AFOSR Overview

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Program Manager
AFOSR/NL
Air Force Office of Scientific Research

Approved for public release.
Air Force Research Laboratory

Directed Energy

AFOSR

Materials & Manufacturing

Space Vehicles

Human Effectiveness

Munitions

Sensors

Information

Air Vehicles

Propulsion

The Air Force’s Corporate Research and Development Laboratory
Vision: The U.S. Air Force dominates air, space, and cyber through revolutionary basic research.

Mission: We discover, shape, and champion basic science that profoundly impacts the future Air Force.

- ID Breakthrough Research Opportunities – Here & Abroad
- Foster Revolutionary Basic Research for Air Force Needs
- Transition Technologies to DoD and Industry

TODAY’S BREAKTHROUGH SCIENCE FOR TOMORROW’S AIR FORCE
AFOSR Roles
AF Basic Research Manager

• Identify Breakthrough Research Opportunities – Here & Abroad
  – Regular interactions with leading scientists and engineers
  – Liaison offices in Europe, Asia, Latin America
  – 179 short-term foreign visitors; 28 personnel exchanges
  – 93 summer faculty; 55 postdocs/senior scientists at AFRL

• Foster Revolutionary Basic Research for Air Force Needs
  – 1162 extramural research grants at 190 U.S. universities
  – 246 intramural research projects at AFRL, USAFA, AFIT
  – 179 STTR small business - university contracts
  – 565 fellowships; 1574 grad students, 530 post-docs on grants

• Transition Technologies to DOD and Industry
  – 58 workshops conducted; 210 conferences co-sponsored
  – 686 funded transitions in FY08 data call (64% response rate)
Basic Research Focus Areas

Aerospace, Chemical & Materials Sciences (RSA)
- Aero-Structure Interactions and Control
- Energy, Power, and Propulsion
- Complex Materials and Structures

Physics & Electronics (RSE)
- Complex Electronics and Fundamental Quantum Processes
- Plasma Physics and High Energy Density Nonequilibrium Processes
- Optics, Electromagnetics, Communication, and Signal Processing

Math, Information & Life Sciences (RSL)
- Information and Complex Networks
- Decision Making
- Dynamical Systems, Optimization, and Control
- Natural Materials and Systems
AFOSR Supports University Individual Investigators

• Goals
  – Provide revolutionary scientific breakthroughs to maintain military air, space, and information superiority
  – Build collaborations between AFRL and universities

• General Process
  – Researchers submit white papers to AFOSR program managers
  – Promising white papers lead to request for full proposals
  – Proposals merit reviewed for *excellence* and *relevance*
  – Individual grants awarded for up to 5-years in duration

• Broad Agency Announcement (BAA) open at all times to innovative ideas [http://www.afosr.af.mil](http://www.afosr.af.mil)

9 Dec 09
AFOSR Supports Multidisciplinary University Research (MURI)

• Achieve significant scientific advances
  – Capture attention of top researchers
  – Build on results of individual-researcher grants
  – Encourage multidisciplinary collaboration
• Up to $1.5M/yr for five years
• Typically 8 research topics per Service
  – Occasional joint topics
  – One or two awards per topic
• Currently there are 61 AFOSR MURI Projects (FY05-09)
  – Funded 15 projects in FY09
Small Business (University-Industry) Collaborations (STTR)

- Small Business Technology Transfer (STTR) program provides up to $850,000 for early-stage R&D directly to small companies working cooperatively with research institutions (http://www.acq.osd.mil/sadbu/sbir/)
  - Company must be U.S. for-profit small business; 500 or less employees
  - Research institution must be a U.S. college or university, FFRDC, or non-profit research institution
  - Principal investigator must be employed at small business or research institution

- Air Force plans to support 30 topics for FY10
  - July 20, 2010: Solicitation issued for public release
  - August 17, 2010: DoD began accepting proposals
  - September 15, 2010: Deadline for receipt of proposals
  - February 3, 2011: Contracts awarded
AFOSR Supports Tomorrow’s S&Es

• National Defense Science and Engineering Graduate Fellowship (NDSEG)
  ✓ Full tuition assistance + $31K/per year stipend
  ✓ Fellows do not incur any service obligation
  ✓ Supports over 550 PhD-track graduate students
  ✓ More info: http://www.asee.org/ndseg

• Awards to Stimulate and Support Undergraduate Research Experience (ASSURE)
  ✓ Provide undergraduates with research opportunities in S&E fields of DoD interest
  ✓ Supports over 500 undergraduate students during summer months
  ✓ More info: http://www.afosr.af.mil

• Presidential Early Career Award for Scientists & Engineers (PECASE)
  ✓ Recognize outstanding young S&Es in AF interest areas
  ✓ 5-year awards $200K/year (up from $100K)
• Young Investigator Program (YIP)
  ✓ Develop long-term relationships with leading junior PIs
  ✓ 127 YIP awards since FY07; 38 awards in FY10
  ✓ Awards up to 5 years at $120K/yr beginning in FY09
  ✓ Must have received PhD in the last five years
National Security Science and Engineering Faculty Fellowships

- DDR&E program, managed by AFOSR
- Objectives
  - Excellent unclassified basic research on topics of interest to DoD
  - Long-term relationships with outstanding faculty and students
  - Familiarity with DoD missions, technologies, and challenges
  - Cadre of technical experts for DoD advisory groups
- Award Information (Eleven awards in FY10)
  - Single-investigator awards up to $850K/yr for up to 5 years
  - Open to faculty at US doctoral degree-granting institutions
  - US citizens and permanent residents are eligible to apply
- Application process (more info at http://nsseff.ida.org/)
  - Letter of intent to nominate from home institution
  - Formal nomination letter and white paper
  - Full proposal and oral presentation (by invitation only)
DoD Basic Research Enterprise

DoD Total FY10 Basic Research Budget = $1.8B
Collective Behavior and Socio-Cultural Modeling

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What are the hard technical issues in your portfolio? #1

• Basic social science often not understood
  – Collective models less developed than individual models
  – Non-rational behavior (e.g., emotions, beliefs, & values) less understood than rationale behavior

• Meso-level less studied and data harder to find

• No standard definitions/taxonomy/ontology for culture; no unified model or theory - embedded in specific social systems, multiple disciplines, but no common language or notation

• DATA ISSUES: Reliance on observational data from multiple sources/biases: Diverse, incomplete, multi-lingual, inconsistent coding, non-current, estimated, codes dropped/added, mixed data including parametric and non-parametric data, survey data limited to stated vs. revealed preferences (semantic reports).
  – Automatically extracted data particularly subject to bias and not easily verifiable - sampling bias, echo, etc.
What are the hard technical issues in your portfolio? #2

• Data often sparse for areas of real interest - limited empirical culture data: field work necessary when data may be manipulated – allows higher standards of verification

• How universal is the dataset: e.g., do gangs share common characteristics with terrorist networks, do the “troubles” in Northern Ireland share commonalities with Middle East terrorism, etc.

• How robust are the models to errors in the data?

• Relevant experimental data very sparse, simplified scenarios & limited choice of laboratory subjects
  — Are on-line games generalizable to real world behavior?

• Reliance on descriptive studies subject to sampling error, random misclassification, selection/measurement bias, & confounding

• Multiple possible independent & dependent variables. Is there continuity of the variables?
What are the hard technical issues in your portfolio? #3

• Causal structure is unknown: Complex, multi-factorial causation is the rule, bi-directional causation possible

• What is the optimum scale at which to model collective behavior?

• Multiple possible modeling approaches
  – Dynamic/temporal dimension (order of actions) & spatial dimensions (geography) poorly captured by existing models. “When” is difficult to predict.

• Multi-level problem: national>regional>local>individual>brain>amygdala>etc

• Computational intractability – Cumulative uncertainty - Multiple possible actions and outcomes (dependent variables) - n possible actions = $2^n$ possible worlds - doesn’t include spatial or temporal dimension

• Model assessment (?” V&V), model generalizability


- Atran, 25 Jan 2009: “Words to End War”
- Atran, 13 Dec 2009: “To Beat Al Qaeda Look to the East”
Building a Community of Practice

- Fragmented research community - social Science Stovepipes: “inventing their own toothbrushes (theories)”

- Barriers at Universities to Multi-disciplinary Research:
  - Dearth of graduate students and training programs
  - Many non-academic proposals
  - Few young investigators

- Creating a community of practice:
  - Interdisciplinary research
  - International participation

- Insufficient AFRL intellectual capital in social science (except Psychology)