ARTIFICIAL INTELLIGENCE

WITHIN AFSC
AIR FORCE AI BASIC RESEARCH

• LARGE KNOWLEDGE BASE/INTELLIGENT RETRIEVAL
  • ANALOGICAL/CASE-BASED REASONING
  • UNCERTAINTY
  • QUALITATIVE REASONING
  • INFORMATION INDEXING

• MACHINE VISION/IMAGE UNDERSTANDING
  • 2-D IMAGES
  • FEATURE COMBINING
  • LOW-, MID-, HIGH-LEVEL VISION ALGORITHMIC MODELING
RESEARCH THRUSTS (CONT.)

- PROBLEM SOLVING UNDER RESOURCE CONSTRAINTS
  - ACCURACY
  - TIMELINESS
  - COMPLETENESS

- MIXED SYMBOLIC AND NUMERIC COMPUTING
  - REASONING ABOUT PHYSICAL SYSTEMS (SYSTEMS WHICH REQUIRE QUALITATIVE AND QUANTITATIVE ANALYSIS)
MINOR AI THRUSTS

1. MACHINE LEARNING
2. PLANNING AND PROBLEM SOLVING
3. MASSIVELY PARALLEL SYSTEMS
4. APPROXIMATE REASONING
5. NATURAL LANGUAGE
AI
&
THE ROME AIR DEVELOPMENT CENTER
Communications Directorate

Communications Network Management
Cooperative distributed problem solving applied to the management and control of communication networks.

Distributed Intelligent Systems for Communication Network Management - Expert system technology applied to traffic monitoring and control for communications networks.

Automated Services for Inter-Personal Communications
Expert systems for communication among dispersed C2 centers.

Network Security Guards
Automated network interfaces for systems of varying security classification levels.

Sentient Radio
Intelligent adjustments for improved radio reception.
Reliability and Compatibility Directorate

Smart Built-In Test and Time Stress Measurement Devices
Develop and implement integrated failure detection and diagnosis mechanisms for electronic systems. Collection, analysis and storage of real-time environmental stress data.

Circuit Diagnostics and Testing
Diagnosis of failures in electronic systems across all levels of maintenance.

Computer-Aided Design for Testability and Reliability
Computer-aided tools for design and testing of electronic circuits and components.

Intelligent Design for Testability - Develop tools for use in conjunction with CAD/CAE package to design electronic circuits or systems with a high inherent level of testability.
Intelligence and Reconnaissance Directorate

Speech Processing and Understanding
Provide information processing assistance for intelligence analysis.

Knowledge-Based Image Interpretation
Advance the state-of-the-art in digital image exploitation.

Automated Database Update
Machine understanding of English text reports of events for database and knowledge base update.

Language Interface Module (LIM) - Integration of natural, human speech and free-form text inputs.

Neural Networks Applied to Model-Based Systems
Improving performance of model-based systems through training from Neural Networks.
Command and Control Directorate

Planning
  Support the rapid, accurate, and efficient creation and modification of plans.

  **Time-Oriented Problem Solving** - Develop problem solving theories about interacting with external events and other intelligent agents.

Knowledge-Based Problem Solving
  Improve parallel, distributed, and real-time problem solving technology.

Knowledge-Based Simulation
  Develop simulation technology that is easier and less costly to use, and more representative of real-world situations.

Knowledge-Based Expert Systems
  Develop component technologies supporting the next generation of knowledge-based expert systems, and applications employing those capabilities across the spectrum of C3I domains.

Knowledge Base/Database Architectures
  Integration of database and knowledge base technology to provide real-time processing of very large knowledge bases.
Command and Control Directorate

Intelligent Interfaces
Make increasingly complex C3I systems more intuitive, and provide intelligent assistance in their use.

Intelligent Man-Machine Interface Evaluation - Facilitate the accessibility and application of current and developing interface technology.

Parallel AI
Identify and exploit parallelism in knowledge-based problem solving.

Software Engineering
Improve software analysis, specification, validation, quality and productivity.

Knowledge Based Software Assistant (KBSA)
Develop a knowledge-based lifecycle paradigm for the design, development, and support of very large software projects.
Surveillance Directorate

Optimal Filtering for Signal Processing
Extracting information from incoming signals for situational and behavioral assessment, system response, and optimal resource management.

High-Level Adaptive Signal Processing - Signal processing testbed for electromagnetic type localization and classification using time-frequency domain feature extraction.

Low Observable and Multitarget Tracking
Target tracking with multispectral knowledge-based surveillance systems.

Multispectral Data Fusion
Associate data from different sensors to increase coverage of low observables.

Knowledge-Based Signal Processing and Data Fusion - Define optimizations for merging numeric and symbolic signals from multiple distributed systems.
Electromagnetic Sciences

Intelligent Antennas
Processing signals for phased-array antennas.

Neural Networks Applied to Signal Analysis
Regeneration of text from corrupted channels.
RADAR ARTIFICIAL INTELLIGENCE UNIVERSITY CONSORTIUM

- Clarkson University
- University of Rochester
- SUNY Buffalo
- AFIT
- Syracuse University
- Colgate University
- Rensselaer Polytechnic Institute
# NORTHEAST AI CONSORTIUM

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<tr>
<th>UNIVERSITY</th>
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<td>Communications Systems Control</td>
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<td>RIT</td>
<td>Speech Understanding</td>
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<td>Time-Oriented Problem Solving</td>
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<td>RPI</td>
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<td>SUNY Buffalo</td>
<td>Expert Systems for Maintenance</td>
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<td>Syracuse University</td>
<td>Intelligent KBSs, Advanced Logic Programming Environments</td>
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<td>University of Mass</td>
<td>Automated Multi-Source KA</td>
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## REQUIREMENTS

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<th>Training Aids for Controllers</th>
<th>Fog Prediction at Launch Sites</th>
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<tr>
<td>Satellite Autonomy</td>
<td>Fault Diagnosis</td>
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<td>V &amp; V of Expert Systems</td>
<td>Environmental Problem</td>
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<td>Identification</td>
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<td>Reduction of Manpower Requirements</td>
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AFSTC AI INITIATIVES

HQ SPACE TECHNOLOGY CENTER

1. EXACT (SBIR ON SATELLITE & NETWORK CONTROL)
2. EXPERT SYSTEMS FOR 1750A ARCHITECTURE
3. V & V FOR EXPERT SYSTEMS
4. AI TECHNIQUES FOR SATELLITE AUTONOMY
5. AUTONOMY TECHNOLOGY SEGMENT

THE WEAPONS LAB

6. RELATIONAL DATABASE NATURAL LANGUAGE INTERFACE
7. NEURAL NET PATTERN RECOGNITION
THE GEOPHYSICS LAB

1. FOG PREDICTION
2. TURBULANCE ADVISOR
3. NEURAL NETWORK CLOUD CLASSIFIER (SATELLITE IMAGERY)

THE ASTRONAUTICS LAB

4. EXPERT SYSTEM FOR NON-DESTRUCTIVE EVALUATION
5. EXPERT SYSTEM FOR ENGINE DESIGN
HUMAN RESOURCES LAB AI THRUSTS

Conducting research to investigate issues involved in applying AI technology to training systems

• TOOLS

   Centers on the construction of tools which facilitate the design, development, and coding of Intelligent Tutoring Systems (ITS)

• TUTORS

   Development of ITSs within the context of Air Force technical training

• TESTBEDS

   Systematically vary ITS designs to investigate the instructional effectiveness of the different design approaches
MAJOR EFFORTS

CURRENT PROJECTS
- Manned threat evaluation and modeling
- Flight performance evaluation
- Hardware Neural Nets
- Noise cancellation
- Auditory signal processing

PROPOSED
- Knowledge Workshop
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<tr>
<th>MUNITIONS</th>
<th>ADVANCED GUIDANCE</th>
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<td>ADVANCED FUZING</td>
<td>IMAGE PROCESSING</td>
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<td>EXPLOSIVES DESIGN SUPPORT</td>
<td>AUTOMATIC TARGET RECOGNITION</td>
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<td>WARHEAD DESIGN SUPPORT</td>
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<td>MUNITION/AIRCRAFT COMM</td>
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<td>COMPUTATIONAL FLUID DYNAMICS</td>
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<td>(GRID GENERATION, MODELING)</td>
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<td>MUNITIONS MAINTENANCE AIDS</td>
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MISSION

- Focus and facilitate AI related efforts within ASD and Wright Research and Development Center
- Address high priority aerospace weapon system requirements
- Provide emphasis on near-term AI technology transition opportunities
- Provide AI education and training
APPROACH

- Technology Assessment
  - Technology Transition
  - In-house Capability Enhancement
  - Advocacy
  - Dayton AI Center
• Miami Valley Research Institute
  Five local universities
  Teknowledge
  Local companies

• Objective:
  - Expand the local AI talent base
  - Study the application of AI technologies to USAF
  - Foster AI technology transition
  - Provide AI education and training
WRDC AI THRUSTS

COCKPIT INTEGRATION

1. LEARNING SYSTEM, PILOT AIDING
2. PILOT'S ASSOCIATE DISPLAYS/CONTROLS
3. INTELLIGENT PILOT-VEHICLE INTERFACE
4. THREAT EXPERT ANALYSIS SYSTEM
5. PILOT'S ASSOCIATE PROGRAM
6. CREW-AIDING PROCESSOR AND DISPLAY SYSTEM
7. V & V OF AI SOFTWARE
AERO PROPULSION AND POWER

1. NEURAL NETWORKS FOR TURBINE ENGINE DIAGNOSTICS

2. PARAMETRIC TRAJECTORY ANALYSIS

MATERIALS

3. QUALITATIVE PROCESS AUTOMATION

4. FEATURE BASED DESIGN

FLIGHT DYNAMICS

5. DIAGNOSTIC ABDUCTIVE AND INDUCTIVE REASONING

6. SPACE TRANSPORTATION

7. FLIGHT CONTROLS (GROUND-BASED, IN-FLIGHT, SELF-REPAIRING DIAGNOSTICS)
AVIONICS

- • MACHINE INTELLIGENCE
  - • NEURAL ADAPTIVE LEARNING
  - • MACHINE PERCEPTION & IMAGE UNDERSTANDING
  - • INTELLIGENT AVIONICS
- • AI PROCESSOR DEVELOPMENT
- • MODEL BASED VISION
SOAPBOX ISSUES

• COMMUNICATION & COOPERATION

• REQUIREMENTS
  
  •  PURE RESEARCH: WHAT DO WE NEED FROM AI BEFORE IT CAN BE APPLIED?
  
  •  APPLIED RESEARCH: WHAT DO I NEED FROM AI BEFORE IT CAN BE APPLIED IN MY DOMAIN?

• PROVE YOUR PUDDING
PRELIMINARY TESTS OF AUTOMATED ASSEMBLY OF SPACE STRUCTURES

R. Will
NASA/Langley Research Center

(Paper not provided by publication date.)
EXPERIMENTAL RESULTS OF INTEGRATED EVA/TELEROBOTIC WORK SITES

D. Akin, J. Hedgecock, and E. Sorenson

(Paper not provided by publication date.)