters should be referred to Deborah Buettner at the Research and Sponsored Projects Office at dbuettne@nps.edu or (831) 656-7893.

Sincerely,

Jeffrey D. Paduan
Dean of Research

Copy to:
MAE/Dobrokhodov/Jones/Kaminer/Millsaps

Budget Summary Year 1:

Faculty labor	440 hours@\$77.77	\$ 34,218.80
	440 hours@\$64.49	\$ 28,375.60
	40 hours@\$79.00	\$ 9,480.00
Fringe (45%):		<u>\$ 32,433.48</u>
Total labor costs:		\$104,507.88
Travel		\$ 10,000.00
Equipment and supplies		\$ 7,600.00
Publications		\$ 1,000.00
Fees		<u>\$ 158.24</u>
Total other direct costs:		\$ 18,758.24
Indirect:		\$ 26,240.00
\$26.24 per labor hour		
Total costs:		\$149,506.12

Budget Summary Year 2:

Faculty labor	440 hours@\$77.77	\$ 34,218.80
	440 hours@\$64.49	\$ 28,375.60
	40 hours@\$79.00	\$ 9,480.00
Fringe (45%):		<u>\$ 32,433.48</u>
Total labor costs:		\$104,507.88
Travel		\$ 10,000.00
Equipment and supplies		\$ 7,600.00
Publications		\$ 1,000.00
Fees		<u>\$ 158.24</u>
Total other direct costs:		\$ 18,758.24
Indirect:		\$ 26,240.00
\$26.24 per labor hour		
Total costs:		\$149,506.12

Budget Summary Year 3:

Faculty labor	440 hours@\$77.77	\$ 34,218.80
	440 hours@\$64.49	\$ 28,375.60
	40 hours@\$79.00	\$ 9,480.00

Fringe (45%):	<u>\$ 32,433.48</u>
Total labor costs:	\$104,507.88

Travel	\$ 10,000.00
Equipment and supplies	\$ 7,600.00
Publications	\$ 1,000.00
Fees	<u>\$ 158.24</u>
Total other direct costs:	\$ 18,758.24

Indirect:	\$ 26,240.00
\$26.24 per labor hour	

Total costs:	\$149,506.12
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Total cost for the project:	\$448,518.36
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Isaac Kaminer
Professor
Department of Mechanical and Aerospace Engineering
Naval Postgraduate School
Monterey, CA 93943

Education:

- B.S. Electrical Engineering, University of Minnesota, August 1983
- M.S. Electrical Engineering, University of Minnesota, August 1985
- Ph.D. Electrical Engineering Systems, University of Michigan, December 1992

Professional Experience:

9/85 – 8/89 Senior Engineer, 757/767 Flight Management Computer Group Boeing Commercial Airplanes Company, Seattle, WA

9/89 – 7/92 Graduate Research Assistant, Department of Electrical Engineering and Computer Science, University of Michigan, MI

8/92 – 4/98 Assistant Professor, Department of Aeronautics and Astronautics, Naval Postgraduate School

6/95 – 8/95 ASEE Fellow at NASA Langley Research Center, Langley, VA.

5/98 – 9-03 Associate Professor, Department of Aeronautics and Astronautics, Naval Postgraduate School

9/03 – to present Professor, Department of Mechanical and Aerospace Engineering, Naval Postgraduate School, Monterey, CA.

Fields of Expertise:

Flight dynamics, Nonlinear control, Optimal control and System Identification.

Honors and Awards:

- NATO Fellowship for Scientific and Technological Exchange, 1994.
- ASEE/NASA Summer Faculty Fellowship, 1995.
- NPS Menneken Annual Faculty Award for Excellence in Scientific Research, 1997, 1999.

Publications:

1. Keller J., Thakur D., Dobrokhodov V., Jones K., Pivtoraiko M., Gallier J., Kaminer I., and Kumar V., “A Computationally Efficient Approach to Trajectory Management for Coordinated Aerial Surveillance,” *Unmanned Systems*, July 2013, Vol. 01, No. 01 : pp. 59-74, doi: 10.1142/S2301385013500040.
2. Xargay E., Kaminer I.I., Pascoal A.M., Hovakimyan N., Dobrokhodov V.N., Cichella V., Aguiar P., and Ghabcheloo R., “Time-Critical Cooperative Path Following of Multiple UAVs over Time-Varying Networks,” *Journal of Guidance, Control, and Dynamics*, Vol. 36, No. 2 (2013), pp. 499-516, doi: 10.2514/1.56538.
3. E. Xargay, V. Dobrokhodov, I. Kaminer, A. Pascoal, N. Hovakimyan, and C. Cao, “Time–Coordinated Path Following of Multiple Heterogeneous Vehicles over Time–Varying Networks,” invited paper in Special Issue on UAVs and Controls for *IEEE Control Systems Magazine* 2012.
4. Dobrokhodov V.N., Xargay E., Hovakimyan N., Kaminer I.I., Kitsios I., Cao C., Gregory I., Valavani L., “Experimental Validation of L1 Adaptive Control: Rohrs' Counterexample in Flight”, *Journal of Guidance, Control, and Dynamics*, 2011, Vol.34: 1311-1328, 10.2514/1.50683.

Vladimir N. Dobrokhodov
Research Assistant Professor
Department of Mechanical and Aerospace Engineering
Naval Postgraduate School
Monterey, CA 93943

Education:

M.S. Aerospace Engineering Sciences, Moscow State Aviation Institute, 1991
M.S. Operations Research, Air Force Engineering Academy, Moscow, 1993
Ph.D. Aerospace Engineering Sciences, Air Force Engineering Academy, Moscow, 1999

Professional Experience:

2/01 – 8/04 National Research Council Post-Doctoral Fellow, Department of Aeronautics and Astronautics, Naval Postgraduate School, Monterey, CA.
8/04 – 12/04 Post-Doctoral Fellow, University of California at Santa Barbara, Electrical and Computer Science Engineering department, Santa Barbara, CA.
12/04 – 12/09 Research Assistant Professor, Department of Mechanical and Aerospace Engineering, Naval Postgraduate School, Monterey, CA.
12/09- to present: Research Associate Professor, Department of Mechanical and Aerospace Engineering, Naval Postgraduate School, Monterey, CA.

Fields of Expertise:

Flight dynamics, Nonlinear control, Optimal control and System Identification.

Honors and Awards:

- National Research Council Post-Doctoral Fellowship: 2001,2002,2003,2004.
- Mikoyan Design Bureau Certificate of Recognition for the best software solution for the Airborne Pilot's Associate, 1999
- Air Force Engineering Academy Award for Excellence in Scientific Research, 1995

Relevant Publications:

1. Keller J., Thakur D., Dobrokhodov V., Jones K., Pivtoraiko M., Gallier J., Kaminer I., and Kumar V., "A Computationally Efficient Approach to Trajectory Management for Coordinated Aerial Surveillance," *Unmanned Systems*, July 2013, Vol. 01, No. 01 : pp. 59-74, doi: 10.1142/S2301385013500040.
2. Xargay E., Kaminer I.I., Pascoal A.M., Hovakimyan N., Dobrokhodov V.N., Cichella V., Aguiar P., and Ghabcheloo R., "Time-Critical Cooperative Path Following of Multiple UAVs over Time-Varying Networks," *Journal of Guidance, Control, and Dynamics*, Vol. 36, No. 2 (2013), pp. 499-516, doi: 10.2514/1.56538.
3. E. Xargay, V. Dobrokhodov, I. Kaminer, A. Pascoal, N. Hovakimyan, and C. Cao, "Time-Coordinated Path Following of Multiple Heterogeneous Vehicles over Time-Varying Networks," invited paper in Special Issue on UAVs and Controls for IEEE Control Systems Magazine 2012.
4. Dobrokhodov V.N., Xargay E., Hovakimyan N., Kaminer I.I., Kitsios I., Cao C., Gregory I., Valavani L., "Experimental Validation of L1 Adaptive Control: Rohrs' Counterexample in Flight", *Journal of Guidance, Control, and Dynamics*, 2011, Vol.34: 1311-1328, 10.2514/1.50683.

Kevin D. Jones
Research Associate Professor
Department of Mechanical Engineering
Naval Postgraduate School
Monterey, CA 93943

Education:

B.S. Aerospace Engineering Sciences, University of Colorado, May 1988
M.S. Aerospace Engineering Sciences, University of Colorado, May 1990
Ph.D. Aerospace Engineering Sciences, University of Colorado, May 1993

Professional Experience:

2/94 – 2/97 National Research Council Post-Doctoral Fellow, Department of Aeronautics and Astronautics, Naval Postgraduate School, Monterey, CA.

2/97 – 7/01 Research Assistant Professor, Department of Aeronautics and Astronautics, Naval Postgraduate School, Monterey, CA.

7/01 to present: Research Associate Professor, Naval Postgraduate School.

Fields of Expertise:

Experimental and Computational Aerodynamics.
Design, manufacture and testing of micro air vehicles.

Honors and Awards:

- Bronze Award from the Royal Aeronautical Society for the paper “Bio-Inspired Design of Flapping-Wing Micro Air Vehicles,” 2006.
- Outstanding Research Achievement, Department of Aeronautics and Astronautics, Naval Postgraduate School, 1999.
- National Research Council Post-Doctoral Fellowship: 1994, 1995, 1996.
- Young Participant Bursary, 12th International Conference on Numerical Methods in Fluid Dynamics, Oxford University, England.

Relevant Publications:

1. Keller J., Thakur D., Dobrokhodov V., Jones K., Pivtoraiko M., Gallier J., Kaminer I., and Kumar V., “A Computationally Efficient Approach to Trajectory Management for Coordinated Aerial Surveillance,” *Unmanned Systems*, July 2013, Vol. 01, No. 01 : pp. 59-74, doi: 10.1142/S2301385013500040.
2. K.D. Jones, V. Dobrokhodov, I. Kaminer, T. Chung, M.R. Clement, M. Kolsch, and R. Zaborowski, “Cooperative Autonomy For The Masses – Fundamental Steps Toward Enabling Complex Multi-Asset Missions With Simple Point-And-Click Tasking,” *AUVSI's Unmanned Systems North America Conference and Exhibit*, Washington DC, August 16-19th, 2011.
3. V. Dobrokhodov, I. Kaminer, K.Jones, E. Xargay, N. Hovakimyan, P. Aquiar, and A. Pascoal, “On Coordinated Road Search using Time-Coordinated Path Following of Multiple UAVs,” invited paper of *AIAA Guidance, Navigation, and Control Conference*, Toronto, Ontario, Canada, August 2-5, AIAA-2010-6188.