PORTFOLIO FOR

PETER G. RAETH

Mr. Raeth joined Ball Aerospace & Technologies Corp in January 1998 as a Computer Scientist and Task Leader. He designs algorithms and heuristics for the Space Based Infrared Systems program. He has over 16 years experience as a program manager and computer engineer as an officer in the United States Air Force. This includes 5 years in industrially funded organizations. His emphasis has been on modeling, simulation, and adaptive automation in the areas of electronic warfare, decision aids for aircraft cockpits, and computer performance analysis. Since leaving the Air Force, he has gained experience in blackbox software test planning, pattern recognition, sensor and data fusion, and distributed processing. He received the BS degree in Electrical Engineering from the University of South Carolina and an MS in Computer Engineering from the Air Force Institute of Technology. He served as a career Air Force officer until March 1997. His assignments included duties in Electronic Warfare flight test support (3246th Test Wing), radar signal passive identification (Avionics Directorate, Air Force Research Lab), and pilot decision aids (Flight Dynamics Directorate, Air Force Research Lab). Just after leaving the service, Mr Raeth worked with Simulation Technologies, Inc performing duties in distributed simulation, distributed processing, and software blackbox testing. He has given lectures and published articles, papers, and reports on the subjects of expert systems and neural networks since 1977. He is editor and a contributing author of the book, "Expert Systems: A Software Methodology for Modern Applications", published by the IEEE Computer Society in 1990. In 1991 he was awarded a research fellowship in neural networks at the University of Dayton Research Institute. Mr Raeth is a member of the electrical engineering honor societies Tau Beta Pi and Eta Kappa Nu, the community service honor society Omicron Delta Kappa, IEEE Computer Society, and the ACM Special Interest Group in Artificial Intelligence. He has twice won the Armed Forces Communications and Electronics Association's gold medal. The Dayton Affiliate Societies Council has twice selected him as one of the Region's Top 20 Technology Leaders. Mr Raeth is a lay minister at his church and enjoys trap, skeet, and sporting clays. He is a member of the Ohio Academy of Science's Science Fair Judging Team. His reading and movie pleasure is science fiction.

EDUCATION

• MS Computer Engineering	Air Force Institute of Technology	1980
• BS Electrical Engineering	University of South Carolina	1979
• AS Electronics Engineering Technology	Trident Technical College	1975

PROFESSIONAL TRAINING

- Research Fellowship in Neural Networks (5 months)
  University of Dayton, 1990

- Certificate in Information Systems (3 graduate course sequence)
  University of Southern California, 1985

PROFESSIONAL AFFILIATIONS

- IEEE Computer Society
- ACM Special Interest Group In Artificial Intelligence
- Tau Beta Pi, Eta Kappa Nu, Omicron Delta Kappa, Arnold Air Society
- Ohio Academy of Science, Science Fair Judging Team

PROFESSIONAL AWARDS

• Air Force Meritorious Service Medal	1997 and 1994
• One of only 14 nominees for Wright Laboratory Leadership Award	1996
• Co-author "The Human-Electronic Crew, Can We Trust the Team", selected in top ten technical reports in Wright Laboratory for that year	1996
• Dayton Affiliate Societies Council, Region's Top 20 Technology Leaders	1995 and 1994
• One of only 10 Americans invited to address the European Workshop on Human-Electronic Crew Teamwork	1994
• Aeronautical Systems Center Nominee for the Air Force Research and Development Award	1991
• Air Force Commendation Medal	1990
• $300 Suggestion Award, "Date Consistency in Personnel Computer Products"	1990
• 3246th Test Wing Test Engineering Shaker and Mover of the Year (Selected for this award in less than one year with Wing.)	1986
• Selected for the Computer Research Scientist USAF career field as the second of only 26 members	1985
• Air Force Achievement Medal	1985
• Armed Forces Communications & Electronics Association Gold Medal	1979 and 1977

CERTIFICATIONS

United States Air Force Officer Career Fields

- Fully Qualified: Computer Research Scientist
- Fully Qualified: Scientific Analyst
- Fully Qualified: Communications/Computer Systems Programmer

USAF Acquisition Professional Development Program Certifications

- Level III: Systems Planning, Research, Development, & Engineering
- Level II: Program Management
- Level II: Test Engineering
- Level I: Acquisition Manager
- Level I: Communications and Computer Systems

PROFESSIONAL EXPERIENCE

Ball Aerospace & Technologies Corp., January 1998 - Present
Computer Scientist* and *Task Leader

Currently, Mr. Raeth is a Computer Scientist providing algorithm and heuristic design, and technology insertion expertise to the Space Based Infrared Systems - Technical Intelligence (SBIRS-TI) program, the group's largest program to date. His other duties include:

- Development of SBIRS project web site
- Recommendation of CASE tools
  - currently working with ObjectTeam, CASE tool for object-oriented A/D/P
- Deployment of team collaboration tools
  - successful deployment of Microsoft NetMeeting
- SBIRS-TI program planning, tracking, and coordination
  - perform project software manager role under Capability Maturity Model (CMM)
- Development of algorithms and heuristics for infrared signal analysis
  - researched, developed, and demonstrated new background filtering method that does not depend on correlated noise, and is domain and spectrum independent

Simulation Technologies, Inc., February 1997 - December 1997
Technical Project Leader

During this time, Mr Raeth was involved in three major areas:

- High Level Architecture (HLA) distributed simulation
- Distributed and parallel computing
- Blackbox software testing

He had the following results:

<u>High Level Architecture</u>

- Prepared a formal HLA object model of the company’s Integrated Unit Simulation System (IUSS), a very large simulation of the individual soldier and small-unit combat. This task was completed one month ahead of schedule.
- Implemented the HLA Run-Time Infrastructure (RTI) for PC-NT computers. The RTI is a software backbone that enables a common LAN of PCs or Unix machines to play in an HLA distributed simulation.
- Developed and conducted two basic HLA demonstrations

- One demonstration was of two countries building up weapons stockpiles. The country with the larger stockpile would attack the country with the smaller stockpile when the smaller stockpile grew to within a given range of the larger stockpile. The software simulating each country ran on its own computer.
- The other demonstration was of a wing operations center. The wing's console was driven by information provided by its various airbases. Each airbase model was initialized by its own database and ran on its own computer.
- Both demonstrations were tolerant of individual participant computers crashing and being restarted. They also employed a combination of DOS and Windows consoles.

- Prepared status and training briefings to mark progress and to inform other engineers within the company.
- Developed automated process for directly translating the simulation object model into the .fed file required by the RTI. This success was expanded by his brief white paper that proposed the development of an automated process that would directly translate the simulation object model into the overhead computer code required by the RTI.

<u>Distributed and Parallel Computing</u>

- This area of activity enabled the company to add processing horsepower to its individual simulations without additional capital expenditure for hardware. By employing the Parallel Virtual Machines (PVM) software backbone, Unix, PC-95, and PC-NT computers on a common LAN can be made to look like a single multi-processor computer.

<u>Blackbox Software Testing</u>

- Developed and applied formal blackbox testing methods on a large ground combat simulation that had never been through any kind of formal software testing. This type of testing examines a software product through the user interface. Whitebox testing works at the code level.
- Developed the testing process from scratch to include test planning in the following areas: policy, installation, documentation, new functionality, limited system test, and full system test. These documented plans were given their first trial during actual beta testing for a major release. An iterative process served to ensure their continual improvement. The result was a test process that ensured formality without being overly restrictive or expensive.
- Prepared a short briefing and bibliography to inform the programming team on the test development process.
- A final benefit of this task was the development of a project set that served as a baseline for regression testing.

Flight Dynamics Directorate, Wright Laboratory, October 1992 - March 1997
Chief, Pilot/Vehicle Interface Technology Branch (Major, USAF)

In this assignment, Mr Raeth led a team of 25 engineers and scientists (10 government and 15 contractor) in the development of advanced cockpit display formats, display controls, and aircrew decision aids. He was responsible for $35 million in budget and facilities, including five cockpit evaluation systems used by 70 research personnel. So successful was this facility that it was used by Wright Laboratory for 200 technology demonstrations per year. Over 800 people per year were accommodated, including foreign and US dignitaries. The facility was featured on US and South American national television, as well as in several Air Force videos. His own and his branch's research was applied to the satisfaction of more than 100 formal warfighting deficiencies. During this period, Mr Raeth achieved the following:

- Initiated $16 million uninhabited combat aerial vehicle program. This program united Wright Laboratory and industry in the Air Force's first program to develop mission-flexible operator-vehicle interfaces for unmanned aerial vehicles performing lethal missions.
- Guided development of air-to-air missile targeting and missile escape decision aid technology. This program received very favorable attention from the Air Force Science Advisory Board and the F-22 program office. This program joined two government organizations with three civilian companies and successfully demonstrated technology that provides increased pilot situation perception and reduced workload, and acts as a force multiplier. Simulations demonstrated 14% higher kill rates for friendly forces when they are outnumbered even 4-to-1. Also leveraged results from the $70 million Army Rotorcraft Pilots Associate and $50 million Air Force Pilots Associate programs.
- Directed organization developing decision aids to be added to Defense Mapping Agency digital landing charts. Simulations demonstrated altitude deviations were reduced 45%, airspeed deviations reduced 25%, and workload reduced 70%.
- Worked with outside funding sources to directly respond to operational commands' needs, thereby doubling his budget. Also worked with industry and academia to provide work-study, visiting faculty, technology sharing, and facilities sharing opportunities to effectively increase manpower 78%. These increases were achieved in spite of a 30% reduction in allocated manpower and funding.
- People in his organization were consistently winning awards. In one 12-month period they won 7 awards.
- Conducted workshops in cockpit decision aid technology that were attended by people from five countries, four government agencies, and three universities.
- Directed Wright Laboratory, Armstrong Laboratory, and NASA team developing cockpit voice control. Simulations demonstrated 97% accuracy in 115dB noise and 3G maneuver forces environments, 40% workload reduction, and 60% increase in pilot head-up time. This program culminated in the Air Force's first-ever voice control flight test for transports and the establishment of a much sought after database of high-noise voice data collected in-flight.
- Directed team developing improved target designation capability. Provided technology that cut target designation time in half.
- Led team in T-38 display modernization program to reduce transition training cost 20%.
- Transitioned $50 million Air Force Pilots Associate program to civilian transports via cooperative research and development agreement with major aircraft manufacturer. Transition of enhanced route management and cruise/climb systems shown to save 120 pounds fuel per flight hour and 200% reduction in route replanning time.
- Co-authored the script and led the production of a premier video documentary of division mission, facilities, and cockpit research. This documentary is being distributed all over the US and to allied nations.
- Developed automated workload allocation heuristic for cockpit applications. Heuristic based on situation attributes affecting pilot trust and projected pilot willingness to allocate workload to the automation. Transitioned academia's empirical and theoretical research into practical software implementation. Extensive technical report now in press

via Mr Raeth's personal cooperative research and development agreement with Wright Laboratory.

- Developed expert systems approach to the management of on-board and off-board information for situation awareness and decision aiding. This work continued his long-standing research into adaptable automation wherein the software does not change, just the database of domain knowledge. Published a detailed technical report on this subject.
- Worked with academia to develop hardware approaches that mirror the algorithms and heuristics used in decision aids and employ processing components already on the aircraft. This helped to establish advanced decision aids as a transitionable technology.
- Worked with academia to develop a missile trajectory prediction heuristic. This technology seeks to identify the missile's target and to give the pilot sufficient warning of a pending missile impact. While this research is in its early stages, initial simulations show a 1 second error in prediction of time of impact. The research continued beyond that point and is being documented in a technical report under Mr Raeth's cooperative research and development agreement with Wright Laboratory.
- Instrumented missile trajectory prediction computer code for the collection of statistics on projections of time and location of impact. This instrumented software was made available to organizations conducting tests using models of friendly and enemy operational missiles.
- Worked with academia to develop hypermedia opportunities for the exposition of technical topics and the transition of technology. Sponsored two graduate students who published theses that laid a base-line of requirements via extensive interviews and literature searches.
- Developed simulation that leveraged research from academia and demonstrated the feasibility of making real-time predictions of numeric sequences without prior knowledge of the changing control law, using the entire expanding data stream, and without knowing when the control law changed. This simulation led to two visiting faculty summer research sessions in missile trajectory prediction.
- Translated from one version of language to another so code could be used on high performance computer. Enabled MS student to complete thesis in neural network applications on time.

Deputy Chief of Staff Office for Science and Technology,
Headquarters Air Force Materiel Command, October 1991 - October 1992
Deputy Air Force Industry Research and Development Manager (Major, USAF)

For this year, Mr Raeth spearheaded initiatives for integrating USAF technology planning with industry research and development (IR&D). This activity enabled the Air Force to leverage 10,000 contractor research projects that were supported by $150 million per year in DoD funds. The following results were achieved:

- Developed smooth process for the release of classified and unclassified information to industry in support of their IR&D projects. This was a significant result involving industry, government field organizations, headquarters, and intelligence communities. Co-authored Command policy in IR&D (AFMCR 550-17) and Air Force regulations governing release of intelligence (AFR 205-2). Presented these results at a national gathering of information release experts.
- Successfully defended the proprietary nature of industry research results. A Freedom of Information Act (FOIA) request demanded release of proprietary contractor data. This

demand was initially supported by the Air Force legal and FOIA communities. Mr Raeth researched the Federal Acquisition Regulations and documented countering citations. He also formed a team of industry and government lawyers to support his insistence that the information was not releasable. Had he not acted, a legal precedent would have been set, industry would have no longer released proprietary research results to DoD, and the opportunity to leverage those results would have been lost. This would have caused a significant interruption of communication between DoD and industry.

- Developed an IR&D project review process that saved the Air Force 900 travel days in its first year over the previous process.
- Developed database that enabled easy access to an industry survey conducted nationwide.

Avionics Directorate, Wright Laboratory, October 1988 - October 1991
Artificial Intelligence Program Manager (Captain, USAF)

As program manager and research scientist, Mr Raeth led a team of 15 government and contractor personnel in the application of adaptive automation technology to the passive identification of radar signals for application to electronic warfare threat alert systems. He also represented the USAF to the electronic warfare passive identification group of the International Technical Cooperation program, an organization of English-speaking nations. The following achievements occurred:

- Led research activities to improve the ALR-56M radar threat alert system. In three years went from basic research to writing a technology transition plan. Developed test facility that included the ALR-56M, bread-boards of the new hardware/software suite, and real-time simulation comparison capability.
- Developed algorithms and heuristics that are easily deployed on parallel processing architectures. These systems require little or no software modification when changes in the threat database occur. Reduced cost of upgrades to major electronic warfare systems ten fold. The time required to identify uncooperative radar threats was decreased an order of magnitude.
- Used imaginative, yet legal, procurement methods to accelerate program 1.5 years in first six months. By combining this with the use of flight test discipline during research phase assessments, he shaved two years off the normal time required to get new technology into operational aircraft.
- Guided a team developing in-house simulators to generate mission oriented scenarios. This effort saved $350 thousand in limited R&D funds and was critical to the testing of adaptive automation systems intended for insertion into radar threat alert systems on board combat aircraft.
- Co-Invented Stretch & Hammer Neural Network, a method for n-dimensional surface interpolation without regular grid. Published this work in two extensive technical reports.

Deputy Commander Office for Electronic Warfare Flight Test, 3246th Test Wing, April 1985 - October 1988
Chief, Electronic Warfare Technical Support Branch (Captain, USAF)

For this assignment, Mr Raeth directed technical support for 57 electronic warfare developmental test programs. These programs included the F-15 Tactical EW System, F-16

Airborne Self-Protection Jammer, B-1B Defensive Avionics System, and the ALR 74/56M Advanced Radar Warning Receiver Competition. He supervised ten government personnel and was the assistant program manager for the engineering support contract. He entered this job as Assistant Branch Chief and was promoted to Branch Chief after the first week. The following accomplishments resulted:

- Led team that salvaged two-thirds of data from three flight test missions when the data was originally thought to be without value. This kept those missions from having to be reflown.
- Developed systems requirements and procurement methods that led to a 74% cost reduction in storage media and a $220 thousand savings in computer hardware. An additional benefit was a savings of one manweek and one cpuweek per test program.
- Developed plan for locating the computer terminals and phone sets for the new LAN and digital telephone network, a $200 thousand installation project.
- Planned and managed the construction a classified computer processing facility for the analysis of EW test data. Final cost was $20 thousand below the original construction and installation estimate.
- Developed computer expert system that enabled previously unachievable automation of the analysis of complex EW test data.
- Increased by 35% the number of flight test programs supported by his organization.
- Completely revamped the time-billing philosophy of his industrially funded branch. Overhead billings reduced 75%.
- Developed automated process for tracking hours billed Vs projects supported for each staff member. Interfaced with official organizational manhour database. Used this process to justify manpower requests and allocations.
- Established automated and administrative processes that decreased late technical reports 80%.
- Developed automated means of organizing and reporting collection data during Wing fund raising drive. Made extensive use of spreadsheet data input, graphics, tables, and recalculation capabilities. Significantly reduced workload since package produced reports for all organization levels.

Deputy Chief of Staff Office for Computer Systems,
Headquarters Air Force Systems Command, June 1983 - April 1985
Information Architecture Project Officer (Captain, USAF)

In this assignment, Mr Raeth translated management concepts in information architectures into implementable initiatives for contractor action. He assisted in the design of user interfaces, configuration management schemes, standards and conventions, and other policies in regard to the modeling methodologies and tools used by the $10 million Information Integration program. As the Command's Productivity Principal, he managed the Command-wide effort to enhance productivity via information systems. The following results were achieved:

- Developed an automated task tracking system for his division that proved so successful that it was adopted as a directorate standard.
- Consummated an agreement with the General Services Administration that cut procurement time for contractor support 50%.

- Developed an Information Resources Management training program for the division's staff that optimized impact while minimizing cost. This program filled several shortfalls that were holding back progress.
- Initiated and co-authored an officer performance report writer's guide that eventually became the Command standard embodied in AFSCP 36-2, "OERs: A Guide for Rating Officials".
- Assisted in the development of the five year budget for the $54 million Air Force Systems Command Info 90 program. Represented this program to the Command's Program Review Council for the FY84 POM.
- Introduced the use of automated statement of work generation tools to the division.

Federal Computer Performance Evaluation and Simulation Center (FEDSIM), Headquarters Air Force, December 1980 - June 1983
Computer Simulation Development Officer (Lt and Captain, USAF)

Directly after commissioning in June 1979, Mr Raeth was sent to the Air Force Institute of Technology to complete a Master of Computer Engineering. He received the first such degree issued by the Institute. FEDSIM was his first assignment after completing that degree. At FEDSIM he served as a consultant in simulation and data processing to the US Navy. He performed work in the areas of computer system simulation, computer system performance evaluation and prediction, and computer system design assessment. He was also an analyst on a project developing system sizing and analysis techniques to support capacity management. These achievements resulted:

- Developed an automated means of directly translating a computer system's log into a workload simulation model. This led to analyst workload reduction that enabled him to work on an addition project.
- Wrote an analysis of proposed approaches to the design of LANs. Identified a flaw in the proposal that would have prevented the proposed system from meeting the customer's needs. This report was so highly regarded by Naval Sea Systems Command that they funded an additional 18 manmonth effort.

PUBLICATIONS

"Transitioning Basic Research to Build a Dynamic Model of Pilot Trust and Workload Allocation", with John Reising, in preparation for submittal to the Journal of Mathematical and Computer Modeling (tbd)

"Review of Bart Kosko's Book 'Fuzzy Engineering'", ACM SIGART Bulletin, Vol 9, # 1, pp 39-41 (Summer 98)

"A Model of Pilot Trust and Dynamic Workload Allocation", with John Reising, Proc IEEE National Aerospace and Electronics Conference (Jul 97)

"Parallel Processing for Real-Time Rule-Based Decision Aids", with Chun-Shin Lin, Proc IEEE International Conference on Systems, Man, and Cybernetics (Oct 96)

"Prediction of Missile Trajectory", with Chun-Shin Lin, Proc IEEE International Conference on Systems, Man, and Cybernetics (Oct 95)

“A Scalable Framework for Adding Crisp Knowledge to Pilot/Vehicle Interfaces”, with Anthony Montecalvo and James Noyes, Invited Paper, Proc IEEE International Conference on Systems, Man, and Cybernetics (Oct 94)

"Cockpit Decision Aids Via Trust-Enhancing Knowledge-Based Techniques", with Anthony Montecalvo and James Noyes, Invited Paper, Proc Joint GAF/RAF/USAF Workshop on Human-Electronic Crew Teamwork, Cambridge, England (Sep 94)

"A Basis Function Approach to Programming Concurrent Voting Systems to Perform Selection Tasks", with Steve Gustafson and Gordon Little, Mathematical Computer Modeling, Pergamon Press, Vol 20, # 3, pp 73-88 (Mar 94)

"The Affect of Personal and Business Standards on Sustained Research Funding" High Tech Communications for Developers (Jun 93)

"A Reading List of Practical Books in Expert Systems and Neural Networks" Neuron Digest (Jan 93)

"Standards in Artificial Intelligence from the Technology Users Point of View", Proc IEEE National Aerospace & Electronics Conference May 92. Presentations made to: World Conference on Expert Systems, Dec 91; American Association for Artificial Intelligence Annual Conference Workshop on Standards in Expert Systems, Jul 91; and Annual Conference of the International Association of Knowledge Engineers, Oct 90

"Applying Technology with NeuralWorks Professional II", Product Review, IEEE Computer Magazine (Jan 91)

"Expert Systems in Process Observation and Control, Parts I and II", AI Expert Magazine (Sep/Dec 90)

"An Experiment with 3-D Surface Maps to Illustrate Neural Network Performance", Proc IEEE/INNS International Neural Network Conference, Paris, France (Jul 90)

"Using 3-D Surface Maps to Illustrate Neural Network Performance", Proc IEEE National Aerospace and Electronics Conference (May 90)

“EXPERT SYSTEMS: A SOFTWARE METHODOLOGY FOR MODERN APPLICATIONS”, Editor and contributing author with numerous coauthors, Book, Structured Reprints Collection, IEEE Computer Society Press (Feb 90)

"Two Expert System Shells for the First-Time Developer", Product Review, IEEE Computer Magazine (Nov 88)

"QFiler - A Disk Manager", Product Review, Newsletter of the Emerald Coast Computer Society (Oct 88)

"An Expert Systems Approach to Decision Support in a Time- Dependent, Data Sampling Environment (A Brief Discussion)", Proc IEEE National Aerospace and Electronics Conference (May 88)

"Artificial Intelligence, An Applications Oriented Approach; By Daniel Schutzer", Book Review, IEEE Expert Systems Magazine (Winter 87)

"Automating Goldenbird Analysis Via Expert Systems", with Patricia Johnson, Proc Annual Joint DOD Electronic Warfare Conference (May 87), Proc Association of Old Crows Joint Western-Mountain Region Technical Symposium (Apr 87)

"New AI Software for a Statistical Decision Support System", with Michael Harding, Proc 51st meeting of the Mississippi Academy of Science (Feb 87), Proc Winter Conference of the American Statistical Association (Jan 87)

"Functional Modeling for Logic Simulation", with John Acken, Proc Institute of Electrical and Electronics Engineers 18th Design Automation Conference (Jul 81)

"A Functional Level Preprocessor for Computer Aided Digital Design" Masters thesis presented to the faculty of the Air Force Institute of Technology, Published under Dept of Commerce DTIC/NTIS # ADA 100784 (Dec 80)

"An Interactive Computer Package for Active Filter Design", with William Barksdale, Proc Institute of Electrical and Electronics Engineers Southeast Conference (Apr 78)

"An Internal Consistency Estimate for Criterion Referenced Tests", with Greg Strasler, Proc National Council on Measurement in Education Annual Meeting (Apr 77)

EXPERIENCE IN SPECIFIC AREAS

Computer Skills

	CURRENTLY USE	PREVIOUSLY USED	COURSE WORK
PROGRAMMING LANGUAGES	C C++ Visual C++ Basic HTML	FORTRAN PASCAL PDP Assembler Simscript II.5 JCL SAS Lisp	Ada IDEF0
DATABASE MANAGEMENT SYSTEMS		dBase PC-File Oracle Condor	
GRAPHICS LANGUAGE/ PACKAGE	PowerPoint	Harvard Correl	
OFFICE AUTOMATION PACKAGES	Microsoft Office Professional Suite	WordPerfect 5.1 Lotus 123	
OPERATING SYSTEMS	UNIX DOS Microsoft Windows	VAX / VMS IBM / 370	

SKILLS SUMMARY

Programming Languages

- ***C/C++/Visual C++***

  - Developed and conducted two basic High Level Architecture distributed simulation demonstrators

    - One demonstration was of two countries building up weapons stockpiles. The country with the larger stockpile would attack the country with the smaller stockpile when the smaller stockpile grew to within a given range of the larger stockpile. The software simulating each country ran on its own computer.
    - The other demonstration was of a wing operations center. The wing's console was driven by information provided by its various airbases. Each airbase model was initialized by its own database and ran on its own computer.
    - Both demonstrations were tolerant of individual participant computers crashing and being restarted. They also employed a combination of DOS and Windows consoles.
  - Developed automated process for directly translating a High Level Architecture simulation object model into the .fed file required by the HLA Run Time Interface. This success was expanded by his brief white paper that proposed the development of an automated process that would directly translate the simulation object model into the overhead computer code required by the RTI.
  - Instrumented missile trajectory prediction computer code for the collection of statistics on projections of time and location of impact. This instrumented software was made available to organizations conducting tests using models of friendly and enemy operational missiles.
  - Developed simulation that leveraged research from academia and demonstrated the feasibility of making real-time predictions of numeric sequences without prior knowledge of the changing control law, using the entire expanding data stream, and without knowing when the control law changed. This simulation led to two visiting faculty summer research sessions in missile trajectory prediction.
  - Developed algorithms and heuristics that are easily deployed on parallel processing architectures. These systems require little or no software modification when changes in the threat database occur. Reduced cost of upgrades to major electronic warfare systems ten fold. The time required to identify uncooperative radar threats was decreased an order of magnitude.
  - Co-Invented Stretch & Hammer Neural Network, a method for n-dimensional surface interpolation without regular grid. Published this work in two extensive technical reports.
  - Translated from one version of language to another so code could be used on high performance computer. Enabled MS student to complete thesis in neural network applications on time.

- ***Pascal***

  - Developed expert systems approach to the management of on-board and off-board information for situation awareness and decision aiding. This work continued his long-standing research into adaptable automation wherein the software does not

change, just the database of domain knowledge. Published a detailed technical report on this subject.
- ♦ Developed computer expert system that enabled previously unachievable automation of the analysis of complex EW test data.

- ***Fortran***

  - ♦ Developed an automated task tracking system for his division that proved so successful that it was adopted as a directorate standard. Accessed data via Oracle DBMS.
  - ♦ Developed software that translated chip-level circuit specifications into specifications required by gate-level simulator. (MS Thesis)
  - ♦ Developed software that accepted frequency specifications and produced component specifications for active analog filter design. Addressed major filter types: low pass, high pass, and band pass. (Senior BS project)

- ***Simscript II.5***

  - ♦ Developed an automated means of directly translating a computer system's log into a workload simulation model. This led directly to analyst workload reduction that enabled him to work on an addition project.

- ***Basic***

  - ♦ Developed automated workload allocation heuristic for cockpit applications. Heuristic based on situation attributes affecting pilot trust and projected pilot willingness to allocate workload to the automation. Transitioned academia's empirical and theoretical research into practical software implementation. Extensive technical report now in press via Mr Raeth's personal cooperative research and development agreement with Wright Laboratory.
  - ♦ Developed automated process for tracking hours billed Vs projects supported for each staff member. Interfaced with official organizational manhour database via Condor DBMS. Used this process to justify manpower requests and allocations.
  - ♦ Established automated and administrative processes that decreased late technical reports 80%. Accessed data via Condor DBMS.
  - ♦ Developed software that automatically edits HTML documents.

- ***HTML***

  - ♦ Building web site that organizes technical information in adaptive automation.
  - ♦ Building web site for the SBIRS-TI program.
  - ♦ Developed software that automatically edits HTML documents.

Database Management Systems

- ***Oracle***

  - ♦ Developed an automated task tracking system for his division that proved so successful that it was adopted as a directorate standard. Accessed data via Oracle DBMS.

- ***Condor***

  - Developed automated process for tracking hours billed Vs projects supported for each staff member. Interfaced with official organizational manhour database via Condor DBMS. Used this process to justify manpower requests and allocations.
  - Established automated and administrative processes that decreased late technical reports 80%. Accessed data via Condor DBMS.

- ***dBase***

  - Developed database that enabled easy access to an industry survey conducted nationwide.

Graphics Language/Package

- ***PowerPoint and Correl***

  - Builds briefings as a normal part of communicating technology recommendations impacts on all projects.
  - Organizes access to external data sources by building sites on the worldwide web.

Office Automation Packages

- ***Microsoft Office Suite***

  - Uses office automation tools like as naturally as one would use a pencil. Begins planning project documentation right from the beginning.

- ***Lotus 123***

  - Developed automated means of organizing and reporting collection data during Wing fund raising drive. Made extensive use of data input, graphics, tables, and recalculation capabilities. Significantly reduced workload since package developed reports for all organization levels.

Operating Systems

- ***Unix/VMS/DOS/MS Windows/IBM 370***

  - Has user-level experience with systems employing these operating systems.
  - Has developed elementary MS Windows consoles.

Technologies/Disciplines

- ***AI/Neural Networks***

  - Developed simulation that leveraged research from academia and demonstrated the feasibility of making real-time predictions of numeric sequences without prior knowledge of the changing control law, using the entire expanding data stream, and without knowing when the control law changed. This simulation led to two visiting faculty summer research sessions in missile trajectory prediction.

- ♦ Developed algorithms and heuristics that are easily deployed on parallel processing architectures. These systems require little or no software modification when changes in the threat database occur. Reduced cost of upgrades to major electronic warfare systems ten fold. The time required to identify uncooperative radar threats was decreased an order of magnitude.
- ♦ Co-Invented Stretch & Hammer Neural Network, a method for n-dimensional surface interpolation without regular grid. Published this work in two extensive technical reports.
- ♦ Translated from one version of language to another so code could be used on high performance computer. Enabled MS student to complete thesis in neural network applications on time.
- ♦ Developed expert systems approach to the management of on-board and off-board information for situation awareness and decision aiding. This work continued his long-standing research into adaptable automation wherein the software does not change, just the database of domain knowledge. Published a detailed technical report on this subject.
- ♦ Developed computer expert system that enabled previously unachievable automation of the analysis of complex EW test data.
- ♦ Led a considerable number of projects in this area. See "Program Management Below"

- ***LAN Design/Implementation***

  - ♦ Implemented the High Level Architecture Run-Time Infrastructure for PC-NT computers. The RTI is a software backbone that enables a common LAN of PCs or Unix machines to play in an HLA distributed simulation.
  - ♦ Enabled the company to add processing horsepower to its individual simulations without additional capital expenditure for hardware. By employing the Parallel Virtual Machines (PVM) software backbone, Unix, PC-95, and PC-NT computers on a common LAN can be made to look like a single multi-processor computer.
  - ♦ Developed plan for locating the computer terminals and phone sets for the new LAN and digital telephone network, a $200 thousand installation project.
  - ♦ Wrote analysis of proposed approaches to LAN design. Identified a flaw in the proposal that would have prevented the proposed system from meeting the customer's needs. This report was so highly regarded by Naval Sea Systems Command that they funded an additional 18 manmonth effort.

- ***Man-Machine Interaction***

  - ♦ Conducted workshops in cockpit decision aid technology that were attended by people from five countries, four government agencies, and three universities.
  - ♦ Co-authored the script and led the production of a premier video documentary of division mission, facilities, and cockpit research. This documentary is being distributed all over the US and to allied nations.
  - ♦ Developed automated workload allocation heuristic for cockpit applications. Heuristic based on situation attributes affecting pilot trust and projected pilot willingness to allocate workload to the automation. Transitioned academia's empirical and theoretical research into practical software implementation. Extensive technical

report now in press via Mr Raeth's personal cooperative research and development agreement with Wright Laboratory.
- ♦ Led a considerable number of projects in this area. See "Program Management Below"

- ***Program Management***

  - ♦ Initiated $16 million uninhabited combat aerial vehicle program. This program united Wright Laboratory and industry in the Air Force's first program to develop mission-flexible operator-vehicle interfaces for unmanned aerial vehicles performing lethal missions.
  - ♦ Guided development of air-to-air missile targeting and missile escape decision aid technology. This program received very favorable attention from the Air Force Science Advisory Board and the F-22 program office. This program joined two government organizations with three civilian companies and successfully demonstrated technology that provides increased pilot situation perception and reduced workload, and acts as a force multiplier. Simulations demonstrated 14% higher kill rates for friendly forces when they are outnumbered even 4-to-1. Also leveraged results from the $70 million Army Rotorcraft Pilots Associate and $50 million Air Force Pilots Associate programs.
  - ♦ Directed organization developing decision aids to be added to Defense Mapping Agency digital landing charts. Simulations demonstrated altitude deviations were reduced 45%, airspeed deviations reduced 25%, and workload reduced 70%.
  - ♦ Worked with outside funding sources to directly respond to operational commands' needs, thereby doubling his budget. Also worked with industry and academia to provide work-study, visiting faculty, technology sharing, and facilities sharing opportunities to effectively increase manpower 78%. These increases were achieved in spite of a 30% reduction in allocated manpower and funding.
  - ♦ People in his organization were consistently winning awards. In one 12-month period they won 7 awards.
  - ♦ Directed Wright Laboratory, Armstrong Laboratory, and NASA team developing cockpit voice control. Simulations demonstrated 97% accuracy in 115dB noise and 3G maneuver forces environments, 40% workload reduction, and 60% increase in pilot head-up time. This program culminated in the Air Force's first-ever voice control flight test for transports and the establishment of a much sought after database of high-noise voice data collected in-flight.
  - ♦ Directed team developing improved target designation capability. Provided technology that cut target designation time in half.
  - ♦ Led team in T-38 display modernization program to reduce transition training cost 20%.
  - ♦ Transitioned $50 million Air Force Pilots Associate program to civilian transports via cooperative research and development agreement with major aircraft manufacturer. Transition of enhanced route management and cruise/climb systems shown to save 120 pounds fuel per flight hour and 200% reduction in route replanning time.
  - ♦ Worked with academia to develop hardware approaches that mirror the algorithms and heuristics used in decision aids and employ processing components already on the aircraft. This helped to establish advanced decision aids as a transitionable technology.
  - ♦ Worked with academia to develop a missile trajectory prediction heuristic. This technology seeks to identify the missile's target and to give the pilot sufficient

warning of a pending missile impact. While this research is in its early stages, initial simulations show a 1 second error in prediction of time of impact. The research continued beyond that point and is being documented in a technical report under Mr Raeth's cooperative research and development agreement with Wright Laboratory.

- ♦ Worked with academia to develop hypermedia opportunities for the exposition of technical topics and the transition of technology. Sponsored two graduate students who published theses that laid a base-line of requirements via extensive interviews and literature searches.
- ♦ Developed an IR&D project review process that saved the Air Force 900 travel days in its first year over the previous process.
- ♦ Led research activities to improve the ALR-56M radar threat alert system. In three years went from basic research to writing a technology transition plan. Developed test facility that included the ALR-56M, bread-boards of the new hardware/software suite, and real-time simulation comparison capability.
- ♦ Used imaginative, yet legal, procurement methods to accelerate program 1.5 years in first six months. By combining this with the use of flight test discipline during research phase assessments, he shaved two years off the normal time required to get new technology into operational aircraft.
- ♦ Guided a team developing in-house simulators to generate mission oriented scenarios. This effort saved $350 thousand in limited R&D funds and was critical to the testing of adaptive automation systems intended for insertion into radar threat alert systems on board combat aircraft.
- ♦ Increased by 35% the number of flight test programs supported by his organization.
- ♦ Completely revamped the time-billing philosophy of his industrially funded branch. Overhead billings reduced 75%.
- ♦ Developed automated process for tracking hours billed Vs projects supported for each staff member. Interfaced with official organizational manhour database. Used this process to justify manpower requests and allocations.
- ♦ Established automated and administrative processes that decreased late technical reports 80%.
- ♦ Developed automated means of organizing and reporting collection data during Wing fund raising drive. Made extensive use of spreadsheet data input, graphics, tables, and recalculation capabilities. Significantly reduced workload since package produced reports for all organization levels.
- ♦ Developed an automated task tracking system for his division that proved so successful that it was adopted as a directorate standard.
- ♦ Consummated an agreement with the General Services Administration that cut procurement time for contractor support 50%.
- ♦ Assisted in the development of the five year budget for the $54 million Air Force Systems Command Info 90 program. Represented this program to the Command's Program Review Council for the FY84 POM.
- ♦ Introduced the use of automated statement of work generation tools to the division.

- ***Simulation/Modeling – Distributed Simulation / Distributed Processing***

  - ♦ Prepared a formal High Level Architecture (HLA) object model of the company's Integrated Unit Simulation System (IUSS), a very large simulation of the individual soldier and small-unit combat. This task was completed one month ahead of schedule.

- ♦ Implemented the HLA Run-Time Infrastructure (RTI) for PC-NT computers. The RTI is a software backbone that enables a common LAN of PCs or Unix machines to play in an HLA distributed simulation.
- ♦ Developed and conducted two basic HLA demonstrations
  - ▪ One demonstration was of two countries building up weapons stockpiles. The country with the larger stockpile would attack the country with the smaller stockpile when the smaller stockpile grew to within a given range of the larger stockpile. The software simulating each country ran on its own computer.
  - ▪ The other demonstration was of a wing operations center. The wing's console was driven by information provided by its various airbases. Each airbase model was initialized by its own database and ran on its own computer.
  - ▪ Both demonstrations were tolerant of individual participant computers crashing and being restarted. They also employed a combination of DOS and Windows consoles.
- ♦ Developed automated process for directly translating the simulation object model into the .fed file required by the RTI. This success was expanded by his brief white paper that proposed the development of an automated process that would directly translate the simulation object model into the overhead computer code required by the RTI.
- ♦ Enabled the company to add processing horsepower to its individual simulations without additional capital expenditure for hardware. By employing the Parallel Virtual Machines (PVM) software backbone, Unix, PC-95, and PC-NT computers on a common LAN can be made to look like a single multi-processor computer.
- ♦ Guided a team developing in-house simulators to generate mission oriented scenarios. This effort saved $350 thousand in limited R&D funds and was critical to the testing of adaptive automation systems intended for insertion into radar threat alert systems on board combat aircraft.
- ♦ Also see "Software Test" below.

- ***Software Test***

  - ♦ Blackbox Software Testing

    - ▪ Developed and applied formal blackbox testing methods on a large ground combat simulation that had never been through any kind of formal software testing. This type of testing examines a software product through the user interface. Whitebox testing works at the code level.
    - ▪ Developed the testing process from scratch to include test planning in the following areas: policy, installation, documentation, new functionality, limited system test, and full system test. These documented plans were given their first trial during actual beta testing for a major release. An iterative process served to ensure their continual improvement. The result was a test process that ensured formality without being overly restrictive or expensive.
    - ▪ Prepared a short briefing and bibliography to inform the programming team on the test development process.
    - ▪ A final benefit of this task was the development of a project set that served as a baseline for regression testing.

- ***STINFO***

  - ♦ Developed smooth process for the release of classified and unclassified information to industry in support of their Industry Research and Development (IR&D) projects. This was a significant result involving industry, government field organizations, headquarters, and intelligence communities. Co-authored Commander's Policy in IR&D (AFMCR 550-17) and Air Force regulations governing release of intelligence (AFR 205-2). Presented these results at a national gathering of information release experts.
  - ♦ Successfully defended the proprietary nature of industry research results. A Freedom of Information Act (FOIA) request demanded release of proprietary contractor data. This demand was initially supported by the Air Force legal and FOIA communities. Mr Raeth researched the Federal Acquisition Regulations and documented countering citations. He also formed a team of industry and government lawyers to support his insistence that the information was not releasable. Had he not acted, a legal precedent would have been set, industry would have no longer released proprietary research results to DoD, and the opportunity to leverage those results would have been lost. This would have caused a significant interruption of communication between DoD and industry.

- ***System Analysis***

  - ♦ Developed expert systems approach to the management of on-board and off-board information for situation awareness and decision aiding. This work continued his long-standing research into adaptable automation wherein the software does not change, just the database of domain knowledge. Published a detailed technical report on this subject.
  - ♦ Worked with academia to develop hardware approaches that mirror the algorithms and heuristics used in decision aids and employ processing components already on the aircraft. This helped to establish advanced decision aids as a transitionable technology.
  - ♦ Led research activities to improve the ALR-56M radar threat alert system. In three years went from basic research to writing a technology transition plan. Developed test facility that included the ALR-56M, bread-boards of the new hardware/software suite, and real-time simulation comparison capability.
  - ♦ Developed algorithms and heuristics that are easily deployed on parallel processing architectures. These systems require little or no software modification when changes in the threat database occur. Reduced cost of upgrades to major electronic warfare systems ten fold. The time required to identify uncooperative radar threats was decreased an order of magnitude.
  - ♦ Led team that salvaged two-thirds of data from three flight test missions when the data was originally thought to be without value. This kept those missions from having to be reflown.
  - ♦ Developed systems requirements and procurement methods that led to a 74% cost reduction in storage media and a $220 thousand savings in computer hardware. An additional benefit was a savings of one manweek and one cpuweek per test program.
  - ♦ Planned and managed the construction a classified computer processing facility for the analysis of EW test data. Final cost was $20 thousand below the original construction and installation estimate.

- ♦ Developed computer expert system that enabled previously unachievable automation of the analysis of complex EW test data.
- ♦ Wrote an analysis of proposed approaches to the design of LANs. Identified a flaw in the proposal that would have prevented the proposed system from meeting the customer's needs. This report was so highly regarded by Naval Sea Systems Command that they funded an additional 18 manmonth effort.

- ***Training***

  - ♦ Led team in T-38 display modernization program to reduce transition training cost 20%.
  - ♦ Developed an Information Resources Management training program for the division's staff that optimized impact while minimizing cost. This program filled several shortfalls that were holding back progress.
  - ♦ Initiated and co-authored an officer performance report writer's guide that eventually became the Command standard embodied in AFSCP 36-2, "OERs: A Guide for Rating Officials".
  - ♦ Taught quarter-length lab course in IBM-PC disk operating system for Okaloosa-Walton Junior College, Crestview Florida.

Areas of Application

- ***Avionics***

  - ♦ See achievements while serving with Wright Laboratory, Flight Dynamics Directorate listed above.

- ***Electronic Warfare***

  - ♦ See achievements while serving with Wright Laboratory, Avionics Directorate listed above.
  - ♦ See achievements while serving with 3246th Test Wing listed above.

- ***Test and Evaluation***

  - ♦ See achievements while serving with 3246th Test Wing listed above.
  - ♦ See "Software Test" category above.

Products Delivered

- ***Prototype Software***

  - ♦ See "Programming Languages" category above.

- ***Study/Analysis Reports***

  - ♦ Besides the documents listed, 3 classified items were published in 1991 and 5 classified items were published in 1990. These were on advanced computing methods for electronic warfare. In addition, most of the projects Mr Raeth led resulted in either technical reports published in DTIC/NTIS or the research literature.

“The LeM^2*R^3 Model of Pilot Trust and Dynamic Workload Allocation”, with John Reising, Wright Laboratory technical report to be published in DTIC/NTIS (Feb 98)

“The Human Electronic Crew – Can We Trust the Team”, with numerous co-authors, Technical Report, Wright Laboratory (Selected in top 10 reports for that year) published in DTIC/NTIS (Jul 96)

"An Application of Exponential Neural Networks to Event-Train Recognition", with Steve Gustafson and Gordon Little, Cameron Station, VA: National Technical Information Service, Report # WL-TR-92-1060 (May 92)

"Stretch and Hammer Neural Networks for N-Dimensional Data Generalization" with Steve Gustafson and Gordon Little, Cameron Station, VA: National Technical Information Service, Report # WL-TR-91-1146 (Jan 92)

"Event-Train Restoration Via Backpropagation Neural Networks" Defense Technical Information Center & National Technical Information Service, Document # AD-A216-308 (Dec 89)

- ***Training Course***

  ♦ Taught quarter-length lab course in IBM-PC disk operating system for Okaloosa-Walton Junior College, Crestview Florida.

Special Certifications

♦ See “Certifications” category above.