

US Air Force Academy

Research Report

Period of Report: 1 July 2002 to 30 June 2003

DIRECTORATE OF EDUCATION
DEAN OF THE FACULTY
UNITED STATES AIR FORCE ACADEMY

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About the Cover

Top Left: Astronautics cadets prepare a test firing of a FalconLaunch rocket motor on the USAFA test range in Jacks Valley.

Top Center: An F-111 shows the near-disastrous effects of a birdstrike near Cannon AFB, NM. USAFA and the Institute for Information Technology Applications are developing a bird avoidance model to aid flight crews in mission planning to avoid such occurrences.

Top Right: Computational fluid dynamics model made by the Modeling & Simulation Research Center of an F/A-18 at high angle of attack shows massively detached flows impinging on vertical tails.

Middle Left: A cadet in a biology class reflects his joy at handling a snake. The mouse in the snake's mouth shares the cadet's enthusiasm for the situation.

Center: Electrical engineering cadets work diligently on a circuit test bench.

Middle Right: A cadet majoring in chemistry presents the results of her research at a national research conference.

Bottom Left: Low power laser light is reflected in an eye-safe experiment in the Laser & Optics Research Center. This work could lead to very large low-cost mirrors in space.

United States Air Force Academy Research Report 2003

Foreword

One of our main goals is to focus and orient our Academy on our great air and space force.
Lt Gen John Rosa, USAFA Superintendent

Everything we do here at USAFA should build towards the desired 'Battlefield Effect.'
Brig Gen Johnny Weida, USAFA Commandant

The Air Force Academy provides undergraduate education and military training to more than 4,000 cadets. The USAFA mission is to inspire and develop outstanding young men and women to become Air Force officers with knowledge, character and discipline; motivated to lead the world's greatest air and space force in service to the nation.

Research complements and enhances the Academy mission through the training and education of cadets. More than any other single activity, research develops the skills our cadets need to be independent learners and critical thinkers. We believe research experience is an essential element of a quality military academy education.

Research is the responsibility of the academic departments, which are allotted 10% of overall faculty staffing for the accomplishment of this important function. Research at the Air Force Academy has three primary goals to augment cadet and faculty training and education:

- Integrating research methods and results into the classroom through faculty professional development;
- Introducing and involving cadets and faculty in the solution of real Air Force challenges;
- Keeping instructors professionally up-to-date and focused on Air Force-relevant topics.

The Director of Faculty Research acts as facilitator to departmental research efforts and acts as the principal Academy interface with the Air Force Office of Scientific Research, as well as the rest of the Air Force Research Laboratory, the Air Force Institute of Technology, the Air Force Scientific Advisory Board, and the Air Force Chief Scientist.

This Research Report is prepared annually to record the significant research contributions of the Air Force Academy, to solicit continued involvement and support from the US Air Force, Department of Defense and other federal agencies (NASA, the National Science Foundation, the National Security Agency, etc.) and to encourage partnering outside of the government through Cooperative Research and Development Agreements.



DAVID A. WAGIE, Brig Gen, USAF
Dean of the Faculty
United States Air Force Academy

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I. Introduction

If you pursue perfection, you can capture excellence.

Vince Lombardi

Research is a cornerstone of the dramatic progress in air and space power observed recently in Afghanistan and Iraq. The faculty, cadets and staff of the US Air Force Academy (USAFA) continue to make substantial contributions to this progress, as documented in the enclosed annual research report for the Academic Year 2002-2003. USAFA research covers a wide variety of technical and non-technical topics of interest to the US Air Force and other US government agencies, most of which were sponsored by one or more USAF or DoD agencies.

Research is vital to the intellectual development and proficiency of our faculty, staff and cadets. The Air Force Academy welcomes the opportunity to conduct research on additional areas of interest to the Air Force and other government and non-government agencies when appropriate expertise and staffing resources are available or provided by a sponsor.

This annual research report

- records outstanding achievements by our faculty, staff and cadets involved in research,
- lists key contacts,
- details a number of statistics,
- honors our award winners, and
- documents our scholarly publications and presentations.

Why Do Research at an Undergraduate Institution?

Involve research in your education. You are teaching people to think critically, to think deeply, and to sort out ill-defined problems. . . . That is something for life.

Professor Daniel Hastings, former Air Force Chief Scientist

We are often asked, “Why do research at the Air Force Academy? Aren’t the Air Force Institute of Technology and the Air Force Research Laboratory more appropriate venues?”

Research at the USAF Academy serves three purposes. First, research **enhances undergraduate learning** by teaching cadets that learning and the acquisition of knowledge are dynamic, living processes. Second, scholarly activity sharpens and **enhances the professional qualifications** of our faculty, most of whom will follow their assignments here with other Air Force assignments. Finally, research aids US national defense by finding workable **solutions to real Air Force problems**.

Research at the Air Force Academy is closely integrated with high-quality teaching at USAFA. Research challenges cadets and faculty to engage in active, collaborative learning, increases one-on-one interaction, and enriches the overall educational experience. We believe this integrated approach is rewarded by consistently high rankings for our academics from the *Princeton Review*; our academic programs are consistently ranked in the top ten in the nation out of approximately 350 colleges and universities. Over the past five years, USAFA has been ranked an average of #3 in the country as the “best overall academic experience for undergraduates.”

In the 2003 edition of the *Princeton Review*, USAFA was ranked #1 in the nation (of the 345 colleges and universities considered) for

- Professors who make themselves accessible,
- Students who never stop studying,
- Great libraries, and
- Well-administered schools.

The **Academy's engineering programs** garner **consistently high rankings** in *US News & World Report's* annual rankings. Time after time, USAFA is listed in the top ten for undergraduate institutions; in 2003, our aeronautical and astronautical engineering programs were ranked **#2 in the nation's** undergraduate programs.

Literature on the impact of research on undergraduate learning indicates we've got the balance between research and teaching about right. According to "Academic Research and Student Motivation in Higher Education," by Jenkins et al., in *Reshaping Teaching in Higher Education: Linking Teaching with Research*, "Both undergraduates and postgraduates think that research activity makes their lecturers more enthusiastic, increases their credibility, and ensures that their knowledge is up-to-date." While some disciplinary variations were noted, the authors reported that all **students value research by their faculty** because it "enhances enthusiasm, credibility, [and] currency... **and "prefer to learn from staff who are involved in research."** (*emphasis added*)

The **American Association of Colleges and Universities (AAC&U)**, in Dec 2000, selected USAFA as a "**Leadership Institution**" as part of AAC&U's Greater Expectations Initiative on Quality Education. As a result, USAFA joined 21 other higher-education institutions in forming the Consortium on Quality Education. Members in the Consortium "serve as models of best practices in undergraduate education."

During the spring 2002 semester, USAFA's fourth-class (freshmen) and first-class (senior) cadets completed surveys from the National Survey of Student Engagement (NSSE). In 2002, more than 360 educational institutions in the United States administered this instrument to 206,844 invited student participants. While the national response rate to the survey was 41%, 73% of USAFA cadets responded. When compared to all NSSE institutions, USAFA ranked in the:

- 94th percentile for fourth-class (freshmen) and 98th percentile for first-class (senior) cadets in the level of academic challenge category,
- 99th percentile for both fourth-class and first-class cadets in the active and collaborative learning category,
- 99th percentile for both fourth-class and first-class cadets in the student-faculty interactions category,
- 87th percentile for fourth-class and the 96th percentile for first-class cadets in the enriching educational experiences category, and
- 95th percentile for fourth-class and 91st percentile for first-class cadets in the supportive campus environment category.

Interested parties or individuals may gain more information about the research programs of USAFA by visiting the research home page at www.usafa.af.mil/dfe/research.htm. The Director of Faculty Research may be reached by phone at (719) 333-4195 or by email at director_facultyresearch@usafa.af.mil. Our Air Force Office of Scientific Research (AFOSR)-sponsored, technically-oriented efforts are organized into the eight Research Centers and one Institute listed on the following page. We encourage direct contact.

Aeronautics Research Center

Director: Dr. Aaron Byerley, aaron.byerley@usafa.af.mil

Website: <http://www.usafa.af.mil/dfan/>

Center for Aircraft Structural Life Extension

Director: Lt Col Scott Fawaz, scott.fawaz@usafa.af.mil

Website: www.usafa.af.mil/dfem/castle

Chemistry Research Center

Director: Dr. John Wilkes, john.wilkes@usafa.af.mil

Website: www.usafa.af.mil/dfc/

Human Environmental Research Center

Director: Dr. Tom Unangst, tom.unangst@usafa.af.mil

Website: www.usafa.af.mil/dfb/herc/index.htm

Laser and Optics Research Center

Director: Dr. Randy Knize, randy.knize@usafa.af.mil

Website: www.usafa.af.mil/dfp/research/lorc/lorchome.htm

Modeling and Simulation Research Center

Director: Lt Col (s) Scott Morton, scott.morton@usafa.af.mil

Website: www.usafa.af.mil/dfan/Research/modeling_and_simulation_center.htm

Space Physics and Atmospheric Research Center

Director: Dr. Geoff McHarg, matthew.mcharg@usafa.af.mil

Website: www.usafa.af.mil/dfp/research/spacephys/index.htm

Space Systems Research Center

Director: Lt Col Jerry Sellers, jerry.sellers@usafa.af.mil

Website: www.usafa.af.mil/dfas/research/index.htm

Institute for Information Technology Applications

Deputy Director of Operations: Lt Col Jim Harper, james.harper@usafa.af.mil

Website: www.usafa.af.mil/iita

The Air Force Academy also performs research in the following areas:

- Behavioral Sciences and Leadership,
- Civil Engineering,
- Computer Science,
- Economics and Geography,
- Electrical Engineering,
- English and Fine Arts,
- Foreign Languages,
- History,
- Law,
- Management,
- Mathematics and Operations Research,
- Philosophy,
- Political Science, and
- Faculty Development.

The Air Force Academy hosts an additional two Air Force Institutes:

The Institute for National Security Studies promotes national security research for the Department of Defense within the military-academic community and supports the Air Force national security education program, promoting, coordinating, and disseminating vital national security research that influences Department of Defense policy development.

Director: Dr. James M. Smith

Website: <http://www.usafa.af.mil/inss/>

The Humanities Institute acts to coordinate and advocate research in the humanities (English and Fine Arts, Foreign Languages, History, and Philosophy) at the Air Force Academy.

Director: Lt Col Tom Krise, Thomas.Krise@usafa.af.mil

Points of contact for each department, research center and institute are listed in Table 2 at the end of this report, immediately prior to the detailed listing of publications. Again, we encourage direct contact.

What follows is a detailed review of the research program at the Air Force Academy, including statistics, highlights, and publications.



Quick Overview of Academic Year 2002-2003

USAFA research has completed the most successful year in its history. In the past two years, external funding of research has nearly tripled. As one can see in Figure 1 (“Numbers you can use”) the research environment at USAFA continues to enjoy strong participation.

We continue to enjoy an energetic and growing base of outside funding and Air Force-relevant support agreements. We were fortunate to add our eighth AFOSR-funded Research Center this year in space physics and atmospheric sciences. Further, the total external research funding continued its strong growth trend, up by more than 56 percent over the previous academic year. Our mature research centers continued to nurture Air Force-relevant, interdisciplinary work of very high quality, as evidenced by the recognition of a growing number of our cadets and faculty members by a variety of research awards.

USAFA research focuses on topics that faculty feel will provide research opportunities for cadets and will have an impact on the Air Force and our nation, including many projects that now relate directly to the operational Air Force mission. Section II of this report lists those research projects that have significantly impacted the Air Force, our nation, and/or USAFA.

Why we track research:

- *Accountability:* we must be good stewards of research funds and manpower resources.
- *Assessment:* we need to track research to gauge the successes or limitations of our research programs.
- *Transition:* our research must be linked to the solution of real Air Force and Defense Department needs.

Numbers you can use (2002-2003)

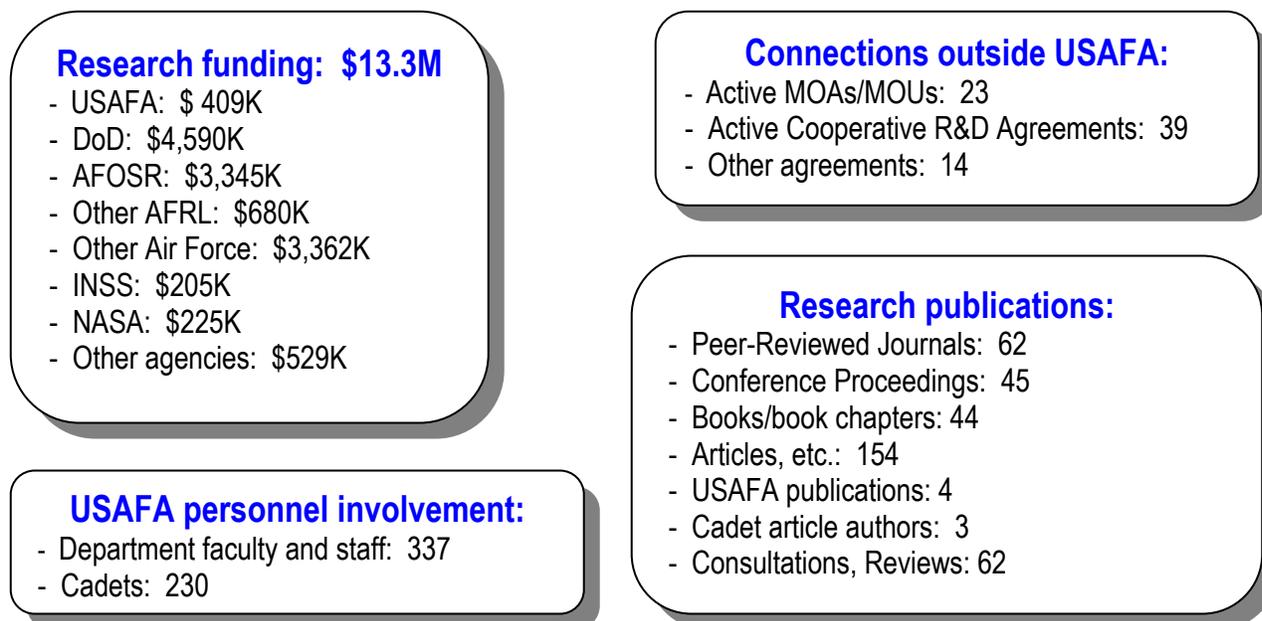


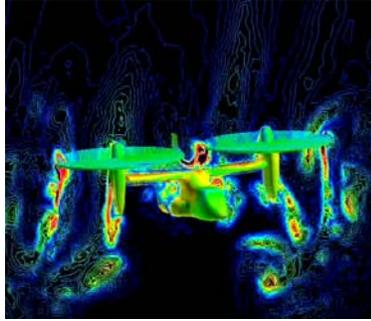
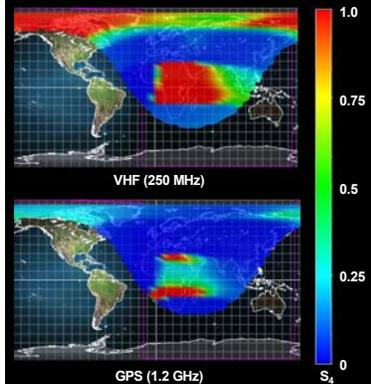
Figure 1. Primary research statistics for Academic Year 2002-2003. Includes in-kind support.

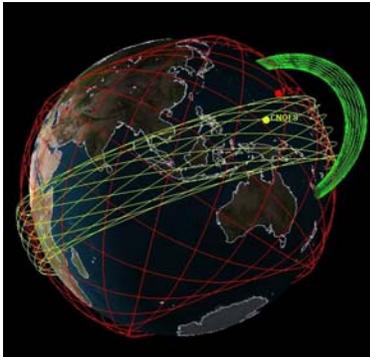
II. Key Research Accomplishments

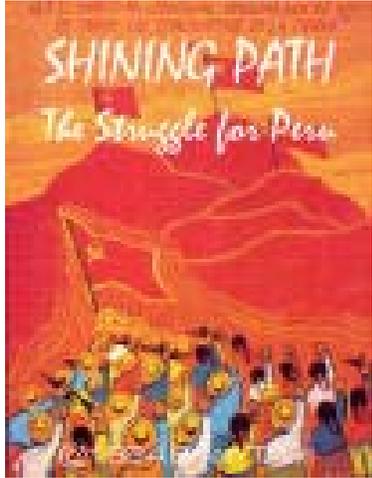
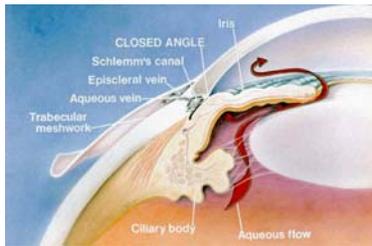
*“Victorious warriors win first and then go to war,
while defeated warriors go to war first and then seek to win.”*

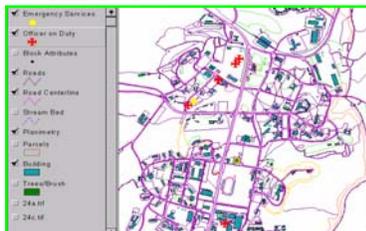
Sun-Tzu

Impact on the Air Force and the Nation

Customer	Department	Impact
<p>AF Special Operations Command, AF Research Laboratory</p> 	<p>Aeronautics (DFAN)</p>	<p>The Modeling & Simulation Research Center provides high-performance computing support for all science and engineering disciplines. As a summer research project, C1C Tom Billingsley modeled the CV-22 tilt-rotor vortex state. The team won three prestigious awards for its computational fluid dynamics modeling, winning the USAF Science & Engineering Award, a NASA Group Achievement Award, and the USAFA Seiler Award for Engineering. Other DFAN national awards included C1C Jaime Koller’s American Inst of Aero and Astro award on C-130 “Commando Solo” drag reduction, which resulted in a 6000-foot ceiling increase and either a 90-minute increase in time on target or a 170-mile radius increase, and Dr. Tom Yechout’s NASA Group Achievement Award for Investigations of the X-38 Crew Return Vehicle.</p>
<p>Air Force Space Command</p> 	<p>Physics (DFP)</p>	<p>Establishment of the Space Physics and Atmospheric Research Center (SPARC), which studies space physics and astronomy, develops payloads for the Academy’s small satellite program, studies applied plasma physics, and models upper atmospheric response to solar and space weather events. Professor Lon Enloe worked with C1C John Fischer and Aeronautics faculty on the physics of the novel plasma flap for aircraft attitude control. Dr. Linda Krause is working with C4C Michael Toth calibrating the newest plasma sensor which will fly on the next Academy FalconSat-3 satellite.</p>
<p>National Security</p> 	<p>Institute for National Security Studies (INSS)</p>	<p>INSS produced <i>Milestones in Strategic Arms Control, 1945-2000: United States Air Force Roles and Outcomes</i> (edited by J. Smith and G. Hall), which was published by Air University Press. INSS also published five Occasional Papers during FY 2002, and three INSS products were showcased in the <i>Aerospace Power/Air and Space Power Journal</i>. INSS continued to host thought-provoking workshops and conferences, notably a Biodefense Workshop in Washington to help set the stage for the HQ/USAF Biodefense Task Force initiation, and a conference “Deterrence and Defense in the Early Twenty-First Century” that began the examination of these core national security concepts in a changing environment.</p>

<p>Air Force Space Command, Air Force Space and Missiles Center, Air Force Research Lab</p> 	<p>Astronautics (DFAS) and Physics (DFP)</p>	<p>The FalconSAT-3 project will carry three DoD payloads: Pulsed Plasma Thrusters, the Flat Plasma Spectrometer to collect detailed measurements of space plasma; and the Plasma Local Anomalous Noise Environment to investigate the localized plasma environment around a spacecraft. Cadets Dave Auston, Trevor Warren and Craig Husby successfully briefed the pulsed plasma thruster experiment to the DoD Space Experiment Review Board (SERB) earning a ranking of 18th out of 45 DoD-wide, clearing the way for all three experiments to be manifested on FalconSAT-3 in support of the SMC Space Test Program. FalconSAT-3 is manifested to launch on a Delta-IV launch vehicle in March 2006. About 30 cadets were actively involved in the FalconSAT program, including C1C Mike Strasser, who presented the FalconSAT program to members of the Senate Armed Services Committee.</p>
<p>Air Mobility Command</p> 	<p>Management (DFM)</p>	<p>Major Andy Armacost won the Institute for Operations Research and Management Sciences best practices award, the 2003 Franz Edelman Award for Achievement, for his research into mathematical optimization techniques for designing the complex air networks of overnight cargo shippers, work that has revolutionized aircraft routing and scheduling processes. Major Armacost is working with researchers from MIT and the Draper Laboratory to develop similar techniques to support Air Mobility Command.</p>
<p>Sensors Directorate and UAV Battlelab</p> 	<p>Electrical Engineering (DFEE)</p>	<p>DFEE is developing and verifying computational electromagnetic codes used to reduce the radar cross section of modern aircraft. This effort is leading to the reduction of on-board adjacent-antenna interference and will eventually lead to the design of complex antenna systems and frequency-selective materials required for advanced platforms such as a Sensorcraft. In addition, DFEE has demonstrated a cooperative “swarm robots” concept: desired collective behaviors of multiple intelligent autonomous mobile robots have achieved optimal search and attack tasks. These efforts continue to find optimal distributed system architectures and communication protocols that incorporate intelligent sensor information.</p>

<p>Global War on Terrorism</p> 	<p>Engineering Mechanics (DFEM) and Philosophy (DFPY)</p>	<p>Captain Jason Bartolomei (DFEM) modeled the workload dynamics of cadets, resulting in the creation of a simulation application called CadetSIM to provide insight into the time requirements for cadets during the school year. The tool has been adopted by the 34th Training Wing to enhance officers' understanding of cadet time. This work led to further research sponsored by the Defense Modeling & Sim Office including the developments of a systems model for predicting terrorism growth dynamics of the Shining Path terrorist organization, and policy analysis for North Korean nuclear nonproliferation. Captain Bartolomei and Maj Casebeer (DFPY) presented their findings to CIA, DIA, RAND, and the Dept of Homeland Security.</p>
<p>The world</p> 	<p>Biology (DFB)</p>	<p>Dr. Mike Wilcox and C1C Omar Kadri have a patent pending for the development of a Cylindrical Implant for Control of Intraocular Pressure, a means of controlling the overpressure in the eye associated with glaucoma, the leading cause of blindness in the world. Dr. Wilcox' world-class modeling of insect vision, in collaboration with the University of Wyoming, promises to deliver revolutionary low-cost sensors for autonomous systems.</p>
<p>Defense Modeling and Simulation Organization, UAV Battlelab</p> 	<p>Computer Science (DFCS)</p>	<p>Maj Al White leads a very active group involving Computer Science majors in a two-semester capstone course to develop an Unmanned Aerial Vehicle (UAV) ground station, computer hardware and software systems that control the planning of UAV missions and all aspects of the UAV flights. This has proven to be an excellent systems integration problem. The UAV work is forming the basis for DFCS and six other Academy departments' establishment the first-ever undergraduate course on UAVs.</p>
<p>Operation Iraqi Freedom</p> 	<p>Chemistry (DFC)</p>	<p>Dr. John Wilkes led a team solving an urgent battery problem for US forces. The USAFA-led team involving cooperative research partners Compact Power Inc. and AAAA Energy Enterprises developed, tested and delivered an alternative battery pack for the warfighters in less than two months. The lithium-ion battery pack is now part of the new Battlespace Air Operations kit, doubling the previous battery's performance, while cutting battery cost by 97%.</p>

<p>Air Force Studies and Analysis Agency</p> 	<p>Mathematics (DFMS)</p>	<p>The Operations Research Team completed a turn-key 4.5-day Air Force Operations Research Analysis Familiarization Course. The course, developed with funding from the Air Force Studies and Analysis Agency (AFSAA), has been taught five times this year and will be offered quarterly around the nation to help train Air Force Ops Research Analysts.</p>
<p>The world community</p>  <p>Radovan Karadzic Rank: Bosnian Serb President Status: At Large</p>	<p>Political Science (DFPS)</p>	<p>Dr. Fran Pilch has published extensively in the area of legal issues relating to war crimes, genocide and sexual violence in war. Dr. Pilch created and directed a multidisciplinary offering: <i>War Crimes, Genocide and Human Rights</i>, co-taught with the Law and History Departments.</p>
<p>The nation</p> 	<p>Civil Engineering (DFCE)</p>	<p>DFCE hosted the second annual Construction Camp at the Academy's Field Engineering and Readiness Lab to provide high school students with an excellent opportunity to gain hands-on experience in engineering and construction in an outdoor environment at the Air Force Academy.</p>
<p>US Air Force and DoD</p> 	<p>34th Education Group</p>	<p>Dr. John Farquhar was named the Allen E. Dorn Award as the Military Strategic Studies Outstanding Researcher of the Year for his book: <i>A Need to Know: The Role of Air Force Reconnaissance in War Planning, 1945-1953</i> (Air University Press) and other research accomplishments.</p>
<p>Department of Defense</p> 	<p>Foreign Languages (DFF)</p>	<p>In a year where the need for Arabic linguists greatly exceeded the DoD supply, DFF undertook a research project to identify and inventory current methods used by linguists to maintain their skills in Arabic, Chinese, Korean, Russian, and Spanish. By collecting input from linguists on best practices and identifying obstacles to those maintenance efforts, DFF will help to foster better retention of critical language skills.</p>
<p>US Air Force</p> 	<p>Institute for Information Technology Applications (IITA)</p>	<p>The HQ USAF Geospatial Integration Office appointed the IITA as the GeoBase research arm for USAF. GeoBase is a geospatial information system to enable base commanders to have a holistic view of all base assets. IITA established a relationship with the Air Force Institute of Technology to sponsor and host GeoBase research, and developed a strategic plan for integrating GeoBase services across USAFA.</p>

Impact on USAFA

Entity Served	Department	Impact
<p>Academy graduates and general public</p> 	<p>Behavioral Sciences (DFBL)</p>	<p>C1C Myzsa Pennell and Dr. David McCone were co-authors on the presentation “A preliminary evaluation of marital and divorce trends among USAFA graduates” that won a research award at the annual meeting of the Rocky Mountain Psychological Association.</p>
<p>USAFA and the USAF</p> 	<p>English and Fine Arts (DFENG)</p> 	<p>Major Doug Cunningham researched and is writing a book detailing the history of the Air Force unit that recruited Hollywood talent to make training films and documentaries during World War II. <i>Celluloid Commandos: Hap Arnold, Jack Warner, and the History of the Army Air Forces First Motion Picture Unit</i> was the result.</p>
<p>USAFA and the USAF</p> 	<p>Economics & Geography (DFEG)</p>	<p>Dr. Robert Waller performed research on USAFA’s privatization (A-76) activities and has presented those findings to the Superintendent.</p>

III. Research Details

A. Total Research Funding: \$13.3 Million

The growing willingness of outside agencies to invest in USAFA research suggests a positive metric of success. Total USAFA research funding (including Dean’s funds) grew by almost 60 percent, from \$8.5 million last year to more than \$13.3 million this year. Importantly, 97 percent came from non-USAFA sources. This reflects in large part the phenomenal growth of in-kind supercomputer support from the DoD High-Performance Computing Modernization Office to the Modeling & Simulation Research Center. The Center for Aircraft Structural Life Extension also saw substantial funding growth from the Aeronautical Systems Center.

Figure 2 shows the explosive funding growth that has occurred: **external research funding at USAFA has grown by a factor of six in the past seven years.** (Data before 1995 generally do not include the value of AFOSR’s now-defunct Frank J. Seiler Research Laboratory.)

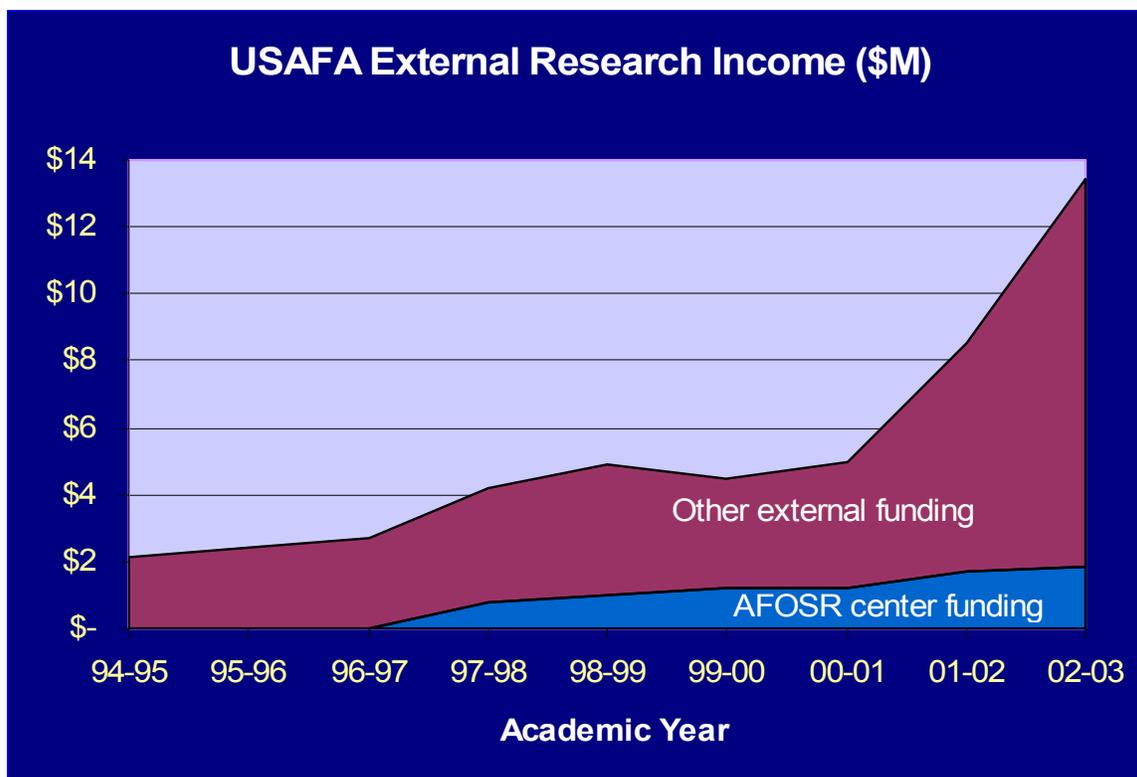


Figure 2. Research funding trends at USAFA.

Research at USAFA is a bargain to outside customers—we currently charge no overhead for faculty salaries, facilities, etc., so the research money goes directly to the research efforts. Outside funding agencies recognize this excellent value and USAFA research, and our customers are reaping the benefits.

Four departments accounted for about 80 percent of the total research support:

- Aeronautics* \$ 6.3 M
 - Engineering Mechanics \$ 2.0 M
 - Astronautics \$ 1.2 M
 - Physics \$ 1.2 M
- (*includes Modeling & Simulation)

Figure 3 shows the overall distribution of funding sources. The DoD contribution (34% of the total) is dominated by in-kind supercomputer time from the High-Performance Computing Modernization Office, and the AFOSR total (25%) includes the substantial value of the people programs such as the Engineer and Scientist Exchange Program and the National Research Council’s visiting scholars program.

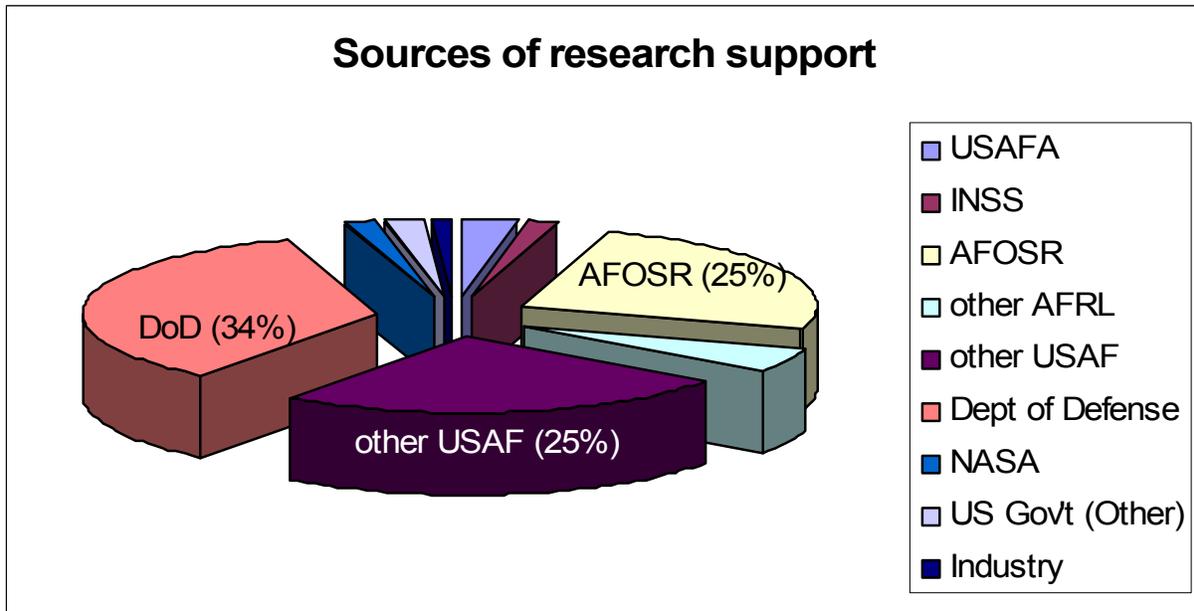


Figure 3. Sources of USAFA Research Funding.

Table 1, on the following page, lists all research funding and in-kind support (e.g., exchange researchers, supercomputer time) received by each department. Understandably, the basic and engineering sciences attracted the lion’s share of external funding.

Research Support Recipients*

Basic Sciences	
Biology	\$ 324,000
Chemistry	\$ 267,000
Computer Science	\$ 385,000
Mathematical Sciences	\$ 60,000
Physics	\$ 1,208,000
Total Basic Sciences	\$ 2,244,000
Engineering Sciences	
Aeronautics	\$ 6,317,000
Astronautics	\$ 1,211,000
Civil and Environmental Engineering	\$ 49,000
Electrical Engineering	\$ 30,000
Engineering Mechanics	\$ 1,985,000
Total Engineering	\$ 9,592,000
Humanities	
English and Fine Arts	\$ 19,000
Foreign Languages	\$ 70,000
History	\$ 2,000
Philosophy	\$ 6,000
Total Humanities	\$ 96,000
Social Sciences	
Behavioral Sciences and Leadership	\$ 52,000
Economics and Geography	\$ 17,000
Law	\$ 60,000
Management	\$ 55,000
Political Science	\$ 29,000
Total Social Sciences	\$ 212,000
Institutes	
National Security Studies	\$ 205,000
Information Technology Applications	\$ 997,000
Total Institutes	\$ 1,202,000
USAFFA-provided	\$ 409,000
Total External Funding	\$12,973,000
Grand Total	\$13,346,000

Table 1. USAFA Research Support Recipients, Academic Year 2002-2003.

* Includes both financial and in-kind support

In addition to outside funding, the Air Force Academy contributes a substantial amount of value to the research program, including faculty time, laboratory space, and capital equipment. When one measures the econometric value of the USAFA contribution, the true value of the overall research program at USAFA grows considerably. Figure 4 shows a first-order approximation of the USAFA organic contribution to research alongside external support. External funding (\$7.7M) is listed separately from in-kind support (e.g., supercomputer time, visiting researchers, USAFA faculty time, etc) for clarity.

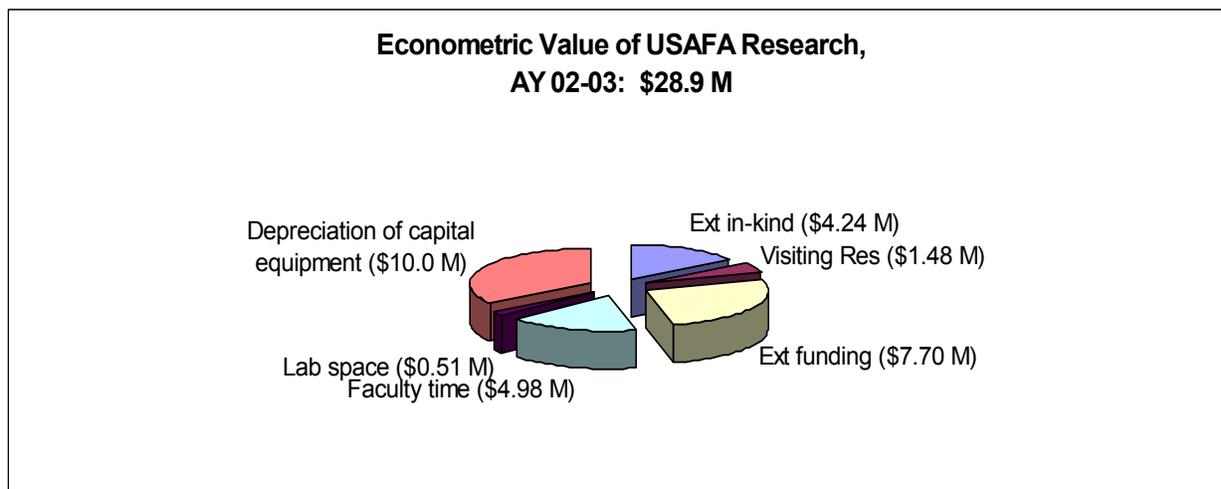


Figure 4. USAFA Research Econometric Value, Academic Year 2002-2003.

In this simple estimate, laboratory space dedicated to research was valued at \$11 per square foot per year, while a simplified 15-year accelerated straight-line depreciation was applied to the replacement value of research capital equipment. Thus, combining external support and the econometric value of the USAFA contribution, the total research program represents an annual effort of approximately \$29 million.

B. USAFA personnel involvement

An important complement to the number of research projects is the overall involvement in research by USAFA faculty and cadets, shown at right in Figure 5. A total of 337 faculty members were counted as active researchers by their departments, the greatest number reported since 1995. Most importantly, departments reported that 230 cadets were involved in research.

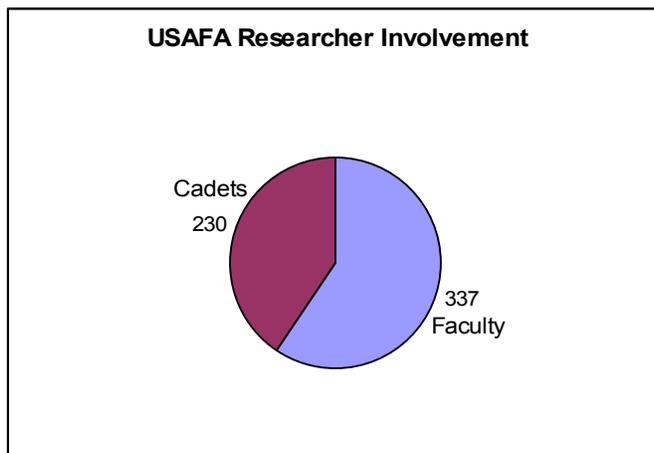


Figure 5. USAFA Researcher Involvement

C. Connections Outside USAFA

Another good metric of research quality and academic standing is relevant partnerships with other universities and government agencies. Some of the vehicles USAFA uses to achieve these connections include:

- **Memoranda of Understanding (MOU) / Memoranda of Agreement (MOA)**, typically between government organizations. We have twenty active MOU/MOAs with other agencies, most notably our MOA with the Air Force Office of Scientific Research (AFOSR) for annual support to the eight USAFA research centers and IITA, plus funding for small “seed” grants, and financial backfill of USAFA faculty exchanges to AFOSR overseas detachments in London and Tokyo.
- **Cooperative Research and Development Agreements (CRADA)**. During the past year, we had 39 active CRADAs. Cooperative Research and Development Agreements allow government agencies to work closely with civilian agencies or industry. In the past year, we have increased our outreach to other universities in the Front Range of the Rockies, most notably to the University of Colorado at Colorado Springs (UCCS). This has led to closer interaction between our faculties and a sharing of our laboratory facilities. At least three graduate students (two M.S., one Ph.D.) have begun graduate degree programs at UCCS because of their new ability to interact with USAFA researchers and facilities.
- **People Programs**. The Engineer and Scientist Exchange Program (ESEP), administered by AFOSR for the Secretary of the Air Force, continues to promote strong interaction: Aeronautics hosted an Israeli and a Korean researcher in the past year, while Law hosted a German attorney. The ESEP program has recently placed five German researchers at USAFA (one each in Aeronautics, Astronautics, Behavioral Sciences, Engineering Mechanics, and the Institute for Information Technology Applications), and another German (electrical engineer) is expected in early 2004. ESEP participants continue to make a strong contribution to USAFA research. AFOSR also funds visiting researchers under the National Research Council (NRC) Research Associates program. This past year saw several NRC visiting researchers in Chemistry and Aeronautics.

D. Research publications and presentations produced by USAFA

Figure 6 includes publications from several categories: journal articles, conference proceedings, books, and book chapters. Publications are clearly one of USAFA’s strengths and are fairly well distributed across the academic departments. The numbers for peer-reviewed journal articles (62) and proceedings (45) are comparable with the previous year, while the number of books and book chapters (44) are substantially higher than in previous years, and the number of reported presentations increased to 295.

While it is worth mentioning that USAFA faculty engage in other important scholarly and outreach efforts (for example, writing book reviews and engaging with nearby public schools in their speaker programs), we do not list those accomplishments here. These important contributions fall outside the realm of this document and are reported in other documents.

The total number of scholarly publications (309) and presentations (295) continued the steady upward trend seen in the past two years, as shown below. Each faculty member involved in research produced almost one publication and almost one presentation this year, a statistic that continues to reflect the faculty’s dedication to our primary focus on teaching and time constraints placed on our faculty by the short staffing situation.

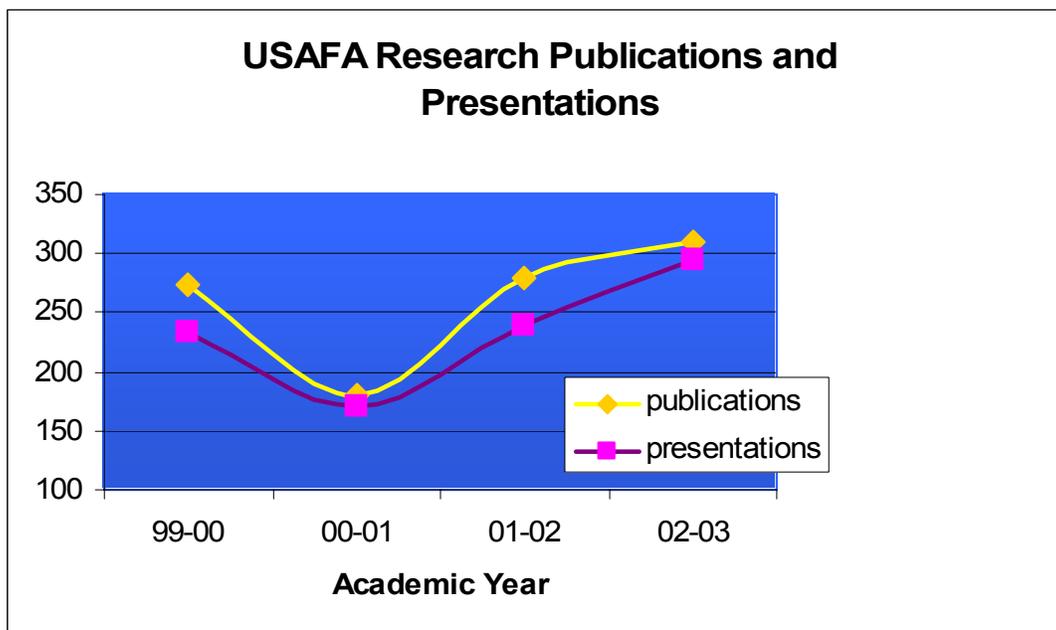


Figure 6. Trends in publications and presentations by USAFA faculty

The Appendix lists publications and presentations for the academic year, arranged by faculty department. Consistent with last year’s practice, book reviews were not part of the graphic; “publications” are only listed if they are considered original research work (journal articles, conference proceedings, original articles etc.) published outside USAFA.

E. Awards

On 17 January 2003, USAFA was honored by the presence of Dr. Alexander Levis, Chief Scientist of the Air Force. Dr. Levis took time from his busy schedule to present the Air Force Science and Engineering Award for Exploratory or Advanced Technology Development to the Computational Fluid Dynamics Research Group of the Department of Aeronautics (Maj Scott Morton, Dr. Douglas Blake, Dr. Russ Cummings, and Maj James Forsythe).

This prestigious award was earned by the development of aircraft aerodynamic simulation technology. The team's technology development for full-aircraft simulation at operational flight conditions has the potential to significantly reduce the acquisition costs of current Air Force aircraft acquisition programs by providing a method of discovering or verifying the existence of aerodynamic phenomena detrimental to the vehicle's performance before first flight of the air vehicle. This work was previously only possible with costly wind tunnel experiments or flight test programs.

Also recognized at the ceremony as recipients of the Institute for National Security Studies Outstanding USAFA Researcher Award were Dr. Paul Bolt (DFPS) and Maj Carl Brenner, formerly of the USAFA Department of Political Science and subsequently a student at Georgetown University in a USAFA-sponsored PhD program, for their paper *Information Warfare Across the Taiwan Strait*. This timely and operationally relevant paper is being published in the *Journal of Contemporary China*.

The Major General Robert E. Linhard Outstanding INSS Researcher Award was presented to Maj Steve Kiser and Maj Troy Thomas, both formerly of the

USAFA Department of Political Science, for their paper *Lords of the Silk Route: Violent Non-State Actors in Central Asia*.

The Frank J. Seiler Excellence in Research Award for Engineering went to Maj Scott Morton for his work in modeling aerodynamic vortex breakdown in post-stall flight conditions. The Frank J. Seiler Excellence in Research Award for Science went to Maj Mace Golden for developing single-stranded DNA molecules possessing modified bases. The work provides tremendous hope for building incredibly sensitive and cheap chemical sensors.

The McDermott Award for Research Excellence was presented to Maj Bill Casebeer. Casebeer was recognized for a large body of work, but primarily for his research into the foundations of morality and moral judgment, exploring the different uses that conceptions of "function" might have for helping us understand just how moral norms can be discovered using the traditional methodological canons of the natural and social sciences. Runner-up for the McDermott Award was Maj Andy Armacost for his work on *Optimization and Decision Support Methods for Large-Scale Systems*, which has had significant impact on optimization methods to be used in planning logistics and mobility systems, including the refining and applying these logistics-planning methods to planning scenarios faced by the Air Mobility Command Tanker Airlift Control Center.



Dr. Levis (center) and the members of the USAFA Computational Fluid Dynamics Research Group.

Cadet First Class Craig van Beusekom of Cadet Squadron 14 was presented with the Thomas D. Moore Award for the outstanding cadet summer research project. Van Beusekom worked with the Surrey Nanosatellite Applications Program (SNAP) as a member of the research and design team. Runners-up for the Moore Award were C1C Elia Burrell, C1C Lena Byrne, and C1C Simon Ritchie.

This year Major Andy Armacost, as part of a research team, won the Institute for Operations Research and the Management Sciences (INFORMS) best practices award, the 2003 Franz Edelman Award for Achievement. The award recognizes the most significant advances in operations research and is based on the impact of the winning team's research on actual operational situations. Major Armacost's research concerned the development of mathematical optimization techniques for designing the complex air networks of overnight cargo shippers, such as the United Parcel Service and Federal Express. Major Armacost helped to create a system that revolutionizes the aircraft routing and scheduling processes performed by the carrier. Major Armacost is currently working with researchers from MIT and the Draper Laboratory in Cambridge, MA, to develop similar techniques to support mobility planning at the USAF Air Mobility Command. Major Armacost and his co-researchers shared the prize with a research team from Canada.

Dr. James B. Pocock of the Department of Civil Engineering (DFCE) received the award for "Best Overall Conference Paper" for a presentation he made at the ASEE national conference in Montreal in June 2002, on project-based education in two of DFCE's construction management courses. Maj. Pete Ridilla was the co-author.

In the humanities, Dr. Jeanne Heidler of the Department of History (DFH) won the Society for Military History's Distinguished Book Award for her work, *Encyclopedia of the American Civil War*.

Cadets representing the Department of Foreign Languages (DFF) won prizes in the 3rd nationwide TOWA Japanese Essay Contest sponsored by the Japanese Association of Greater Philadelphia (JAGP) in November 2002. C2C Kathryn Young received the "Consulate General of Japan in New York Award," C2C Ariel Kayne received the "Kodansha America Award," and C2C Jeffrey Provenzano received the "JASGP Friendship Award."

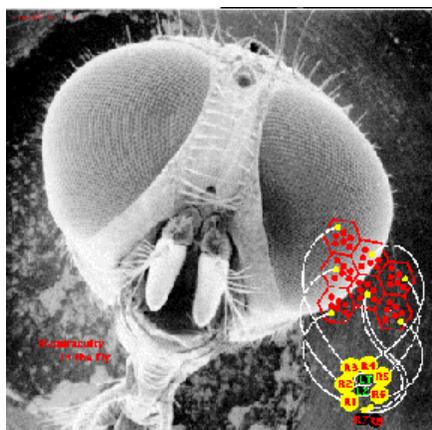
USAFA cadets also won prizes in the 16th Colorado Statewide Japanese Speech Contest sponsored by the Japan Foundation, the Consulate-General of Japan, the Colorado Japanese Language Education Association, and the University of Colorado Boulder Department of East Asian Languages and Civilizations in November 2002. C2C John Oberle won First Prize in the College II Category, and C2C Kathryn Young won Second Prize in the College III Category.

F. Reprints from USAFA Discovery www.usafa.af.mil/dfe/discovery.htm

Compound Eyes on Machines?

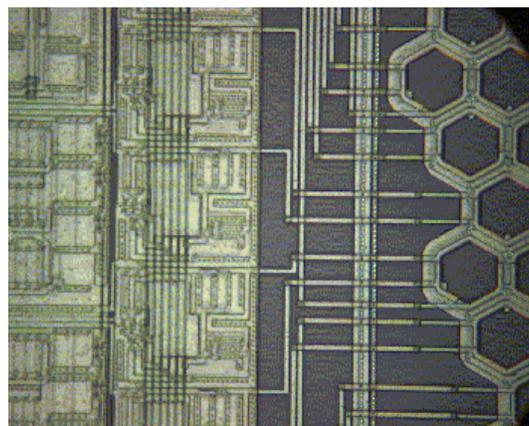
More precisely, what's in a brain?

Ramon y Cajal, arguably the greatest neuroanatomist to have lived, gave us the Neuron Doctrine. That is, a brain is made up of individual cells called neurons and that these cells talk to one another at specific points of contact. Cajal was a so-called comparative anatomist. He examined cellular anatomy in every different kind of animal he could find. In particular he looked at their eyes, because they are extensions of the brain, thinking that structural aspects common to all would suggest their functional aspects. Astonishingly he found 1:1 structural homology for each retinal cell in mollusks (clams and squids), animals with backbones, like birds, frogs, lizards, monkeys or the largest group of all, insects! At the turn of the century, there were few tests of cell function. Now, electrical activity from single cells in animal eyes has been recorded for over fifty years. The same functional cell types are present in all the retinas of all the animals ever looked at. The interpretation is that if the structural and functional homology is the same in all eyes, information-processing principles must at least be similar. If we could understand how those principles work in any one eye, we gain insight to the function in other eyes.



The military has long envied animal vision systems because they perform much better than machine vision systems, and yet they appear to have such slow hardware. Animal eyes are the ultimate parallel processors. However, communication between cells is by chemical neurotransmission. Chemical diffusion alone takes almost 1 millisecond. No amount of parallel processing can make up for such a long delay, so how can they be so fast at some tasks like pattern recognition? We think the more important answer lies in what information the cells encode and how they communicate it. What we found is a lot more processing than we thought occurs early in the retina, electrically and in real-time.

In the biology labs we record electrical activity from cells in the compound eye and then simulate cellular interaction in order to understand the information processing principles. Once we understand what the cells are telling each other and how, we can make discreet electronic circuitry that does the same thing. We have that circuitry made into a silicon chip, test it and deliver the results to our sponsor, the Naval Air Warfare Center, Weapons Division. Our present prototype has the photosensors and all the processing circuitry on the same piece of silicon. It does all the processing and does it in real-time. It allows us to track targets moving at very high speeds. The prototype is the proof-of-concept that the only spatial resolution limits are contrast and the wavelength of light. However, the best part comes last. Performance of the



electronic circuitry makes specific predictions about the nature of the interaction in living cells, and we can test those interactions in living animals by recording their activity in response to different stimulation that we never thought of before. If silicon really does the same thing a living eye does, then we think we've finally gotten it right.

As part of our research we intend a 2-D demonstration of performance advantages of compound eyes mounted on model cars that can chase targets and avoid obstacles at the same time. In this effort we are joined by John Davis, a graduate student from the University of Wyoming; his mentor, former deputy director of Electrical Engineering at USAFA, Lt Col (ret) Steve Barrett; and a visiting professor in Aeronautics, Lt Col Kelly Cohen of the Israeli Defense Force, an expert in application of "fuzzy logic." The advantages of this approach are robust computation that will allow the vehicle to navigate in a completely unstructured environment. What we are really exploring is the minimal hardware to accomplish a mission. What we really want to understand is the computational tools animals use to accomplish their missions and apply them to machines to realize the same enhanced performance.

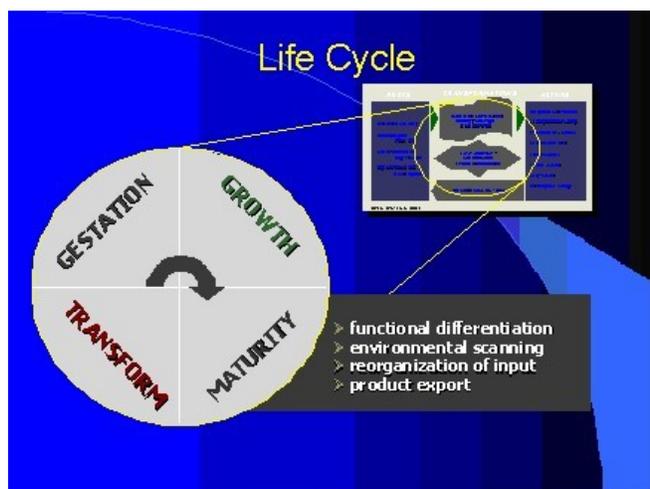
Information processing in deeper layers in the eye is unknown. First we plan to reconstruct cellular interconnections in the inner plexiform layer in 3-D using a high voltage electron microscope now on line in the biology department. Then ongoing electrical recording will help us understand the information processing in that layer.

Interdisciplinary USAFA Team Models Terrorist Group Formation

In order to cope effectively with the threat presented by terrorist groups and other violent non-state actors, warfighters and policymakers alike need to understand how terrorist organizations form and grow. What are the critical factors that cause otherwise nonviolent populations to choose indiscriminate violence as a means to impose their will on others? What critical indicators and warnings tell us when it is likely that a population will become violent, and can these markers serve to highlight transitions between phases in the growth profile that is characteristic of terrorist groups? And how do these insights help us deter and combat terrorism?

To answer these pressing questions, and possibly even to produce tools that can predict the growth of violent non-state actors, three USAFA researchers are using techniques from systems engineering, computer simulations from dynamic systems, and metaphors from developmental biology. Captain Jake Bartolomei of the Engineering Mechanics Department, Major Bill Casebeer of the Philosophy Department, and Major Troy Thomas, formerly with the Political Science Department but now the chief of intelligence for the First Fighter Wing, are working together to bring a suite of unusual disciplinary backgrounds and paradigms to bear on the complex system that is terrorism.

To frame the problem, the team employed a biological and open systems approach. The team realized early on that there was no unifying framework for thinking about terrorist organizations. Using a biological metaphor, we saw that such organizations could be treated the way a developmental biologist would treat a living organism: as a system which exists in an open environment and that has a definable life-cycle, with critical transition points between phases of the cycle,” says Casebeer. Understanding what inputs are necessary for terrorist “organisms” to have a genesis point, grow, reach maturity, and transform or die, is critical for coping with such groups effectively at all points in their ontogeny or development (see Figure 1).



But Major Thomas’s background in political violence, and Major Casebeer’s study of philosophy of biology, required supplementation to actually produce a working simulation of such a system. Captain Bartolomei’s expertise in dynamic systems modeling, and the unusual systems engineering and design approach he brought to the problem of thinking about the terrorist organization/environment interface, proved critical to getting a working model off the ground.

Attacking a modeling problem is a lot like designing a product, which is why it’s so useful to bring systems engineering tools and processes to these issues. Who are the customers of the system? What functions does the system have to accomplish to satisfy the customer’s demands? What activities does the system engage in so as to accomplish these functions? What are the critical measures of performance, or vital signs, which relate to these activities? What external variables affect performance; in other words, what are the system drivers? Engineers are required to answer these questions whenever they

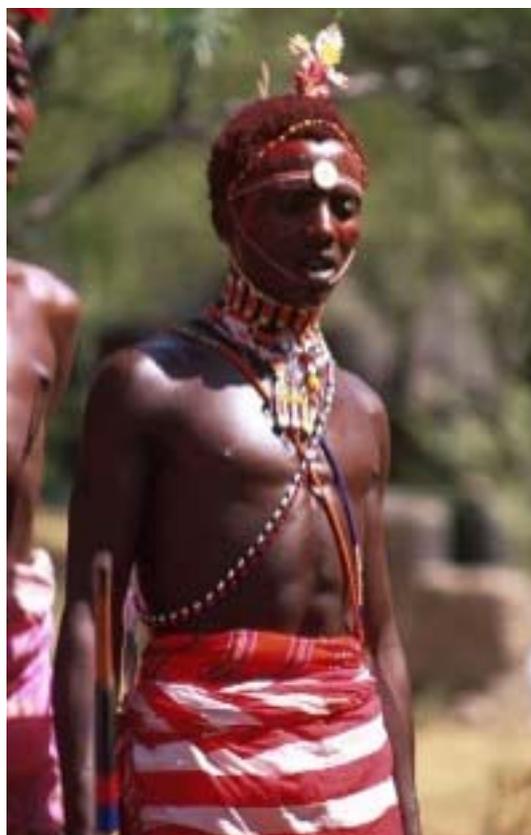
design a product...The team is demonstrating that these same thought processes can be brought to bear to problems that aren't traditionally thought of as being engineering issues.

The team is in the process of building "modules" that model the relevant causal structures necessary for terrorist groups to accomplish their primary functions, which include: attracting people, acquiring material, formulating an agenda, propagating an agenda, protecting critical organs, gathering intelligence and committing terror. The centerpiece of the model thus far is the "attract people" module, which represents the variables that feed population disaffection, including availability of food and water, respect for basic human rights, presence of free market mechanisms, and level of acceptance of violence as a problem solving method. The module aggregates these approximately 40 variables into mid-level intervening variables: the Maslow quotient--dealing with basic physical needs, safety-security needs, etc.; the Smith quotient--dealing with economic and market-related factors; the Dewey quotient--dealing with freedom and education related variables; and the Camus quotient--dealing with existential issues about self-identity. These variables influence a set of differential equations that simulate the dynamic behaviors that characterize recruitment activity.

The team is in the process of validating the simulation. Thomas and Casebeer conducted exploratory research last year involving the development of a violent movement among the Masaai of Tanzania. In addition, Casebeer will apply the model to Peru's history with the Sendero Luminoso early this summer, and Casebeer and Thomas will both travel to the former Soviet state of Georgia to discuss the government's strategy to cope with the Chechen rebels. The team hopes their model will satisfactorily replicate the histories of these case studies. More ambitiously, the team is in the process of collating the empirical databases needed to validate these kinds of models. "This has been an eye-opener," Casebeer notes. "As an intelligence officer, this kind of work is invaluable...it directs us toward collections requirements that the intelligence community is otherwise overlooking." The team believes the blind-spots that this method helps us identify may be more important than the output of the simulation itself.

The team has presented its results to terrorism experts at the RAND headquarters in Santa Monica, the RAND east coast headquarters in Washington, D.C., the National Military Joint Intelligence Center at the Pentagon, the Naval Postgraduate School's Department of Defense Analysis, and to modeling experts at a Santa Fe Institute attended by CIA analysts and representatives from the national laboratories (Los Alamos, Sandia, and Argonne). They will complete their modeling work by the end of the summer, and after validating the simulation will detail what implications it has for deterring and war-fighting with terrorist organizations. The team expresses grateful appreciation to the sponsors of this research, including the Air Force's Institute for National Security Studies, the Air Force's Institute for Information Technology Applications, and the Department of Defense's Defense Modeling and Simulation Office.

A Maasai warrior



Space Assets Monitor Hurricanes

Geoff McHarg, Lt Col, USAF (ret.)

Hurricanes in Canada you say? Yeah, right! Late on Sunday evening, 28 September 2003, Hurricane Juan visited the maritime coast of Halifax, Nova Scotia, uprooting trees, killing two people, and causing extensive structural damage. The number of casualties could have been much worse – especially if no weather satellites or weather satellite-derived intensity estimates were available.

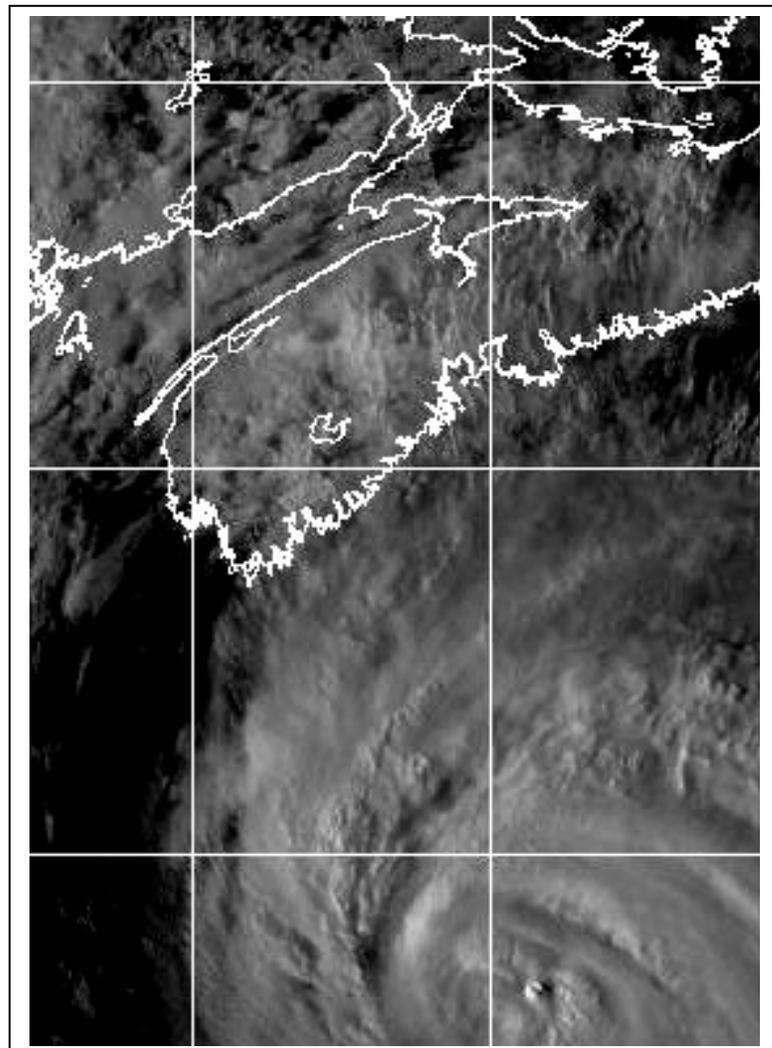
Since 1998, the Department of Physics (DFP) has been involved in weather satellite-based remote sensing of tropical cyclones. Through a joint research initiative, DFP and the University of Wisconsin-Madison Cooperative Institute for Meteorological Satellite Studies (UW/CIMSS -- <http://amsu.ssec.wisc.edu>) have developed a novel intensity estimation technique based on accurate characterization of the thermal structure of the tropical cyclone inner eye wall region.

“It’s a fairly simple concept,” according to Major Kurt Brueske, an Associate Professor within DFP. “Sinking air within the eye is compressed and warmed adiabatically and the magnitude of warming characterizes the vigor of the storm. If you design a space-based sensor (passive microwave radiometer) that is sensitive to terrestrial radiation emitted by atmospheric molecular oxygen, you can measure this heat signature and determine intensity quantitatively.” The latest generation of National Oceanic and

Atmospheric Administration (NOAA) polar orbiting weather satellites have just the right sensor to accomplish this task – the Advanced Microwave Sounding Unit (AMSU).

In addition to intensity estimates, some of the most valuable information on tropical cyclone structure and intensity are the planar cross sections of the warm core available to forecasters at the National Hurricane Center Tropical Prediction Branch (NOAA/TPC) in near real-time. “For the first time ever, analysts at TPC can use AMSU data to discriminate whether a system is truly tropical by the presence (or lack of) of a vertically-developed warm core” according to Major Brueske.

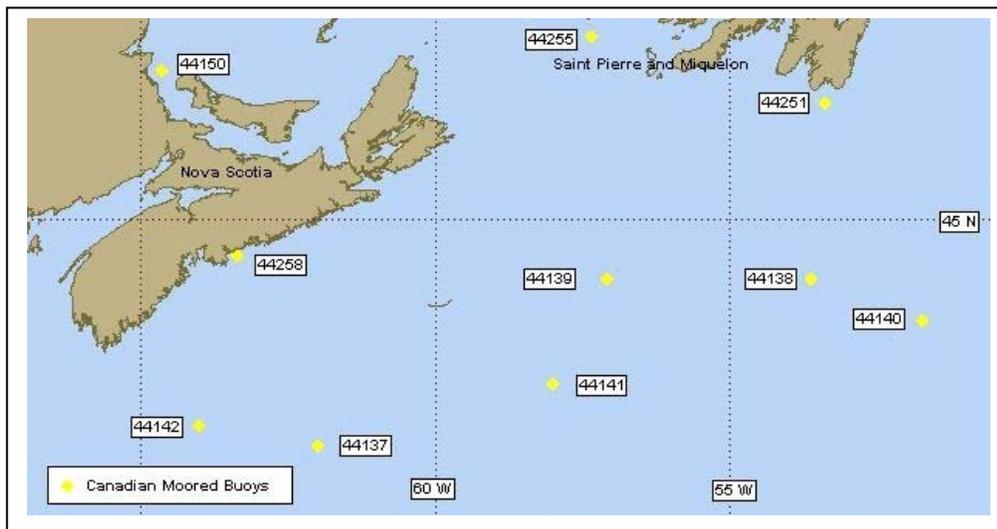
Hurricane Center forecasters used AMSU warm core observations to initially diagnose Juan as tropical, thereby initiating the forecast and warning process to include public advisories, track forecasting and an analysis of future intensification potential. AMSU-based intensity



Hurricane Juan, as seen from space, nears Nova Scotia

estimates are also competitive with – and in some circumstances superior – to other geostationary weather satellite-based techniques.

Major Brueske is currently the Co-Project Investigator responsible for transitioning the AMSU-based tropical cyclone intensity estimation technique into operations at NHC/TPC as part of the US Weather Research Program Joint Hurricane Testbed in 2003. The Air Force Weather Agency also recently identified the technique for transition into operations at the USAF strategic weather forecasting and analysis center at Offutt AFB.



Locations of sensor buoys that were used to track the hurricane

USAF Supports Space Shuttle *Columbia* Accident-Investigation Board

Lt Col Larry Butkus (Deputy for Curriculum, Department of Engineering Mechanics) served as an engineering investigator on the staff of the Columbia Accident Investigation Board beginning on 4 March. During his four months in residence with the Board, Lt Col Butkus was primarily responsible for investigating the role of the External Tank in the accident. These responsibilities included gaining a thorough understanding of the foam insulating materials, participating in several tests and demonstrations, developing a plausible explanation for the foam loss from the External Tank during launch of mission STS-107 that is the most probably root cause of the accident, and examining mission, weather, and production data for trends associated with foam loss events throughout the history of the Space Shuttle Program.

The Board consisted of thirteen flag officers or equivalents. It was supported by approximately eighty staff. Butkus was one of only two active-duty engineers, and the only one from the Air Force.

During the investigation, LtCol Butkus received and presented technical briefings to the Board and to representatives from NASA's Johnson, Marshall, and Kennedy Space Centers, RAND, Lockheed Martin, Boeing, and the United Space Alliance. He was also the Board's primary liaison with the NASA team in charge of developing the launch/ascent portion of the working scenario that became the basis for the narrative reconstruction of Columbia's final mission. In addition, Lt Col Butkus researched or directed efforts to examine other issues including impact damage modeling techniques, the Orbiter's aging structure, and corrosion concerns.

LtCol Butkus returned from his extended TDY to NASA on 1 July but continues the support the investigation e-mail and telephone. His involvement with NASA will extend beyond the Board's investigation with his nomination to the Independent Technical Assessment Team for the External Tank which will focus on long-term improvements for this critical element in the Space Shuttle System.

Blood for Oil?

Richard L. Fullerton
United States Air Force Academy, CO 80840

The Bush administration offered many laudable justifications for the war with Iraq including the elimination of Saddam Hussein's WMD programs, ridding the Middle East of a violent dictator with a history of unprovoked attacks against his neighbors, eradication of Baath Party support for terrorism, and liberation of the oppressed Iraqi people. However, one justification categorically denied by the administration was that the war was about gaining access to Iraq's lucrative oil fields. In a CBS interview in November 2002, Secretary Rumsfeld unequivocally declared, "It has nothing to do with oil, literally nothing to do with oil."

Despite the administration's repeated denials, "No Blood for Oil" became the rallying cry of anti-war activists worldwide. Even well-respected news magazines propagated the theory that we were invading Iraq to gain access to her oil fields. But there are far cheaper ways for the U.S. to get oil, and fighting simply to gain access to Iraq's oil is not an economically or morally sound reason for war. To understand these issues, we must first dispel some misconceptions about the world's oil supply and our dependence on it.

The World Still Has Plenty of Oil

News of impending oil shortages and forecasts of looming energy crises have been reported off and on for more than a century. In 1874, just twenty-five years after the world's first oil well was drilled in Pennsylvania, the state's geologist direly warned, "the U.S. [has] enough petroleum to keep its kerosene lamps burning for only four years." But, of course, huge new oil fields were soon discovered in Ohio, Texas, and elsewhere. After U.S. domestic oil production peaked in 1970 the frequency of "expert" warnings accelerated. In 1972, a group of experts known as the Club of Rome predicted the world's oil supply would be exhausted by 1990. A Carter Administration study in 1980 cautioned that the world was running out of oil and peak production would occur around 1990. In 1984, the Worldwatch Institute's *State of the World* book warned in bold print, "The combination of geological, economic, and psychological factors is likely to place end-of-century oil output well below the current level." More recently, a 1998 *Scientific American* article by geologists Colin Campbell and Jean Laherrere predicted a permanent decline in world oil production beginning in 2004. Of course, none of these alarming claims have come true. Following each dire prediction, new oil fields have been discovered, and new technologies are increasing the amount of oil engineers can extract from existing fields.

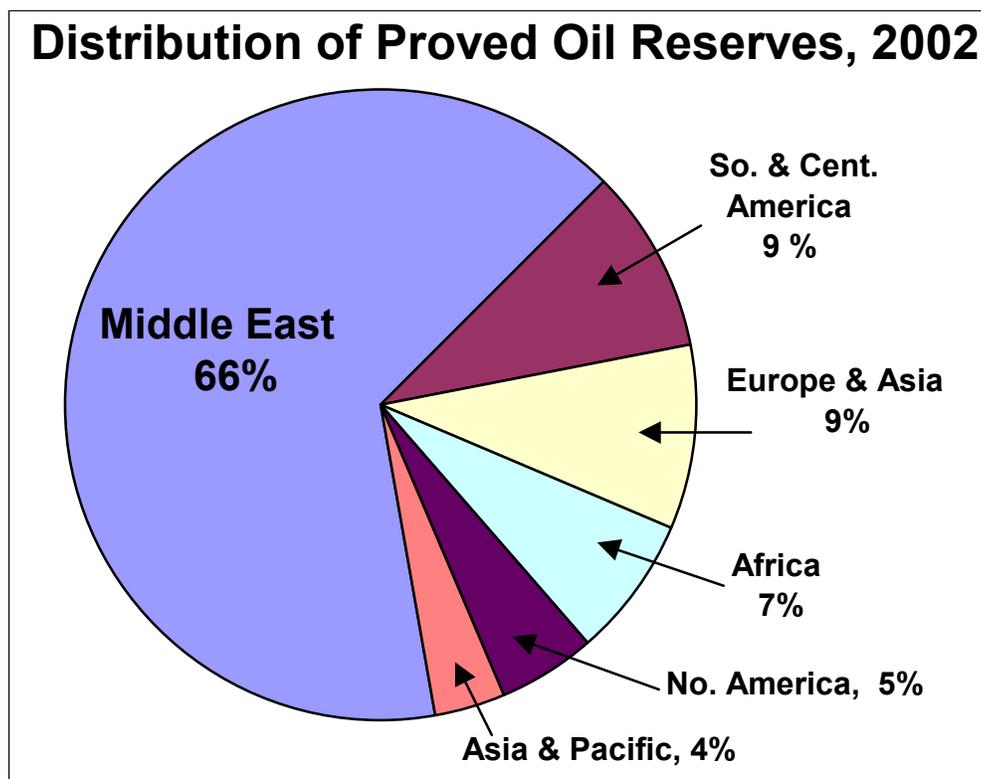
During the 1940s, experts placed the total quantity of the world's recoverable oil at 600 billion barrels. By the 1970s, those estimates had been revised to two trillion barrels. Today, the most recent U.S. Geological Survey (USGS) report forecasts a mean estimate of the world's recoverable oil to be three trillion barrels – three times the cumulative amount the world consumed in the entire 20th century! In November 2000, about the same time *USA Today* was republishing Mr. Campbell's warnings of an impending decline, officials of the US Energy Information Administration (EIA) were briefing in more professional, but less public, forums that the peak in world production remains decades away. Similarly, in March 2000, the project chief of the World Petroleum Assessment stated, "There is still an abundance of oil and gas in the world, . . . Since oil became a major energy source about 100 years ago, about 539 billion barrels of oil have been produced outside of the U.S. We now estimate the total amount of future technically recoverable oil, outside the U.S., to be about 2,120 billion barrels."

Despite all of the alarming press reports (which make snappy headlines and sell lots of papers) an objective review of the data suggests the world has plenty of oil left to satisfy our energy needs for decades to come. As the American Petroleum Institute has noted, "normal market processes coordinated by price have *never* exhausted a non-renewable resource, and there is no reason to expect them to do so in the case of oil. At this

point, there are no market signals suggesting world oil resources are becoming scarcer than they were a half century ago.” Indeed, the inflation-adjusted price of oil was lower in 1998 than it had been in more than 50 years. Even at today’s “high” prices, National Defense University economist Don Losman points out that, “a gallon of gasoline sells for less than a gallon of Coca Cola, milk, bottled water, or even discounted mouthwash.” Oil is cheap because it is surprisingly abundant. If the world has an oil problem today, it is not a problem of how much oil but rather where the oil is located.

Location . . . Location . . . Location

Only about 3% of the world’s remaining proved oil reserves are found in the U.S. In contrast, two-thirds of the world’s reserves are located in the Middle East.



Middle Eastern oil is also the cheapest in the world. According to estimates by Cornell University economist Duane Chapman, oil production costs across the Persian Gulf are less than \$5 per barrel, compared to \$15 per barrel for oil extracted from North Sea fields and Alaska. Based on these figures, Dr. Chapman estimates the remaining value of the Middle East’s untapped oil at \$61 trillion. This vast treasure, in a sparsely populated and underdeveloped region, proved irresistible to Saddam Hussein on more than one occasion. In 1980, he invaded and fought an eight-year war with Iran. In 1990, he conquered Kuwait. Had he successfully defeated and occupied both nations, he would have controlled a third of the world’s proved oil reserves—enough to replace Saudi Arabia as the dominant player in the world market. More importantly, he could have used those oil revenues to fund his weapons programs, dominate the region militarily, and transform his image into one of a modern-day Nebuchadnezzar. It was these dangerous hegemonic aspirations that required a U.S. military response.

For the complete article, visit <http://www.usafa.af.mil/dfe/discovery/0903/main0903.htm>

IV. Conclusions and Challenges

This annual report provides a detailed look at some key metrics for research at USAFA. The Air Force Academy continues to be an extremely cost-effective research institution. Our first-order econometric modeling has shown what our customers have known for years: that for every outside dollar invested, USAFA matches their investment with significant faculty time and facilities value. This has been confirmed by the rapid growth in external research funding witnessed in the past two years. Much of this growth is traceable to new efforts in Space Physics and Atmospheric research, and strong growth in the Aging Aircraft and Modeling and Simulation areas.

Another healthy sign has been the increasing faculty interest in learning- and education-related research through several academic departments and in the Institute for Information Technology Applications, especially through programs sponsored by the National Science Foundation.

Challenges that will require increased energy from this office in the coming year include:

- Implementing an improved financial management process to support best business practices,
- Formalizing a procedure to tap indirect costs, to fund much-needed administrative support of the growing program, and
- Enhancing external connections with the Air Force Research Laboratory, the other military academies, and graduate schools.

This detailed review of research at USAFA is a necessary and useful part of the research program at the Academy. It reflects the high standards of excellence throughout the Air Force Academy and provides a mirror for our researchers to gauge their efforts, resulting in more useful and Air Force-relevant research.

Table 2. USAF Academy Research Points of Contact

<i>Department</i>	<i>Contact</i>	<i>Phone 719-333-</i>	<i>e-mail (@usafa.af.mil)</i>
<i>Basic Sciences</i>			
Biology	Lt Col Erick Snellman	6026	Erick.Snellman
Chemistry	Dr. John Wilkes	6005	John.Wilkes
Computer Science	Maj Leemon Baird	8321	Leemon.Baird
Mathematics	Dr. Ralph Boedigheimer	6996	Ralph.Boedigheimer
Physics	Dr. Derek Buzasi	4570	Derek.Buzasi
<i>Engineering</i>			
Aeronautical	Dr. Aaron Byerley	3436	Aaron.Byerley
Astronautical	Dr. Scott Dahlke	4462	Scott.Dahlke
Civil and Environmental	Dr. Jim Pocock	7471	James.Pocock
Electrical	Dr. Randy Musselman	4211	Randall.Musselman
Engineering Mechanics	Dr. Brian Self	2517	Brian.Self
<i>Humanities</i>			
English & Fine Arts	Lt Col James Meredith	8474	James.Meredith
Foreign Languages	Lt Col Rich Sutherland	3201	Richard.Sutherland
History	Lt Col Howard Jones	8613	Howard.Jones
Philosophy	Maj Bill Casebeer	8659	William.Casebeer
<i>Social Sciences</i>			
Behavioral Sciences & Ldrshp	Dr. Michelle Butler	7991	Michelle.Butler
Economics & Geography	Dr. Jamie Harris	3068	Jamie.Harris
Law	Dr. Chad Austin	2816	Chad.Austin
Management	Dr. James Barker	2315	James.Barker
Political Science	Dr. Damon Coletta	2270	Damon.Colletta
<i>AFOSR-sponsored Research Centers</i>			
Aircraft Struct. Life Extension	Lt Col Scott Fawaz	6266	Scott.Fawaz
Aeronautics	Dr. Aaron Byerley	3436	Aaron.Byerley
Chemistry	Dr. John Wilkes	6005	John.Wilkes
Human-Environmental	Dr. Tom Unangst	6015	Tom.Unangst
Modeling & Simulation	Lt Col (s) Scott Morton	9387	Scott.Morton
Laser & Optics	Dr. Randy Knize	4165	Randy.Knize
Small Satellite	Lt Col Jerry Sellers	3315	Jerry.Sellers
Space Physics & Atmospheric	Dr. Geoff McHarg	2460	Matthew.McHarg
<i>Other Institutes</i>			
Inst National Security Studies	Dr. James M. Smith	7144	James.Smith
Inst Information Tech Apps	Lt Col Jim Harper	3978	James.Harper
Humanities Institute	Lt Col Tom Krise	4337	Thomas.Krise
34 th Education Group	Dr. Brent Talbot	9426	Brent.Talbot
Uninhab Aerial Vehicles Grp	Lt Col Dave Bossert	8489	Dave.Bossert
Instit Research & Assess	Lt Col Daniel Zalewski	6724	Daniel.Zalewski
Cadet Summer Research	Maj Timothy Landvogt	3080	Timothy.Landvogt
Director, Faculty Research	Lt Col Rob Fredell	4195	Rob.Fredell

Appendix. List of Publications and Presentations

Department of Aeronautics

Publications:

BOSSERT, D. and K. Cohen. "PID and Fuzzy Pitch Attitude Hold Systems," AIAA Atmospheric Flight Mechanics Conference, August 2002.

BYERLEY, A., O. Stormer, J. Baughn, and T. Simon. "A "Cool" Thermal Tuft for Detecting Surface Flow Direction," ASME Journal of Heat Transfer, Volume 124, Number 4, August 2002.

BYERLEY, A., O. Stormer, J. Baughn, and T. Simon. "Using Gurney Flaps to Control Laminar Separation on Linear Cascade Blades," ASME Journal of Turbomachinery, Volume 125, January 2003.

COHEN, K., T. McLaughlin, S. Siegel, and J. Myatt. "Fuzzy Logic Control of a Circular Cylinder Vortex Shedding Model," 41st AIAA Aerospace Sciences Meeting, January 2003.

COHEN, K., T. McLaughlin, S. Siegel, and J. Myatt. "Proper Orthogonal Decomposition Modeling of a Controlled Ginzburg-Landau Cylinder Wake Model," 41st AIAA Aerospace Sciences Meeting, January 2003.

COHEN, K., T. McLaughlin, and S. Siegel. "Feedback Control of a Cylinder Wake Low-Dimensional Model," 55th APS/DFD Meeting, Vol. 47, No. 10, Paper DN 2, November 2002.

CUMMINGS, R., J. Forsythe, S. Morton, and et al. "Progress on Detached-Eddy Simulation of Massively Separated Flows," 2002 AMOS Technical Conference, September 2002.

CUMMINGS, R. and D. Hall. "STOL Aircraft Design for Undergraduates," AIAA Biennial International Powered Lift Conf., November 2002.

CUMMINGS, R., M. Baker, D. Mathias, and K. Roth. "Numerical Investigation of Slat and Compressibility Effects for a High-Lift Wing," Journal of Aircraft, Vol. 39, No. 5, September 2002.

CUMMINGS, R. and D. Hall. "Runway Independent STOL Regional Airliner Configuration Studies as Teaching Tools," AIAA Biennial International Powered Lift Conf., November 2002.

LIST, J., A. Byerley, T. McLaughlin, and R. Van Dyken. "Using a Plasma Actuator to Control Laminar Separation on a Linear Cascade Turbine Blade," AIAA Aerospace Sciences Meeting, AIAA Paper 2003-1026, January 2003.

MADDOX, S., J. Forsythe, K. Squires, and J. Wurtzler. "Detached-Eddy Simulation of the Ground Transportation System," Engineering Foundation Conference, December 2002.

MITCHELL, T. and P. Molton. "Vortical Substructures in the Shear Layers Forming Leading-edge Vortices," AIAA Journal, Vol. 40, No 8, August 2002.

MORTON, S., J. Mitchell, and D. Hajek. "Detached-Eddy Simulations and Reynolds-Averaged Navier-Stokes Simulations of Delta Wing Vortical Flowfields," Journal of Fluids and Engineering, Vol. 124, December 2002.

MORTON, S., R. Cummings, J. Forsythe, and M. Steenman. "DES Grid Resolution Issues for Vortical Flows on a Delta Wing and an F-18C," AIAA 41st Aerospace Sciences Meeting, January 2003.

MORTON, S., R. Cummings, J. Forsythe, and K. Wurtzler. "High Resolution Computational Unsteady Aerodynamic Techniques Applied to Maneuvering UCAVs," RAES Aerospace Aerodynamics Research Conference, June 2003.

SERRANO, M., W. Johnson, J. Forsythe, and S. Morton. "Computational Aerodynamics of the C-130 in Airdrop Configurations," AIAA 41st Aerospace Sciences Meeting, January 2003.

SIEGEL, S., K. Cohen, and T. McLaughlin. "Observability Conditions for POD Modes in a Circular Cylinder Wake," 55th APS/DFD Meeting, Vol. 47, No. 10, Paper DN 4, November 2002.

SIEGEL, S., K. Cohen, and T. McLaughlin. "Low-Dimensional Feedback Control of the von Karman Vortex Street at a Reynolds number of 100," IUTAM Symposium: Fluid-Structure Interactions, June 2003.

SIEGEL, S., K. Cohen, T. McLaughlin, and J. Myatt. "Real-Time Particle Image Velocimetry for Closed-Loop Flow Control Studies," 41st AIAA Aerospace Sciences Meeting, January 2003.

SMITH, D., T. McLaughlin, and S. Siegel. "Modeling of the Wake Behind a Circular Cylinder Undergoing Rotational Oscillation," 1st AIAA Flow Control Conference, June 2003.

WELLS, S. and R. Hess. "MIMO Sliding Mode Control for a Tailless Fighter Aircraft, An Alternative to Reconfigurable Architectures," AIAA GNC Conference, August 2002.

YECHOUT, T., T. Nettleblad, and C. Johnston. "X-38 Mid Rudder Feasibility and Parafoil Cavity Investigations," Department TR, September 2002.

YECHOUT, T., T. Nettleblad, and C. Johnston. "Investigations of X-38 Modifications to Reduce Yawing Moment Excursions: Central Fence, Flat Plate, and Thick Rudder," Department TR, October 2002.

YECHOUT, T., T. Nettleblad, and C. Johnston. "X-38 Ring Wing Design Parameter Investigation," Department TR, December 2002.

YECHOUT, T. and S. Chadsey. "AC-130H Drag Definition Flight Test Program," AIAA Aircraft Technology, Integration, and Operation, October 2002.

Presentations:

BOSSERT, D., D. Bossert, and T. Yechout. "A MATLAB-Based Flight Simulator for Flight Mechanics Education," 2002 AIAA Atmospheric Flight Mechanics Conference, Monterey, CA, US, August 2002.

COHEN, K., T. McLaughlin, and S. Siegel. "Sensor Placement Based on Proper Orthogonal Decomposition Modeling of a Cylinder Wake," 3rd AIAA Fluid Dynamics Conference and Exhibit, Orlando, FL, USA, June 2003.

CUMMINGS, R., M. Sanchez, L. Clarke, and et al. "The New Face of Space--Exciting The Next Generation," World Space Congress, Houston, TX, October 2002.

ENLOE, C., T. McLaughlin, and R. Van Dyken. "Mechanisms and Responses of a Single Dielectric Barrier Plasma," 41st AIAA Aerospace Sciences Meeting, Reno, NV, USA, January 2003.

LUCHTENBERG, M., K. Cohen, S. Siegel, and T. McLaughlin. "Vortex Shedding in the Cylinder Wake: A Comparison between 2D- and 3D Results," 42nd AIAA Aerospace Sciences Meeting, Reno, NV, USA, January 2003.

MITCHELL, T., S. Morton, X. Huang, and N. Verhaagen. "NATO RTO AVT Task Group-080 "Vortex Breakdown Over Slender Wings" Validation and Verification, Conclusions and Recommendations," AIAA 21st Applied Aeronautics Conference, Orlando, FL, USA, June 2003.

MORTON, S. "High Reynolds Number DES Simulations of Vortex Breakdown Over a 70 Degree Delta Wing," AIAA 21st Applied Aeronautics Conference, Orlando, FL, USA, June 2003.

MORTON, S., J. Forsythe, M. Steenman, and R. Cummings. "Multidisciplinary Applications of Detached-Eddy Simulation to Separated Flows at High Reynolds Numbers (Challenge 92)," High Performance Computing Users Group Meeting, USAFA, CO, USA, June 2003.

SIEGEL, S., T. McLaughlin, and K. Cohen. "Feedback Control of a Circular Cylinder Wake in Experiment and Simulation," 33rd AIAA Fluid Dynamics Conference and Exhibit, Orlando, FL, USA, June 2003.

SIEGEL, S., K. Cohen, and T. McLaughlin. "Cylinder Wake Feedback Control," AFOSR Workshop on Dynamic Systems and Control, Pasadena, CA, USA, August 2002.

YECHOUT, T. "A MATLAB-Based Flight Simulator for Flight Mechanics Education," AIAA Atmospheric Flight Mechanics Conference, Monterey, CA, August 2002.

Department of Astronautics

Presentations:

- FRANZ H. and B. Crawford. "Investigating Laser Accelerated Plasmas For Space Propulsion," AIAA Student Conference, Boulder, CO, April 2003.
- FRANZ, H. and B. Crawford. "Investigating Laser Accelerated Plasmas For Space Propulsion," Space Grant Conference, Boulder, CO, April 2003.
- GRANGER, A., "Stellar Coordinate Determination," AIAA Student Conference, Boulder, CO, April 2003.
- GRANGER, A., "Stellar Coordinate Determination," Space Grant Conference, Boulder, CO, April 2003.
- HANS, B., "Navigation Satellite Constellation Design: Impact On Accuracy And Availability," AIAA Student Conference, Boulder, CO, April 2003.
- HANS, B. "Navigation Satellite Constellation Design: Impact On Accuracy And Availability," Space Grant Conference, Boulder, CO, April 2003.
- SCHLAGHECK, C., "Weight Loss Effects Associated With A Rotating Charged Cylinder," Space Grant Conference, Boulder, CO, April 2003.
- SCHLAGHECK, C. "Weight Loss Effects Associated With A Rotating Charged Cylinder," AIAA Student Conference, Boulder, CO, April 2003.
- SELLERS, J. "Building a Cadre of Space Professionals: Hands-On Space Experience at the USAF Academy," AIAA RESPONSIVE SPACE CONFERENCE, REDONDO BEACH, CA, April 2003.
- SELLERS, J. "Flight-Proven Nano-Satellite Architecture For Hands-On Academic Training at the US Air Force Academy," World Space Congress, Houston, TX, October 2002.
- VAN BEUSEKOM, C. "Three-Axes Attitude Determination and Control Systems Design for Low-Cost Micro-Satellites," IEEE Aerospace Conference, Montana, March 2003.
- VAN BEUSEKOM "Three-Axes Attitude Determination For Falconsat-3," AIAA Student Conference, Boulder, CO, April 2003.
- VAN BEUSEKOM "Three-Axes Attitude Determination For Falconsat-3," Space Grant Conference, Boulder, CO, April 2003.

Department of Biology

Publications:

- COX, A., M. Johnson, D. Lykins, and J. Obringer. "Applications of the Comet Assay to Measure Initial DNA Damage in Mammalian Cells Exposed to 532 nm, 3 ns Laser Beams," USAF Laser Bioeffects Workshop, 1, August 2002.
- COX, A., M. Johnson, and J. Obringer. "A Technique Designed to Reduce DNA Repair in Mammalian Cells During and Following Laser Exposures In 96-Well Plates," 9th Annual Michaelon Conference on EMF Bioeffects, August 2002.
- COX, A. "NASA Study Section on Space Tadiological Health Topics," March 2003.
- HALE, D., S. Berend, M. Engstrom, and I. Greenbaum. "II. Meiotic Behavior Of B Chromosomes Suggests a Y-Chromosome Origin of Supernumerary Chromosomes," Cytogenetics and Cell Genetics, 95, January 2003.
- NOYD, R. "The Botany Lab: A Learning Station Approach," Dept of Biology, USAFA, January 2003.
- SNELLMAN, E. "Purification and Properties of the Extracellular Lipase, Lipa of Acinetobacter Sp. RAG-1," European Journal of Biochemistry, 269, December 2002.

UNANGST, E. and M. Halloran. "Portable Technology in the Field Environment: a Case Study," USAFA Educator, 10, July 2002.

UNANGST, E. and B. Wunder. "Body Composition Dynamics in Meadow Voles (*Microtus Pennsylvanicus*) of Southeastern Colorado," American Midland Naturalist, 149, January 2003.

UNANGST, E. and L. Merkley. "The Effects of Lipid Location on Non-Invasive Estimates of Body Composition," Journal of Experimental Biology, 205, December 2002.

UNANGST, E. and B. Wunder. "Food And Water Effects on Meadow Vole Body Composition Once Captured in Live-Traps," Biochemistry and Physiological Zoology, 75(6), December 2002.

UNANGST, E. and B. Wunder. "Lab Fattening and Dietary-Fat Effects on Meadow Voles (*Microtus Pennsylvanicus*)," Western North American Naturalist, 63, January 2003.

VEVERKA, D. "Efficacy of the Trans-Theoretical Model in Improving Nutrition and Exercise Habits in Enlisted Air Force Men," Military Medicine, 168, May 2003.

WILCOX, M., J. Anderson, P. Wade, and S. Barrett. "Segmentation and 3D Reconstruction of Biological Cells From Serial Slice Images," Biomedical Instrumentation, 39, January 2003.

WILCOX, M. and S. Barrett. "Edge Encoding Mechanisms In the Parallel L4 Neuron Array of the Fly (*Musca Domestica*)," Biomedical Instrumentation, 39, January 2003.

WILCOX, M. "Compound Eyes on Machines?" USAFA Discovery, March 2003.

Presentations:

COX, A. "My Travels Across the Electromagnetic Spectrum and Elsewhere," Center for Devices and Radiological Health, FDA, Rockville, MD, May 2003.

LYKINS, D. "Laser Bioeffects in Differential Protein Expression in Human Skin Cells," AFOSR Laser Bioeffects Collaborative Workshop, Kennebunkport, ME, August 2002.

MARESH, R. "Spatial Disorientation Training at the U.S. Air Force Academy," Aerospace Med Assoc, San Antonio, TX, May 2003.

NOYD, R. "A Charter Approach to Curriculum Integration and Synthesis," Int, Curriculum, Assessment and Planning Conf., Cancun, Mexico, May 2003.

NOYD, R. "Overteaching, Can You Do Too Much?" Boot Camp for Professors, Leadville, CO, July 2002.

NOYD, R. "The Use of Learning Centers in the College Classroom," Teaching for a Change Conference, Steamboat Springs, CO, June 2003.

SNELLMAN, E. "Changes in Fatty Acid Components of Human RPE Cells in Response to Laser Exposure," USAF Laser Bioeffects Workshop, Kennebunkport ME, August 2002.

SNELLMAN, E. "Purification and Properties of the Extracellular Lipase, Lipa, Of Acinetobacter Sp.," American Society for Microbiology, Washington. D.C., May 2003.

WESTMORELAND, D. "Plasma ElecrolYTE Changes in Response to Maximal and Submaximal Exercise Regimes," Annual Meeting, Beta Beta Beta Biological Honor Society, Salt Lake City, UT, April 2003.

Department of Behavioral Sciences and Leadership

Publications:

BUTLER, M. & Bennett, T. (2003). In search of a conceptualization of multiple sclerosis: A historical perspective. *Neuropsychology Review*, June; 13(2).

BUTLER, M. & Bennett, T. (in press). Published Abstract: In search of a conceptualization of multiple sclerosis: A historical perspective. *Archives of Clinical Psychology*.

- CAMPBELL, W. K., Foster, C. A., and Finkel, E. J. (2002). Does self-love lead to love for others?: A story of narcissistic game-playing. *Journal of Personality and Social Psychology*, 83, 340-354.
- CHEN, G., Webber, S., Bliese, P., Mathieu, J., Payne, S., Born, D. H., & Zaccaro, S. (2002). Simultaneous Examination of the antecedents and consequences of efficacy beliefs at multiple levels of analysis. *Human Performance*, Vol. 15(4), 381-410.
- CROOKS, S. M. & Katayama, A. D. (2002). Effects of On-Line Note-Taking Format on Comprehension of Electronic Text. *Research in the Schools*, 9, 21-33.
- JACKSON, J. (2002). Mentoring in the Military: Application and Evaluation of a Formal Mentoring Program. Institute for National Security Studies report.
- KATAYAMA, A. D. & Crooks, S. M. (in press). Differential Effects of Studying Completed Or Partial Graphically Organized Notes On-Line. *Journal of Experimental Education*.
- MASTROIANNI, G. R., Chuba, D. M., & Zupan, M.O. (2003). Self-pacing and cognitive performance while walking. *Applied Ergonomics*, 34(2), 131-139.
- MASTROIANNI, G. R. (2003). Milgram and the Holocaust: A Reexamination. *Journal of Theoretical and Philosophical Psychology*, 22(2), 501-516.
- MCKINNEY, E.H., Barker, J. R., Smith, D. R., & Davis, K (2002). The role of communication values in swift starting action teams. In *Academy of Management 2002 Proceedings*, Denver CO.
- POWELL, S. (In Press). A Review of the Inference Learning Test. In J. Impara and B. Plake (Eds.), *The Mental Measurement Yearbook*. Lincoln, NE: Buros Institute.
- POWELL, S. D. & McCone, D. R. (In Press). A review of the Executive Control Battery. In J. Impara and B. Plake (Eds.). *The Mental Measurement Yearbook*. Lincoln, NE: Buros Institute
- POWELL, S., Hagen, K., & Korn, T. (2003). Treating pseudoseizures and related behaviors in an adult male with an intractable seizure disorder. *Clinical Case Studies*, 2 (1) 78-89.
- POWELL, S., PLAMONDON, R., & Retzlaff, P. (2002). Screening cognitive abilities in adults with developmental disabilities: Correlations of the K-BIT, PPVT-3, WRAT-3, and CVLT. *Journal of Developmental and Physical Disabilities*, 14, 239-246.
- SCHOOL SPIRIT STUDY GROUP. (in press). *Measuring School Spirit: A National Teaching Exercise. Teaching of Psychology*. [This project was completed by a consortium of instructors at 20 colleges and universities, including Steven M. Samuels, USAFA.]
- SAMUELS, S. M. & Gibb, R. W. (2002). Self-efficacy assessment and generalization in physical education courses. *Journal of Applied Social Psychology*, 32 (6), 1313-1326.
- SEGAL, H. G., DeMeis, D., Wood, G., & Smith, H L. (2003). Future events, early experience, and mental health: Clinical assessment using the Anticipated Life History measure. *Assessment*, 10(1), 29-40.
- SMITH, D. R., & Mitchell, T. R. (2003). Overconfidence, transactive memory, and collective efficacy in student transport pilot crews. *Proceedings of the 12th International Symposium on Aviation Psychology*, Dayton, Ohio USA.
- SMITH, D. R., Wells, M. J., & Mitchell, T. R. (2003). The role of technology and transactive memory on fighter performance and situational awareness. *Proceedings of the 12th International Symposium on Aviation Psychology*, Dayton, Ohio USA.
- STAAL, M. A. (in press). Stress and Suicide in the Military: Service-Specific Risk Factors. In Columbus, F. (Ed.). *Advances in Psychology Research*. Hauppauge, NY: Nova Science.
- STAAL, M.A. (2003). Airsickness Assessment and Intervention. *The Air Force Psychologist*, 21(1), 9-13.
- TWENGE, J. M., Campbell, W. K., & Foster, C. A. (in press). Parenthood and marital satisfaction: A meta-analytic review. *Journal of Marriage and the Family*.

Presentations:

BILLINGTON, I. M. & Pringle, H. L. (2003). The effects of color, size and eccentricity on peripheral target detection. Poster presented at the American Psychological Association (APA) Divisions 19 and 21 Midyear Symposium, 4-6 March, Fort Belvoir, VA.

BOCHTE, D. L. & Pringle, H. L. (2003). Assessing the Effects of Highlighting Validity on Eye Movements. Presented at the American Psychological Association (APA) Divisions 19 and 21 Midyear Symposium, 4-6 March, Fort Belvoir, VA.

BORN, D. H. (2003). Women and Career Paths in Military Psychology -- Advice for Graduate Students and New Psychologists. Chair of Session for American Psychological Association (APA) Divion 19, 7-10 August, Toronto, Canada.

BOSSERT, D. E.; Royer, E. G.; Rathbun, T.; Schorsch, T.; White, A.; Patrey, J.; & Pack, D. (2003). Teaching Unmanned Aerial Vehicle (UAV) Concepts at the Undergraduate Level: One Approach. Presented at the AIAA Atmospheric Flight Mechanics Conference.

BUTLER, M., Shamblin, K., Powell, S., & Bochte, D. (2003). Assessing the convergent and divergent validity of measures of verbal memory and nonverbal reasoning ability in a college population. Paper presented at the Rocky Mountain Psychological Association Conference, Denver, CO.

BUTLER, M. & Bennett, T. (2003). Abandonment of the study of cognitive deficits in multiple sclerosis: Insights from the rivalry between neurology and psychiatry. Oral paper presented at the Rocky Mountain Psychological Association conference, Denver, CO.

CAMILLERI, J., Hansen, S., & Patrey, J. (2003). Display issues in Uninhabited Aerial Vehicle performance. Poster resented at the Rocky Mountain Psychology Association conference, Denver, CO.

FRONK, J., Wozniak, K., & Condit, D. (2003). Pilot decision making and low fidelity simulation. Poster presented at the Rocky Mountain Psychology Association conference, Denver, CO.

GODFREY, J., Strouse, T., & Patrey, J. (2003). Target identification in multiple display control stations. Poster presented at the Rocky Mountain Psychology Association conference, Denver, CO.

GODFREY, J., Helms, N., Stewart, T., Stimmel, E., & Patrey, J. (2003). The effect of distraction on UAV operator performance. Presented at the American Psychological Association (APA) Divisions 19 and 21 Midyear Symposium, 4-6 March, Fort Belvoir, VA.

JACKSON, J., Rate, C., & Foster, C. (2003). Emotional intelligence and transformational leadership. Poster accepted for presentation at the 111th convention of the American Psychological Association, Toronto, Canada.

JOHNSON, S. K., Powell, S & Katayama, A. (2003). Gender Stereotyping in the Classroom. District 38 Teacher In Service.

JOHNSON, S. K. (2003). A mentoring model theory: Mentoring protocols for teaching professionals. National Institute on the Teaching of Psychology, St Petersburg, FL 2-5 Jan 2003.

JONES, S. K. (2003). "Exploring the antecedents of student cynicism." Presented at the United States Naval Academy.

KATAYAMA, A. D., Shambaugh, R. N., & Edmonds, T. (2003, April). Inadequacies of the Copy-and-Paste Method of On-line Notetaking: Why Keying-in the Notes May Lead to Higher Knowledge Transfer. Paper presented at the annual meeting of the Rocky Mountain Psychological Association, Denver, CO.

KATAYAMA, A. D., Rodriguez, A., Warash, B., & Bodnovich, K. (2003, February). Why Preschoolers Make Judgments Under the Influence of Color. Paper presented at the annual meeting of the Eastern Educational Research Association, Hilton Head, SC.

KOTTE, S. Purtee, M., Krusmark, M., & Gluck, K. Verbal Protocol Analysis of Uninhabited Aerial Vehicle (UAV) Subject Matter Experts (SMEs). Poster presented at the American Psychological Association (APA) Divisions 19 and 21 Midyear Symposium, 4-6 March, Fort Belvoir, VA.

LASS, N., Katayama, A. D., & Massey, A. (2002, October). Listeners' Preferences for Spanish-Accented English Speakers. Paper presented at the annual meeting of the American Speech-Language-Hearing Association, Atlanta, GA.

LEREW, D. R., McCone, D. R., & Jackson, R. J. (2002). Self-reported symptomatology in college students seen for mandatory counseling. Poster presented at the Annual Meeting of the American Psychological Association.

LEREW, D. R., & Staal, M. A. (2003, August). Gender differences in perceptions of leadership characteristics using a five-factor model of personality assessment. Poster accepted for presentation at the 111th convention of the American Psychological Association, Toronto, Canada.

MACHALEK, R., Patrey, J., Katayama, A. D., & Born, D. (2003). Suspending Routine Duty: Celebration and Commemoration in Military Holidays. Paper presented at the Institute for Communitarian Policy Studies annual meeting. Washington, D.C., April 11-12, 2003.

MASTROIANNI, G. R. (2003). Psychology, Nazis and Nazism. Presented at the Annual Meeting of the Rocky Mountain Psychological Association, 11 April 2003.

MCCONE, D. R., O'Donnell, K. A., & Pennell, M. (August, 2003). An evaluation of marital and divorce trends among USAFA graduates. Poster to be presented at the Annual Meeting of the American Psychological Association.

PATREY, J. (2003). Enriched interface design – information distinctiveness and performance trade-offs. Accepted for presentation at the 111th convention of the American Psychological Association, Toronto, Canada.

PATREY, J. & Dickinson, M. (2003). The effect of information distinctiveness on working memory and performance. Presented at the Rocky Mountain Psychology Association conference, Denver, CO.

PATREY, J. (2003). Competing processes in interface design. Presentation at the 75th Aerospace Medical Association (ASMA), 7 May, San Antonio, TX.

PATREY, J. (2002). The Military Psychologist in 2002: Selection, Training, Interfaces, Performance, & Protection. Invited colloquium at Colorado State University, Department of Psychology.

PATREY, J. & Dickinson, M. (2002). The effect of information distinctiveness and modality on serial recall. Presented at the Defense Advanced Research Projects Agency (DARPA) Augmented Cognition Program Review, 10-12 July, Washington DC. [invited presentation]

PENNELL, M., McCone, D. R., & O'Donnell, K. A. (2003). A preliminary evaluation of marital and divorce trends among USAFA graduates. Poster presented at the Annual Meeting of the Rocky Mountain Psychological Association.

POWELL, S., & Butler, M. (2003). Learning and memory recall compared to spatial reasoning and verbal comprehension: Cognitive ability testing across the bell curve. Poster presented at the Fourth Tsukuba International Conference on Memory, Tsukuba, Japan.

POWELL, S., & McCone D., (2002). Multimodal treatment of seizures and aggressive behaviors. Poster session presented at the American Psychological Association Annual Conference, Chicago, IL.

ROBINSON, D. H., Katayama, A. D., Odom, S., Beth, A., & Ping, Y. (2002). Training students to take more graphic notes. Paper presented at the annual meeting of the American Psychological Association, Chicago, IL.

SAMUELS, S. M. (2003). Resolving the Conflict Between Ethical and Realistic War Fighting: Extending Walzer's "Dirty Hands" Exemption to the Military. Invited address presented at the National Character and Leadership Symposium, United States Air Force Academy, CO.

SAMUELS, S. M. (2002). Social Psychological Insights into Ethical Behavior: Barriers and Solutions, Invited address presented to the Defense Industry Initiative Best Practices Forum, Washington DC.

SANFORD, G. B., Paige-Dobson, B. Greer, E., Jones, D., & Powell, S. (2002). Counseling Center Directors: Leadership Issues for the 21st Century. Paper presented at the annual conference of the Association of University and Counseling Center Directors, Honolulu, HI.

- SELF, B., Maresh, R., Shpak, E., Ercoline, W., & Pringle, H. (2003). Spatial Disorientation Training at the US Air Force Academy. Presentation at the 75th Aerospace Medical Association (ASMA), 7 May, San Antonio, TX.
- SHAMBAUGH, N. & Katayama, A. D. (2003, April). Using Eggen and Kauchak's Variable Classes To Study the Teaching of Two Cognition Courses. Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL.
- SHPAK, E., Self, B., Maresh, R., Ercoline, W., & Pringle, H. (2003). Spatial Disorientation Training at the US Air Force Academy. Poster presented at the American Psychological Association (APA) Divisions 19 and 21 Midyear Symposium, 4-6 March, Fort Belvoir, VA.
- SMITH, D. R., & Mitchell, T. R. (2002, August). Collective Efficacy and Team Performance on the Ground and in the Air. In C. G. Collins and S. Parker (Chairs), *Collective Efficacy: New Directions for Predicting Team Effectiveness*. Symposium conducted at the meeting of the Academy of Management, Denver, CO.
- SMITH, H. L. (2003, April). Teaching as transformation: Development of a classroom leadership scale. Paper presented at the Annual Meeting of the Rocky Mountain Psychological Association, Denver, CO.
- SMITH, H. L. (2003, March). Transforming Air Force Academy cadets in the classroom: Development of a classroom leadership scale. Presented at the American Psychological Association (APA) Divisions 19 and 21 Midyear Symposium, 4-6 March, Fort Belvoir, VA.
- SMITH, J., Godfrey, J., Forsythe, C., & Bernard, M. (2003). Thinking about thinking: Development of the Metacognitive Survey. Presented at the American Psychological Association (APA) Divisions 19 and 21 Midyear Symposium, 4-6 March, Fort Belvoir, VA.
- STAAL, M. A., & Lerew, D.R. (2003). Measuring leadership using the five-factor model of personality, a poster accepted for presentation at the annual meeting of the Society for Personality Assessment, San Francisco, CA.
- WEEKS, M., & Carlson, K. (2003). Evaluating the Impact of a FYE Course on Student Cynicism Toward College. Poster presented at the Rocky Mountain Psychological Association Conference, Denver, CO.

Department of Chemistry

Publications:

- BALAICH, G., Sarah Bragg, J. Johnson, and N. heimer. "New C₂-Symmetric Cyclopentadiene Dimer from Sodium Naphthalenide Reduction of 1,3,6-Tri(tert-butyl)fulvene," *Acta Crystallographica Section E*, 58, September 2002.
- GOLDEN, M., Brian D. Collins, Michael C. Willis, and Tad H. Koch. "Selection of Highly Specific and Sensitive ssDNA Photocross-linking Aptamers to Target Proteins Using PhotoSELEX and Their Diagnostic Potential," *Gene Cloning and Expression Technologies*, September 2002.
- HICKS, B. "Green Fluorescent Protein: Applications and Protocols," *Methods in Molecular Biology*, September 2002.
- VAN VALKENBURG, M. and Michael D. Annable. "Mobilization and Entry of DNAPL Pools by Cosolvents Into Finer Sand Media: Two-dimensional Chamber Studies," *Journal of Contaminant Hydrology*, 59/3-4, November 2002.
- MORGAN, M. and Jessica Lotridge. "Comparison of 1- and 2-Pentanol Solubilization in Cationic Surfactant Micelles," *Journal of Undergraduate Education*, 1/3, September 2002.
- WILKES, J., M. Van Valkenburg, Margaret Williams, and L. Vaughn. "Ionic Liquid Heat Transfer Fluids," *Proc 15th Symposium on Thermophysical Properties*, June 2003.
- WILKES, J. "Ionic Liquids in Perspective: The Past with an Eye Toward the Industrial Future," *Ionic Liquids: Industrial Applications for Green*. 818, August 2002.

WILKES, J. "Ionic Liquids in Synthesis—Introduction," *Ionic Liquids in Synthesis*, January 2003.

WILKES, J. "The Past, Present and Future of Ionic Liquids as Battery Electrolytes," *Green Industrial Applications of Ionic Liquids*, February 2003.

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CASEBEER, W., "The Moral Dimensions of Torture Interrogation," *Association for Practical and Professional Ethics Twelfth Annual Conference*, Charlotte, NC, February 27 – March 2, 2003. Organizer and presenter on panel about moral issues in the war on terrorism.

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COOK, J. 75-minute presentation on professional ethics to approximately 250 Utah Guardsmen in September

COOK, J. Joint Service Conference on Professional Ethics presentation ("Offensive Defense"), January, 2003.

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HEDAHL, M. "Stop Calling it the War on Terrorism: An Argument for Moral Clarity," Joint Service Conference on Professional Ethics.



*Members of the **Army Air Forces First Motion Picture Unit (FMPU)** on the set of the World War II training film, **Resisting Enemy Interrogation**. Famed character actor **Arthur Kennedy** sits to the right of the desk. The photo—courtesy of one of the unit's still photographers, **Peter Basch**—was collected by **Major Doug Cunningham**, Department of English, while conducting research for his book on the history and films of the FMPU.*