Integrity ★ Service ★ Excellence

Mathematics, Information, and Life Sciences

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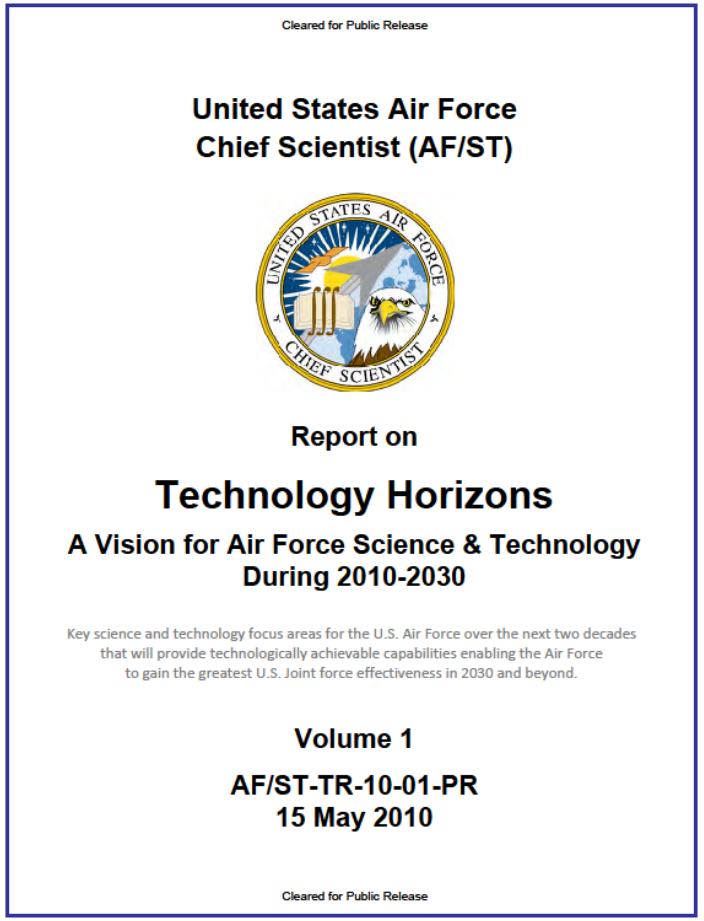
AF/ST Technology Horizons

- Focus on 10-20-year time horizon
- Tech Horizons Grand Challenges:
  - Inherently Intrusion-Resistant Cyber Networks
  - Trusted Highly-Autonomous Decision-Making Systems
  - Fractionated, Composable, Survivable Remote-Piloted Systems
  - Hyper-Precision Air Delivery in Difficult Environments
- Not all the technologies require new basic science



Cleared for Public Release

United States Air Force
Chief Scientist (AF/ST)

Report on

Technology Horizons

A Vision for Air Force Science & Technology During 2010-2030

Key science and technology focus areas for the U.S. Air Force over the next two decades that will provide technologically achievable capabilities enabling the Air Force to gain the greatest U.S. Joint force effectiveness in 2030 and beyond.

Volume 1

AF/ST-TR-10-01-PR
15 May 2010

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Available at: http://www.af.mil/information/technologyhorizons.asp

The AirForce 10yr + 10 Yr Outlook:

Technology Horizons Report

Priority Key Technology Areas / (RSL) as Research Opportunities !!!

- Autonomous systems
- Autonomous reasoning and learning
- Resilient autonomy
- Complex adaptive systems
- V&V for complex adaptive systems
- Collaborative/cooperative control
- Autonomous mission planning
- Cold-atom INS
- Chip-scale atomic clocks
- Ad hoc networks
- Polymorphic networks
- Agile networks
- Laser communications
- Frequency-agile RF systems
- Spectral mutability
- Dynamic spectrum access
- Quantum key distribution
- Multi-scale simulation technologies
- Coupled multi-physics simulations
- Embedded diagnostics
- Decision support tools
- Automated software generation
- Sensor-based processing
- Behavior prediction and anticipation
- Cognitive modeling
- Cognitive performance augmentation
- Human-machine interfaces

http://www.af.mil/shared/media/document/AFD-100727-053.pdf

RSL Scientific Goals

Information and Complex Networks

- Reliable and secure exchange of information
- Secure-by-design network and system software and architectures
- Exploitation of massive real-time data
- Mathematical basis for predictable operation of networks and systems

Decision Making

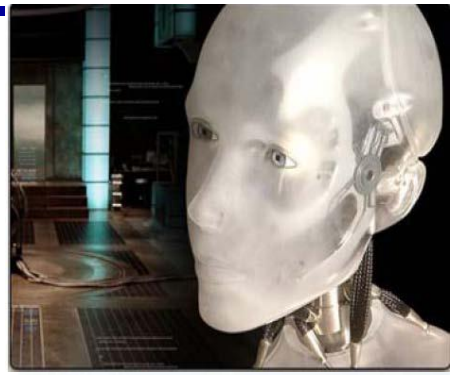
- Mathematical laws, foundational scientific principles, and new, reliable and robust decision-making algorithms
- Trust and mixed human-machine decision making.
- Understanding and predicting socio-cultural variations of influence

Dynamical Systems, Optimization & Control, and Computational Math

- Mathematical foundations of control including V&V
- Distributed, multiagent control; quantum control; vision-based control
- Optimization and discrete mathematics for solving large, complex problems
- Multidisciplinary optimization and control; complex systems
- Uncertainty quantification
- Computational strategies for complex multiscale system modeling

Natural Materials and Systems

- Using, mimicking, or altering ways that natural systems build materials and sensors and perform under extreme conditions.



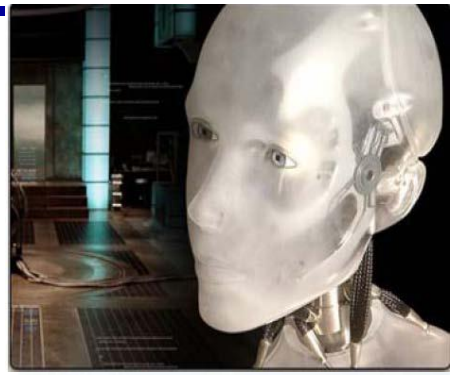
RSL Technical Programs

Information and Complex Networks
- Complex Networks (Bonneau)
- Information and Operations Security (Herklotz)
- Software and Systems (Bonneau)
- Science of Information, Computation and Fusion (Nguyen)
- Dynamic Data Driven Applications Systems (DDDAS) (Darema)

Decision Making
- Cognitive Modeling and Robust Decision Making (Myung)
- Trust and Influence (Lyons)

Dynamical Systems, Optimization & Control, and Computational Math
- Dynamics and Control (Fahroo)
- Optimization and Discrete Mathematics (Hearn)
- Computational Mathematics (Fahroo)

Natural Materials and Systems
- Sensory Information Systems (Larkin)
- Bioenergy (Bradshaw)
- Natural Materials and Systems (DeLong)



Some New Directions

(Cross-Directorate /Cross-DoD/Cross-Agencies/International Collaborations)

- **Additional topics of emphasis in FY12 BAA**
  - **Bionavigation (Bio)**
  - **Neuromorphic Computing (Human)**
  - **Multi-scale Modeling (Math)**
  - **Foundations of Information Systems (Info)**
- **BRI Topics**
  - **Bionanocombinatorics (Bio)**
  - **Trust & Influence (Human)**
  - **Design Under Uncertainty (Math)**
- **Areas of reduced emphasis:**
  - **Biofuels (Bio)**
  - **Agent-based systems and software (Info)**
  - **Computational methods of socio-cultural modeling (Human)**


QUESTIONS?