

N90-25504

ARTIFICIAL INTELLIGENCE

WITHIN

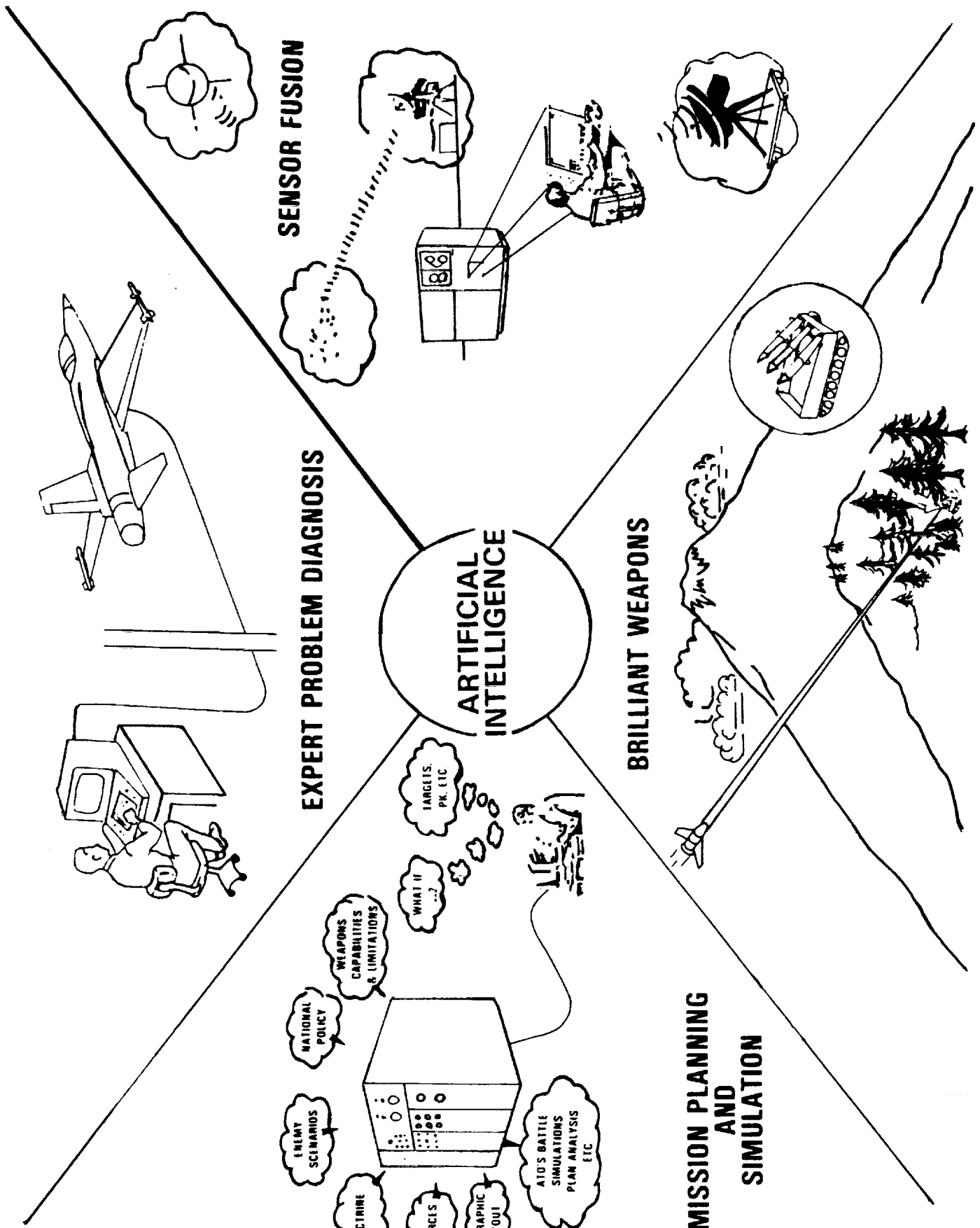
AFSC



HEADQUARTERS AIR FORCE SYSTEMS COMMAND
ANDREWS AFB DC 20334-5000

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AI

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THE AIR FORCE

OFFICE OF SCIENTIFIC

RESEARCH



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**

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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.

Sentinel 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.

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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 tested 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

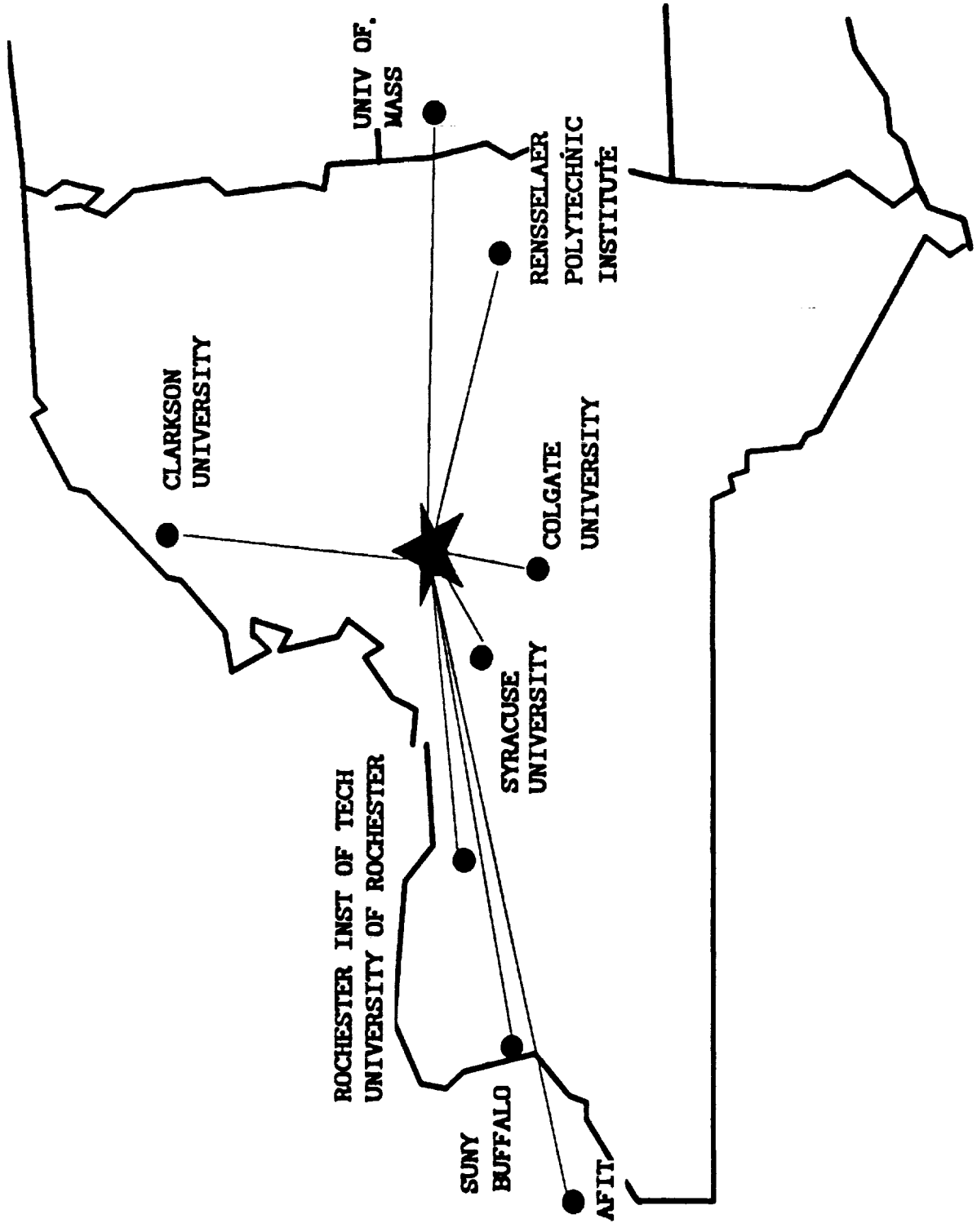
Intelligent Antennas

Processing signals for phased-array antennas.

Neural Networks Applied to Signal Analysis

Regeneration of text from corrupted channels.

RADC ARTIFICIAL INTELLIGENCE UNIVERSITY CONSORTIUM



NORTHEAST AI CONSORTIUM

UNIVERSITY

TECHNICAL PROGRAM AREA

CLARKSON

COMMUNICATIONS SYSTEMS
CONTROL

RIT

SPEECH UNDERSTANDING

UNIVERSITY OF ROCHESTER

TIME-ORIENTED PROBLEM SOLVING

RPI

PHOTO INTERPRETATION

SUNY BUFFALO

EXPERT SYSTEMS FOR MAINTENANCE

SYRACUSE

INTELLIGENT KBSS, ADVANCED LOGIC
PROGRAMMING ENVIRONMENTS

UNIVERSITY OF MASS

AUTOMATED MULTI-SOURCE KA

AI

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THE SPACE

TECHNOLOGY

CENTER



REQUIREMENTS

INTELLIGENT CONSOLE
FOR SATELLITE
CONTROLLERS

TRAINING AIDS FOR
CONTROLLERS

FOG PREDICTION AT
LAUNCH SITES

SATELLITE AUTONOMY

FAULT DIAGNOSIS

RANGE SCHEDULING

V & V OF EXPERT
SYSTEMS

ENVIRONMENTAL
PROBLEM
IDENTIFICATION

AUTONOMY FOR
NAVIGATION AND
CONTROL

REDUCTION OF MANPOWER REQUIREMENTS

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**

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THE HUMAN RESOURCES

LABORATORY



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

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THE ARMSTRONG AEROSPACE
MEDICAL RESEARCH LAB



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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THE ARMAMENT LAB



AFATL AI INTEREST

<p>MUNITIONS</p> <p>ADVANCED FUZING EXPLOSIVES DESIGN SUPPORT WARHEAD DESIGN SUPPORT</p>	<p>ADVANCED GUIDANCE</p> <p>IMAGE PROCESSING AUTOMATIC TARGET RECOGNITION REAL TIME INFERENCING MUNITION/AIRCRAFT COMM</p>
<p>AEROMECHANICS</p> <p>DATA ANALYSES FOR GUN TUNNEL A/C INTERFACE CERTIFICATION XRAY IMAGE ANALYSES COMPUTATIONAL FLUID DYNAMICS (GRID GENERATION, MODELING) MUNITIONS MAINTENANCE AIDS</p>	<p>ANALYSIS AND STRATEGIC DEFENSE</p> <p>IMAGE PROCESSING REAL TIME INFERENCING AUTOMATIC TARGET RECOGNITION</p>

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THE WRIGHT RESEARCH

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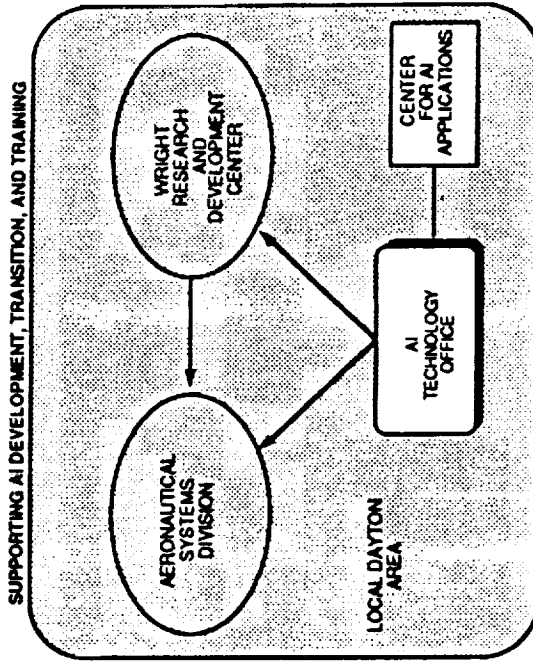
DEVELOPMENT CENTER





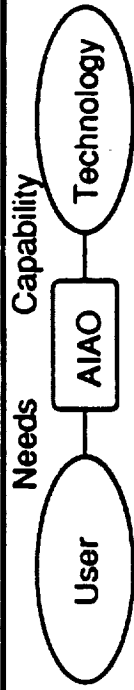
MISSION

- 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



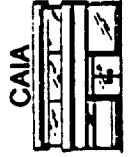
• Technology Assessment

• Technology Transition

• In-house Capability Enhancement

• Advocacy

• Dayton AI Center



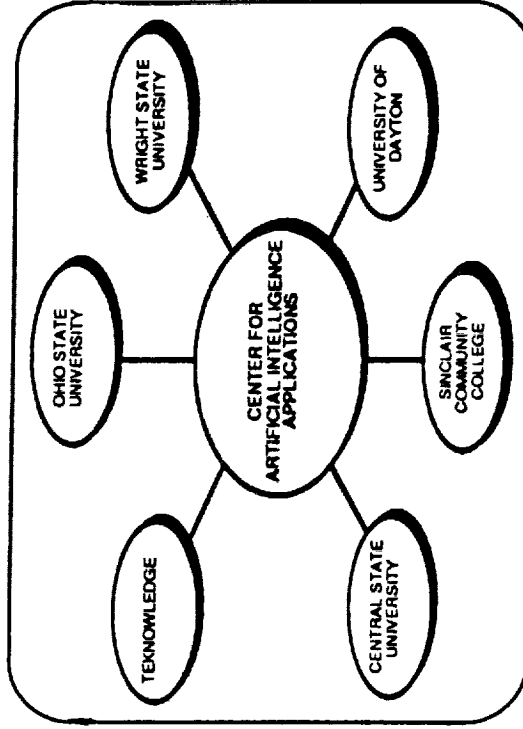


DAYTON CENTER FOR ARTIFICIAL INTELLIGENCE APPLICATIONS

- **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.)

