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Space Systems Academic Group

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**SPACE SYSTEMS
ACADEMIC GROUP**

**RUDOLF PANHOLZER
CHAIRMAN**

SPACE SYSTEMS

OVERVIEW:

The Space Systems Academic Group (SSAG) along with eight academic departments is an integral part of the Graduate School of Engineering and Applied Sciences. As an interdisciplinary association of professors it provides direction and guidance for two curricula: Space Systems Engineering and Space Systems Operations.

Officer students in the Space Systems curricula fulfill degree requirements for a Master of Science in the department of their choice or in a specialized Engineering Science. A space-oriented thesis is mandatory as well as course work to fulfill the requirements of a space billet. Officer graduates are prepared to manage the technical aspects of a space system life cycle including design, development, installation, and maintenance of spacecraft, space payloads, supporting ground stations, terminals, and C3 connectivity.

The SSAG serves as the focal point for all space-related research performed at the Naval Postgraduate School (NPS). A major goal is to couple NPS space research efforts with the graduate education of military officers. This is typically accomplished through space-related thesis research in several areas and includes small satellite projects created specifically as an educational tool for officer students. The SSAG oversees classified and unclassified student involvement in research activities and helps facilitate their placement in follow-on tours.

CURRICULA SERVED:

- Space Systems Operations
- Space Systems Engineering

DEGREES GRANTED:

- Master of Science in Space Systems Operations
- Master of Science in Astronautical Engineering
- Master of Science in Electrical Engineering
- Master of Science in Mechanical Engineering
- Master of Science in Applied Physics

RESEARCH THRUSTS:

- Military Applications for Space
- Space Reconnaissance and Remote Sensing
- Radiation Hardened Electronics for Space
- Design, Construction and Launching of Small Satellites
- Classified (SCI level) Research
- Satellite Communications Systems
- Military Space Systems and Architectures

RESEARCH CHAIRS:

- Navy Space Technology Program Chair
- Navy Tactical Exploration of National Capabilities (TENCAP) Space Chair
- Space Systems Academic Chair
- NASA Michael J. Smith Space Systems Chair
- National Reconnaissance Office Chair
- Lockheed Martin Space and Missile Operations Chair

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RESEARCH CENTERS:

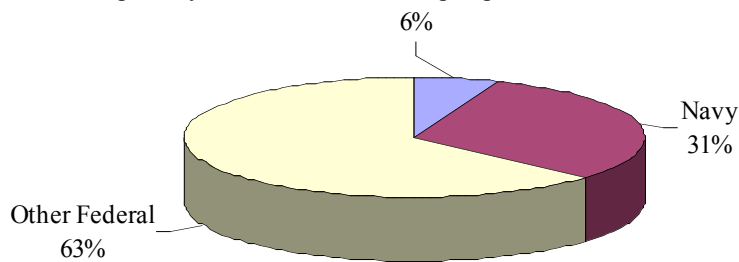
- Spacecraft Research and Design Center
- Center for Reconnaissance Research
- Center for Radiation Hardened Electronics
- Center for Cryptologic Research

RESEARCH FACILITIES:

- Open Site EMI/EMC Facility
- Satellite Ground Station Facility
- Space Warfare Computer Laboratory
- FLTSATCOM Satellite Operations
- Simulation and Test Laboratory
- Spacecraft Attitude Dynamics and Control Laboratory
- Spacecraft Environmental Simulation and Test Laboratory
- Radiation Effects Laboratory
- Solar Simulation Facility
- NPS-AFRL Optical Relay Spacecraft Laboratory
- Flash X-Ray Facility
- Electron Linear Accelerator
- Small Satellite Test and Development Laboratory
- Smart Structures Laboratory

RESEARCH PROGRAM (Research and Academic)-FY2004:

The Naval Postgraduate School's sponsored program exceeded \$92 million in FY2004. Sponsored programs included both research and educational activities funded from an external source. A profile of the sponsored program for the Space Systems Academic Group is provided below:



Size of Program: \$1,038K

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CONFIGURABLE FAULT-TOLERANT ARCHITECTURES FOR RELIABLE SPACE-BASED COMPUTING

Herschel H. Loomis, Professor
Department of Electrical and Computer Engineering
Sponsor: Secretary of the Air Force/FMBMB-AFOY

OBJECTIVES: To demonstrate the value of the remote configurability of the field programmable gate arrays (FPGA) to space computing. To develop a single-event upset (SEU)-tolerant space-based computer using commercial, off-the-shelf (COTS) FPGAs to demonstrate the feasibility of using triple modular redundancy (TMR) to correct errors without resort to system reset. To build and fly a configurable fault-tolerant mission computer on NPSSAT, Midstar, and a satellite in a high-radiation orbit.

KEYWORDS: Space-Based Computing, FPGA, NPSSAT, Midstar, Satellite

MARITIME DOMAIN AWARENESS SYSTEM DEMONSTRATION

Herschel H. Loomis, Professor
Department of Electrical and Computer Engineering
Sponsor: Naval Postgraduate School

SUMMARY: Defined the appropriate data sources, developed a tool set for data manipulation and display, and demonstrated improved maritime domain awareness.

KEYWORDS: Maritime Domain Awareness

MARITIME DOMAIN AWARENESS TOOL DEVELOPMENT

Herschel H. Loomis, Professor
Department of Electrical and Computer Engineering
Sponsor: Navy Tactical Exploration of National Capabilities (TENCAP)

SUMMARY: Developed tools and techniques for data fusion and analysis in support of the maritime domain awareness system demonstration. This research was an extension of the Center for Defense Technology and Education for the Military Services (CDTEMS) Maritime Domain Awareness (MDA) project. Navy Tactical Exploration of National Capabilities (TENCAP) provided additional funding to supplement the CDTEMS funding.

KEYWORDS: Maritime Domain Awareness Tools

PROJECT GUSTY ORIOLE, COMPUTER ALGORITHMS AND ARCHITECTURES FOR SPACE APPLICATIONS

Herschel H. Loomis, Professor
Department of Electrical and Computer Engineering
Sponsor: National Reconnaissance Office

SUMMARY: This project was concerned with the application of computer algorithms to specific military space projects, the development of specialized computer architectures for military space applications, and the support of the space initiative.

KEYWORDS: Gusty Oriole, Space Applications.

ADVANCED MULTI-JUNCTION SOLAR CELLS MEASUREMENT SYSTEM FOR NPSAT1 SATELLITE

Rudolf Panholzer, Professor

SPACE SYSTEMS

**Space Systems Academic Group
Sponsor: Space Missile Command**

SUMMARY: Funded officer student design and development of a measurement system for advanced multi-junction solar cells to be used on the NPSAT1 micro-satellite.

KEYWORDS: Solar Cells, NPSAT1, Satellite

FERROELECTRICITY RESEARCH NEWSLETTER

**Rudolf Panholzer, Professor
Space Systems Academic Group
Sponsor: Office of Naval Research**

SUMMARY: Provided funding for a quarterly research newsletter designed to supply information on national and international symposia, conferences, workshops, and meetings which deal with topics of interest to scientists, engineers, and students in the field of integrated ferroelectrics research.

KEYWORDS: Ferroelectricity, Newsletter

SPACE SYSTEMS ACADEMIC GROUP

**Rudolf Panholzer, Professor
Space Systems Academic Group
Sponsor: National Aeronautics and Space Administration - Dryden Flight Research**

TECHNOLOGY REVIEW AND UPDATE (TRAU)

**Rudolf Panholzer, Professor
Space Systems Academic Group
Sponsor: Various**

TECHNOLOGY REVIEW AND UPDATE (TRAU) FOR TECHNICAL PERSONNEL

**Rudolf Panholzer, Professor
Space Systems Academic Group
Sponsor: Various**

SUMMARY: This course was intended for military and civilian (both government and non-government) technical personnel interested in refreshing and updating their knowledge in the areas of Internet security, electro-optical and infrared systems, the future of technology, micro-electro-mechanical systems (MEMS), integrated circuits, bioengineering and biotechnology, integrated circuits and satellite communications systems. Each participant in this course was expected to be involved in work in at least one of the areas mentioned. The course provided a good overview and stressed the more practical aspects of the topics listed.

KEYWORDS: Space Systems Academic Group

AEROASSISTED MANEUVERS AND MISSION DESIGN

**I. Michael Ross, Professor
Department of Mechanical and Astronautical Engineering
Sponsor: National Aeronautics and Space Administration - Jet Propulsion Laboratory**

SUMMARY: Over the past few years, the Jet Propulsion Laboratory (JPL) and the Naval Postgraduate School have been performing collaborative research in aeroassisted maneuvers and mission design. One of

the key products of this research has been the development of ACAPS, a user-friendly software for modeling, simulating and visualizing aeroassisted maneuvers. The objective of this proposal was to set up a five-year partnership between JPL and NPS for research centered along aeroassisted maneuvers and mission design.

KEYWORDS: JPL, Aeroassisted Maneuvers, ACAPS

FIRST PRINCIPLES PREDICTION OF X-RAY IMPULSE

Donald v. Z. Wadsworth, Senior Lecturer

Department of Electrical and Computer Engineering and Space Systems Academic Group

Sponsor: Strategic Systems Program

SUMMARY: This research was an extension of the “First Principles Prediction of X-Ray Impulse” research project conducted by the Naval Postgraduate School (NPS) in support of the stockpile-to-target stewardship (STS) program. The initial multi-year objectives were achieved and documented by the end of the fourth quarter of 2003:

1. Studied and archived key data (reports and interviews) relevant to predicting the vulnerability of an RB aeroshell to an x-ray burst in space;
2. Compared the capability of existing physics-based models (finite-element hydrocodes and radiation deposition codes) to predict blow-off impulse and damage to various RB composite materials;
3. Modified a selected code to improve fidelity and applicability to STS;
4. Validated the modified code against existing test data (UGT and AGT);
5. Established a core effort in support of the Strategic Systems Programs (SSP), involving NPS faculty (Physics, Mechanical Engineering, Space Systems, and Electrical Engineering), graduate students, and consultation with Department of Energy National Laboratories, the Defense Threat Reduction Agency (DTRA), the Air Force Research Laboratory (AFRL), etc.

The extension broadens the scope of previous efforts to include validated modeling of RB vulnerability in the case of new RB materials and new threats, and mitigation of identified limitations in the hydrocode physics models.

KEYWORDS: X-Ray, STS, RB

**SPACE SYSTEMS
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**2004
Faculty Publications
and Presentations**

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CONFERENCE PUBLICATIONS

Sakoda, D., "NPSAT1 Mission Operations," Integrated Payload Working Group (IPSWG) Meeting #6 for the DoD/STP STP-1 Mission, Cape Canaveral AFS, FL, June 2004.

Sakoda, D., "NPSAT1 Project Status and Safety Assessment," Integrated Payload Working Group (IPSWG) Meeting #7 for the DoD/STP STP-1 Mission, Titusville, FL, December 2004.

Sakoda, D., "NPSAT1 Thermal Modeling Status," Integrated Payload Working Group (IPSWG) Meeting #7 for the DoD/STP STP-1 Mission, Titusville, FL, December 2004.

Sakoda, D., "Value of Small Satellites," Panel Brief and Q&A, Small Payload Rideshare Conference, Anchorage, AK, May 2004.

