
PURDUE UNIVERSITY
SCHOOL OF AERONAUTICS AND ASTRONAUTICS

Final Technical Report:
1997 NASA Academy in Aeronautics

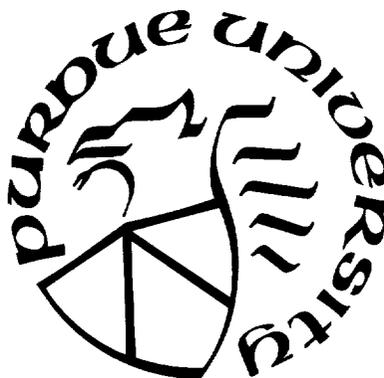
By
Dominick Andrisani, II

Professor, School of Aeronautics and Astronautics
Director, Indiana Space Grant Consortium
Purdue University
West Lafayette, IN 47907-1282

Submitted to
NASA Dryden Flight Research Center
PO Box 273
Edwards, CA 93523-0273

As a Final Report for
NASA Grant/Cooperative Agreement No. NAG4-114
Technical Officer: Eugene L. Duke

June, 1998



1282 Grissom Hall
West Lafayette, Indiana 47907-1282

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Background and Summary



The NASA Academy in Aeronautics at the Dryden Flight Research Center (DFRC) was a ten-week summer leadership training program conducted for the first time in the summer of 1997. Funding was provided by a contract between DFRC and Purdue University. Mr. Lee Duke of DFRC was the contract monitor, and Professor Dominick Andrisani was the principal investigator. Five student research associates participated in the program. Biographies of the research associates are given in Appendix 1. Dominick Andrisani served as Dean of the NASA Academy in Aeronautics.

NASA Academy in Aeronautics is a unique summer institute of higher learning that endeavors to provide insight into all of the elements that make NASA aeronautical research possible. At the same time the Academy assigns the research associate to be mentored by one of NASA's best researchers so that they can contribute towards an active flight research program. Aeronautical research and development are an investment in the future, and NASA Academy is an investment in aeronautical leaders of the future.

The Academy was run by the Indiana Space Grant Consortium at Purdue in strategic partnership with the National Space Grant College and Fellowship Program. Research associates at the Academy were selected with help from the Space Grant Consortium that sponsored the research associate. Research associate stipend and travel to DFRC were paid by the students' Space Grant Consortium. All other student expenses were paid by the Academy.

Since the Academy at DFRC had only five students the opportunity for individual growth and attention was unique in the country. About 30% of the working time and most of the social time of the students were spent as a "group" or "team." This time was devoted to exchange of ideas, on forays into the highest levels of decision making, and in executing aeronautical research. This was done by interviewing leaders throughout the aerospace industry, seminars, working dinners, and informal discussions. The other 70% of the working time was spent working on the technical research project with the engineering mentors. Abstracts of those projects are given in Appendix 4.

We tried to spark the leadership qualities of the research associates by giving them challenging assignments and a full agenda. While we encouraged them to stay together as much as possible, we did not want them to feel trapped. All students were housed together in Lancaster, California, about 30 miles from NASA Dryden. To cover living expenses students were paid a per diem (\$24/day) for each day of the Academy. One three bedroom apartment with two baths for five research associates and local transportation were also provided.

The highlights of the 1997 program included trips to NASA Headquarters, the U.S. Congress, Goddard Space Flight Center, National Air and Space Museum, Planetfest in Pasadena, the Jet Propulsion Laboratory, Ames Research Center, Stanford University, Lockheed-Martin Skunkworks, USAF Test Pilot School, National Test Pilot School, Scaled Composites, Inc., the FAA High Desert TRACON, and AeroVironment, Inc.

Students had a chance to meet with leaders from throughout the aerospace industry including NASA Administrators Dan Goldin, Bob Whitehead, Spence Armstrong, and Wil Trafton. Students from the Dryden Academy interacted with NASA Academy students at the Goddard and Ames Academies and participated in a video conference with the Marshall Academy as well.

As shown in Table 1 the Academy was started in 1993 by Dr. Gerry Soffen at the Goddard Space Flight Center (GSFC). In 1994 Marshall Space Flight Center (MSFC) started an Academy and in 1997 Ames Research Center (ARC) and Dryden Flight Research Center (DFRC) started as well.

NASA Center	Specialization	1993	1994	1995	1996	1997	Total
GSFC	Earth & Space Science	19	24	23	24	23	113
MSFC	Transport, Microgravity		14	14	14	10	52
ARC	Astrobiology					11	11
DFRC	Aeronautics					5	5
Total Alumni							181

Research Associate Selection Process



Selection criteria for students to attend the Academy included demonstrated enthusiasm and interest in space, leadership potential, interest in specific research projects, and overall academic quality (honors, awards, GPA, etc.). To be eligible to apply the student must as of May 1997

- have been a junior, senior, or first year graduate student,
- have been maintaining a B average while majoring in engineering, math, computers or other areas of interest to the aerospace program,
- and be a US citizen or permanent resident.

Underrepresented minority and female students were encouraged to apply.

Student participants (research associates) were selected through a two-step process. Students applied for the program through the Space Grant Consortium in their state. Each state Consortium performed a rank ordering and only nominated only those students they were willing and able to fund. The Consortia paid the student a stipend (typically \$3000-\$4000) and travel to DFRC. Final selection of students to the Academy was made by a committee headed by Lee Duke and consisting of the five research mentors, Al Bowers, Joe Pahle, Marty Brenner, Tony Whitmore, and Kajal Gupta. Recommendations from the Dean were also considered. This process ensured a good "match" between the research associate and mentor. This match is shown in Table 2.

Research Associate	Mentor	Project Title
Jessica Gonzalez	Kajal Gupta	Structural Computational Fluid Dynamics Modeling
Joseph Mueller	Joe Pahle	Validating Linear Models of the F-18 High Alpha Research Vehicle
Heath Roettig	Tony Whitmore	Grid Verification for Modeling of Formation Flying of the Pathfinder Aircraft using CFD 2000
Kyle Snyder	Marty Brenner	Limit Cycle Behaviors of a Nonlinear Structure by Wavelet Transforms
Laura Thackray	Al Bowers	Aerodynamic Performance of the Apex Aircraft Wing with Structural Deflections

Activities for the 1997 NASA Academy



Seventy percent of research associate working time was spent on research under the direction of the research mentors listed above. The remainder of research associate time was spent on activities summarized below. The purpose of these activities was expose the research associates to all of the elements that make NASA aeronautical research possible, including activities in the government sector, industry, and academia.

A calendar of events for the 1997 NASA Academy in Aeronautics is given in Appendix 3. These activities are summarized below.

Government Related Activities

Meetings or briefings by NASA Managers and Scientists:

Dan Goldin, NASA Administrator, at NASA Headquarters and at Planetfest'97,
General Spence "Sam" Armstrong, Associate Administrator for Human Resources and Education at NASA Headquarters,
Wil Trafton, Associate Administrator for Spaceflight at NASA Headquarters,
Bob Whitehead, Associate Administrator for Aeronautics and Space Transportation Technology,
Ken Szalai, Director of Dryden Flight Research Center,
Ed Stone, Director of Jet Propulsion Laboratory, at Planetfest'97,
Donna Shirley, Manager Mars Exploration Program, JPL, at Planetfest'97,
William O'Neil, Program Manager of Project Galileo at JPL,
Dave Morrison, Director of Space Astrobiology, Ames Research Center,
Mike Dudley of Ames, "High Speed Civil Transport,"
Doug O'Handley, Special Assistant to the Center for Mars Exploration and Director of the Ames Astrobiology Academy, "Space Exploration Initiative,"
Everette Gibson and David McKay, JPL, "Mars Meteorite with Signs of Life, Latest Status of the Investigation,"
Gerry Soffen, NASA HQ, founder of the NASA Academy,
Story Musgrave, NASA Astronaut, at Planetfest'97,
Buzz Aldrin, former NASA Astronaut (Apollo 11), at Planetfest'97,
Sam Thurman, JPL guidance team for Mars Pathfinder.

Meetings with DFRC Branch Chiefs:

Vicki Regenie, Flight Systems Branch, (6/5/97),
Pat Stoliker, Dynamics and Control Branch (6/9/97),

Mike Kehoe, Aerostructures Branch(6/10/97),
Bob Curry, Aerodynamics (6/17),
Ron Young, Flight Instrumentation Branch (7/9),
Ron Ray (for Bill Bircham), Propulsion Branch (7/15).

Other DFRC Talks:

Ken Iliff,
Bill Dana, at lunch,
Gordon Fullerton,
Al Bowers, "The Flying Wing,"
Dil Hunley, Dryden historian.

Dinner Dialog Guests (for dinners arranged by the research associates and generally held at the apartment of the research associates):

Duane Deets, (Chief of Aerospace Projects Directorate),
Rogers (chief test pilot) and Judy Smith,
Ken Szalai (Center Director),
Kevin (Deputy Director) and Linda Peterson,
Jeff Bauer (project engineer on the Pathfinder aircraft),
Dr. Peter Diamandis (President, The X-Prize).

DFRC Events:

NASA Family Picnic (6/14/97),
F-18 SRA flight operations from control room (7/2/97),
Thermostructures Facility, at DFRC,
SR-71 suit-up, takeoff and control room,
DFRC Engineering Simulator Tour,
SR-71 Simulator Tour.

Other NASA Sites Visited:

Goddard Space Flight Center (6/26/97),
NASA Headquarters (6/27/97),
Jet Propulsion Laboratory (7/2/97, 8/1/97),
Ames Research Center (7/18/97).

Other NASA Facilities Toured:

Space Station Mockup, at Ames,
Refurbished 12 foot Wind Tunnel, at Ames,
Kuiper Airborne Observatory, at Ames,
Ames Aerospace Encounter, at Ames.

Other Government Sites Visited:

U.S. Senate Office Buildings in Washington D.C.,
U.S. Capitol,
FAA TRACON at EAFB (7/10/97),
Library of Congress in Washington.

Industry Related Activities

Meet with Industry Leaders:

Burt Rutan, Scaled Composites,
Shawn Roberts, National Test Pilot's School,
Paul MacCready, AeroVironment, Inc.

Meet with Professional Leaders:

Bruce Murray, President The Planetary Society, at Planetfest'97,
Louis Friedman, Executive Director, The Planetary Society, at Planetfest'97.

Other Distinguished Speakers or Contacts:

Ann Druyan, Co-producer of the movie Contact, wife of Carl Sagan,
Dr. Robert Zubrin, Pioneer Astronautics, Mars Direct Mission,
Dr. Toshiaki Takemae, The Institute of Space and Astronautical Science,
Japan, leader of water rocket workshops at Planetfest'97.

Private Companies Visited:

Scaled Composites, Inc., Mojave,
National Test Pilot School, Mojave,
AeroVironment, Inc., Simi Valley (7/30),
Lockheed-Martin Skunkworks, Palmdale, X-33.

Aerospace Museums Visited:

National Air and Space Museum in Washington, DC,
Planes of Fame in Chino, CA.

University Related Activities

Meet with Academic Leaders:

Professor Ilan Kroo, Stanford U., Flight Research Laboratory,
Professor Per Enge, Stanford U., Wide Area GPS Laboratory,
Professor Steve Rock, Stanford U., Robotics Laboratory,
Professor Robert Twiggs, Stanford U. Space Systems Dev. Lab,
Professor Marchello Napolitano, U. of W. Virginia, neural networks.

General Public Related Activities

Volunteered at Planetfest in the "Childs Universe", built 300 water rockets and supervised 1000 launches,
Attended public meeting at Lancaster High School concerning the Environmental Impact Statement on the development and flight testing of the X-33, (7/21).

Overall Budget for the 1997 NASA Academy in Aeronautics



	Amount
A. Salary for Dean	
(before June 1, after Aug 9)	\$5,715
B. Fringe	\$1,876
C. Total Compensation and fringe (A+B)	\$7,591
D Non-personal direct costs	
Housing including utilities, furnished	
3-bedroom apartment for RAs	\$4,290
Per Diem for Five RAs (@\$24/day)	\$8,400
Final Dinner Meeting	\$144
Travel	
Trips (6 to D.C. @750)	\$4,500
Rental car at D.C.	\$200
Rental Mini-Van (Hertz)	\$3,369
Gasoline	\$629
Trip (Dean to NASA DFRC, October '97)	\$1,000
Other S&E	\$621
TOTAL NON-PERSONAL DIRECT COSTS (D)	\$23,153
E Total Direct cost (C+D)	\$30,744
F. Indirect cost .39 of MTD	\$11,990
G. Total Cost (E+F)	\$42,734

Concluding Remarks



An extraordinary educational experience was completed on time, at cost, and without distracting incident.

The educational model used by the Academy was highly successful. Motivated students were exposed to, taught by, given a chance to observe, given a chance to interact in formal and informal settings with expert practitioners of aerospace engineering. Suitably interested students given access to great minds learn profucious amounts at a tremendous rate. The learning process is not so much by lecture as it is by example, by case study, almost as if by osmosis. The process is amazing to watch and rewarding to make happen.

Showing students how and where things are done in the "real world" is a tremendous educational benefit. It is motivational.

The five research associates and Professor Andrisani had a once-in-a-lifetime experience. The five research associates bonded into a tight lifetime group of friends.

NASA was presented with all its "warts" and the research associates loved it and came to understand the workings of the aerospace industry.

There is a high likelihood that these five research associates will end up working in the aerospace industry (see Appendix 5: So Where are They Now?). NASA should endeavor the hire these students since NASA's investment in them is considerable.

Close friendships were formed with research associates at the Ames Astrobiology Academy and the NASA Academy at Goddard Space Flight Center. By endeavoring to interact with the other Academies, the research associates came to view the four distinct Academies as part of one larger whole. Their view of NASA was expanded by this as well as their personal network of colleagues. All of this will make them stronger leaders in the future.

**The NASA Academy is a rare and precious jewel as an educational program in this country. For this program NASA made available
sufficient access to key people and places,
sufficient financial resources,
sufficiently few students,
and sufficient time
to educate students in the highly effective way used by the NASA Academy.**

Appendix 1: Biographies of Research Associates



————— Jessica Gonzalez —————

University of Puerto Rico, Mayaguez Campus

Faculty: Engineering
Major: Chemical Engineering
Graduation Date: May/97

NASA Academy Research Project: Structural Computational Fluid Dynamics Modeling

Mentor: Dr. Kajal Gupta

Address: c/9 T-10 Santa Juana 3
Caguas, P.R. 00725

e-mail: "Jessica Gonzalez Santana" <lsantana@ameritech.net>

Work Experience:

08-94	05-97	Tutor: Chemistry, Pre-Calculus, and Physics Tutoring Program University of Puerto Rico, Mayaguez Campus
01-96	05-97	Research Assistant: Determination and Identification of Gibberellins in Coffee Seeds PI: Dr. Doris Ramirez; Ph.D. Biochemistry
01-97	05-97	Research Assistant: Electrolytic al Removal of Nitrate from CELSS crops PI: Dr. Guillermo Colon; Ph.D. Chemical Engineering
08-96	12-96	Teacher Assistant: General Biochemistry course Professor: Dr. Doris Ramirez; Ph., Biochemistry

Honors and Awards:

Chemical Engineering Representative of the National Engineering Honor Society (TbP); Member of the American Institute of Chemical Engineers (AIChE); Member of the Institute of Chemical Engineers of Puerto Rico (IIQPR); NACME Scholarship; Dean's List; Member of the Delta Phi Eta Sorority.

Activities and Interests:

These are reading, writing, singing, acting, dancing, and aerobics.

Joe Mueller

University of Minnesota, Minneapolis, Minnesota
Major: Aerospace Engineering and Mechanics

NASA Academy Research Project: Validating Linear Models of the F-18 High Alpha Research Vehicle, Mentor: Joe Pahle

School Address:

Apt. 119 Dinnaken House
Minneapolis, MN 55455
e-mail: "Joseph B. Mueller" <muel0053@tc.umn.edu>

Home Address:

2536 Peace Drive
Duluth, MN 55811

Leadership Experience:

New Student Weekend Counselor: Participated in 10 weeks of leadership enhancement which encompassed diversity training, conflict management, effective communication skills, and group dynamics understanding; this training was put to work at an introductory weekend for college freshmen. (April -- September, 1995 & 1996)

New Student Weekend Co-Chair: Attended a 20 week program for advanced leadership training, learning the tools necessary to facilitate and train a group of 20 NSW Counselors over a 10 week period. (December 1996 -- Present)

Community Advisor, Frontier Hall: Planned programs, conducted meetings, and advised the house government for a community of 40 residents. In addition to maintaining security and running the front desk, my responsibilities included creating and ensuring a healthy community for each and every resident. (September 1996 -- June 1997)

Honors and Awards:

1996 Rose Minkin Scholarship, 1994 Army ROTC Scholarship
1994 Presidential Scholarship, 1997 Boeing Scholarship
Member of Tau Beta Pi, National Engineering Honorary Society
Golden Key National Honor Society, Dean's List Six Quarters

Activities & Interests: Basketball, running, hang-gliding, fishing, chess, mystery novels, poetry, everything gothic, physics, stand-up comedy, movie-critiquing, frisbee, quotes, white-water rafting, and tickle-me-elmo.

"If *hopeless romantic* could be found in the dictionary, my picture would surely be there along with it. Throughout my life, I have been a faithful dreamer, with my head in the clouds and my heart on my sleeve. In that sense, I am just a child at heart, clinging to that vivid dream of becoming an astronaut, and smiling in awe as dreams, sometimes, slowly come true. And now, the NASA Academy has brought me face to face with my dream, challenging me to turn fantasy into reality. I have so much to learn, so far to grow, and I am ecstatic to be on my way."

ROSE-HULMAN INSTITUTE OF TECHNOLOGY
Terre Haute, Indiana

MECHANICAL ENGINEERING
Bachelor of Science, May 1998

NASA ACADEMY RESEARCH PROJECT: Grid Verification for Modeling of
Formation Flying of the Pathfinder Aircraft using CFD 2000

Mentor: Tony Whitmore

e-mail: roettih@rose-hulman.edu

Home Address

247 10th Ave. W.
Kalispell, MT 59901
(406) 756-8510

School Address

6710 Wabash Ave. #25
Terre Haute, IN 47803
(812) 877-6736

EXPERIENCE

1995-Present: **Rose-Hulman Institute of Technology**
Terre Haute, Indiana
Mechanical Engineering Department Dynamics Lab Operator.
Instruction in use of specialized computer software.

Fall 1996: **Center for Industrial Statistics**
Terre Haute, Indiana
Project Researcher
Failure analysis of components manufactured by TRW of
Marshall, Illinois.

HONORS AND AWARDS

Steinhauser Award, Tau Beta Pi Honor Society (Vice President), Pi Tau
Sigma Honor Society.

ACTIVITIES AND INTERESTS

Aikido, kendo, flying, tennis, golf, reading, and the space program.

"Ever since I can remember I have dreamed of becoming an astronaut. To this end I decided to study engineering. I attended Flathead Valley Community College in Kalispell, Montana for two years before transferring to Rose-Hulman in 1995. After I complete my undergraduate work I plan to work in industry for a few years before returning to school to obtain my M.S. and Ph.D. in engineering. Once I have completed those I intend to apply to the astronaut program. I believe that in order to accomplish things one must take risks. However the risks must always be weighed against the rewards. I also believe that I can accomplish anything I set out to do, including becoming an astronaut."

Kyle T. Snyder

University of Tennessee Space Institute
Tullahoma, TN
Master of Science in Applied Mathematics, May 1998

NASA Academy Research Project: Limit Cycle Behaviors of a Nonlinear Structure by Wavelet Transforms, Mentor: Marty Brenner, Structural Dynamics

Address:
505 Rickenbacker Dr.
Tullahoma, TN 37388
(615) 393-4652

Education:
Catawba College, Salisbury, NC., B.A. 1996.
Majors in Mathematics and Computer Science. Minor in History.

e-mail: "Kyle T. Snyder" <ksnyder@utsi.edu>

Experience: Graduate Research Assistant at UTSI.

As a member of the Computational Information Processing Group, I helped develop a Wavelet Analysis Package for PCs. The package is designed to be a tool for teachers and instructors that are introducing the modern techniques to students and users not familiar with wavelets. Projects include designing and implementing Graphical User Interfaces, testing and debugging code written in Tcl/Tk (a scripting language for building GUIs and for linking with C), and learning new applications and research done in the field of wavelet analysis.

Also as a member of the CIPG, I am responsible for the group's computer network maintenance and upgrades. This includes installing operating systems, software for the group members, and building a WWW Homepage for the group.

Interests: Wavelet analysis methods in nonlinear systems (the NASA project) and image processing. Chaotic dynamics and fractal dimensions.

Activities: Basketball, volleyball, weight-lifting, reading, SIAM President at UTSI, and student government at UTSI.

"The 1997 NASA Academy at Dryden is not only providing me the opportunity to apply the math skills that I have developed, but is also fulfilling a dream. Working for NASA, living in CA, conducting research on an important projects that interests me, are goals already achieved. Thanks Mom and Dad, there is no telling where I will stop!"

Appendix 2: Abstracts of Research Projects



AERODYNAMIC AND FLIGHT TEST DATA ANALYSIS

Mentor: Al Bowers, Aerodynamics Branch

Comparison of wind tunnel data to flight measured data is the ultimate goal of this research. The Research Associate will work in three areas. The first area is reduction and interpretation of wind tunnel data. Often wind tunnel data comes in a very raw form which is not usable for determination of aerodynamic coefficients or for simulation databases. Research Associates must understand the way the wind tunnel data is gathered and how it is applied to equations of motion. Once these differences are understood, the raw wind tunnel data can be processed to extract the most important characteristics.

The second area is in the processing and analysis flight data. Raw flight data is often unsuited to direct comparison with wind tunnel data, so post flight data processing is required to make the two data sets compatible.

The third area is the collection of the flight data. Careful collection of flight data is a major responsibility, to ensure that accurate measurements are made. Defining the experiment and instrumentation, interaction with the test pilots and test conductors is key to ensuring the flight test maneuvers will be performed in a satisfactory manner and that the resulting data are useful for scientific study.

FLIGHT CONTROL ENGINEERING

Mentor: Joe Pahle, Flight Controls Branch

The Research Associate will serve as a flight controls engineer on a flight program to be determined. A flight controls engineer translates basic requirements for vehicle or experiment trajectory and control (position, attitude, rates, and accelerations) into mathematical models, algorithms and software in order to achieve the scientific objectives of the experiment.

The flight controls engineer is responsible for an evaluation of stability, robustness, handling qualities, and performance in the presence of uncertainty throughout the design process. A flight controls engineer works closely with other engineering discipline groups (e.g., simulation, aerodynamics, propulsion, avionics, systems, structures, instrumentation), pilots, and aircraft crew.

IN-FLIGHT AIRCRAFT AEROELASTIC DYNAMIC MODELING

Mentor: Marty Brenner, Flight Controls Branch

The Research Associate will assist in developing aeroelastic models of aircraft. Aeroelastic models are subject to errors from simplifying assumptions in structural dynamics and aerodynamics. A primary objective of this research is to formulate an accurate aircraft dynamics model based on flight data by characterizing in-flight linear, nonlinear, and time-varying dynamics. Attempts are being made to identify and generate models separating the linear, nonlinear, and uncertain dynamics of an elastic aircraft in a time-varying environment. The ability to identify and generate models describing nonlinear phenomena, such as buzz and limit cycle oscillations, would be profoundly important to the flight test community for stability estimation. This research also addresses a vital concern to the controls community which is almost entirely dependent on mathematical model-based methodologies. Flight-derived models that minimize the uncertainty or maximize confidence are desired for in-flight robust aeroelastic stability evaluation.

Critical tools to achieve these objectives include implementation of on-line algorithms for multi-resolution (time, frequency, scale) decomposition since efficiency in flight testing is a direct function of computational processing time. Three main research areas needed to accomplish this goal focus on adaptive signal processing, characterizing nonlinear dynamics, and in-flight implementation. Wavelet analyses and other modern signal processing algorithms are being researched for implementation to extract the nonlinear from the linear, while minimizing uncertainty. Wavelet-based approaches provide the only known systematic tools for signal processing of time-varying systems. This integrated research effort requires innovative data processing, modeling, and identification.

FLIGHT EVALUATION OF A NEURAL NETWORK-BASED FLUSH AIRDATA SENSING (FADS) SYSTEM

Mentor: Stephen A. Whitmore, Flight Controls Branch

Flush Airdata Sensing (FADS) systems were developed in response to the problems associated with intrusive instrumentation booms. These methods infer the airdata parameters from pressure measurements taken with an array of ports that are flush to the surface of the aircraft, and are thus completely non-intrusive to the external flow. A prototype real time flush airdata sensing (RT-FADS) system has been developed at DFRC. The RT-FADS system included pressure sensors, computational hardware, onboard program data storage, and interface to the aircraft instrumentation system.

The FADS solver algorithms are non-linear, and calibration of the semi-empirical model is difficult, and that process is very labor intensive. Additionally, the solver algorithm was demonstrated to have marginal numerical stability under certain supersonic flight conditions. The FADS airdata estimation problem thus provides an ideal task for the implementation of a neural network identification scheme. A neural network-based FADS system promises to be easier to calibrate and inherently more stable. As an

initial stage in the development of a neural network flush airdata sensing system, a neural network was developed to represent the mapping between the pressure-matrix-input and the airdata-output vector spaces. The solver algorithm was a multi-layered, feed-forward neural network with a modified back propagation training algorithm. The trained network successfully predicted airdata parameters from the FADS pressure inputs for the remaining 3600 frames of the same flight data set. The resulting FADS neural network allows for accurate airdata estimation over the range of flight conditions considered. The results of this investigation demonstrate that neural networks can be applied to flush airdata systems, and in the absence of failures in the sensor measurement streams, can be as robust as the existing semi-empirical model.

The primary difficulty with neural based solver algorithms is that the algorithms have no robustness to measurement failures in the incoming data stream. Of particular interest is the development of neural-based schemes for detection and classification of failed measurement streams.

This project would require the Research Associate to analyze existing FADS data bases to develop reliable methods for classification of appropriate ranges of validity for the measurements. In addition the Research Associate will to develop neural based schemes for detecting failures in real-time and substituting equivalent synthesized readings so that the neural based solver code will remain stable.

MULTIDISCIPLINARY MODELING AND SIMULATION

Mentor: Kajal Gupta

The candidate will be offered the opportunity to work in the area of multidisciplinary modeling and simulation of flight vehicles. This involves such disciplines as CFD, computational chemistry, propulsion, structures and controls engineering among others and the student will learn use of the NASA multidisciplinary analysis program STARS (SStructures, Aerodynamics & Related Systems).

STARS CFD analysis is based on the finite element discretization which has proved to be useful for interaction with other disciplines such as structures. Also CFD analysis of model combustor section involving fuel injection is of importance from propulsion point of view.

The student will also be exposed to current NASA project works such as X-33, F-18 HARV, and Apex projects.



Appendix 3: Calendar of Activities



Appendix 3: Calendar of Activities

June 1997

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1 8:00a Kickoff Meeting over breakfast 10:00p Primes of Fame in Chino	2 8:30a Meeting With Mentors 8:00p Rap Session at Apt	3 1:00p OFRC Tour (Meet at Security office)	4 6:00p Rap Session at Apt	5 2:00p Talk by Vicki Rappene (F. Sys. Br. Cf., Bld 4840, Rm 202 Conf) 6:00p Dinner Dialog Bob Meyer & Maria Bohm-Meyer at Apt. 6:01p Bob is head of Research Engineering Directorate 6:02p Maria is associate head of Flight Ops Directorate	6 Major weekend event	7
8 4:00p Barbeque at Kevin Petersons, 532 W Ave J-13	9 2:00p Pat Stollwer, Dynamics A Control Br. Cf., Bld. 4840, R 202 8:00p Rap Session at Apt	10 9:00a Brian Kish at AFPS, PIO 10:00a AFPS, Dan Gleason 2:00p Mike Kehoe, Aerosturctures, B4620, R207	11 6:00p Rap Session at Apt	12 9:00a NTPS (Roberts) 10:00a Scated Comp (Routen) 6:00p Dinner, Dwan Deets, RAT Ft Res Prog Mgr	13 10:30a NASA Family Picnic, Lancaster City Park, 10th & K-8	14
15 Six Flags Father's Day	16 10:00a Academy Photo at X-1 in front of B4603 8:00p Rap Session at Apt	17 Andisant to Ames for ASEE Tour	18 6:00p Rap Session at Apt	19 2:00p Bob Curry, Aerodynamics, B4600, Code R Conf Rm 2000	20 10:00a Talk by Ken Mill, Code R Conf Room	21 Tour of LA & Hollywood Andisant to Indiana
22	23 6:00p Rap Session at Apt	24	25 RAs To Washington Andisant to Washington	26 6:00a Goddard Tour 1:00p Capital Hill 6:00p Peter Diamonds	27 9:00a Sam Armstrong 10:00a Dan Golden 2:00p Will Trinton 3:30p Bob Whitehead 6:00p Dinner DC	28 DC Tour, Air & Space Museum Baltimore Island Waterway
29 Return to Lancaster	30 6:00p Rap Session at Apt	1 11:00a Public Affairs (Fusion, Madscham) 4:00p Dinner (Subst. Program Burn, Chaps Hall)	2 To Pittsburgh 12:00p STVA, Rpt 1:00p STVA, Rpt	3 To Pittsburgh	4 To Pittsburgh Dinner (Pittsburgh Lunch)	5

July 1997

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
29 Return to Lancaster 6:00p Prescreening of Movie Contact	30 6:00p Rap Session at Apt	1 11:00a Public Affairs (Robin McMeekin) 6:00p Dinner Dialog, Rogers Smith, Chief Pilot	2 To Planetfest 10:00a SRA Flight 1:00p SRA Flight	3 To Planetfest	4 To Planetfest Mare Pathfinder Lands	5 To Planetfest
6 To Planetfest 6:00p Prescreening of Movie Contact	7 6:00p Rap Session at Apt	8 11:00a Lunch w/Bill Dana, meet on patio with food	9 2:00p Ron Young (Flight Instr Br. BK1, 4800, Rm 2206) 6:00p Rap Session at Apt	10 10:30a Tour FAA Tracon (Eric Konecadden) 6:30p Dinner Dialog (Kevin & Linda Peterson)	11 10:00a Al Bowers "The Flying Wings", presentation practice session	12 To San Diego zoo and beach
13	14 6:00p Rap Session at Apt	15 2:00p Bill Burcham (or Ron Ray), Prop., B4800, Code R Conf Rm, Rm 2000	16 6:00p Rap Session at Apt	17 Visit Stamford 1:00p Ham Kroc 2:00p Steve Rock 3:00p Per Edge 4:00p Bob Twigg	18 Visit to Ames	19 Camping at Sunset State Beach with Ames Academy
20 17 Mile Drive, Pebble Beach	21 6:00p Rap Session at Apt	22 9:30a Loads Tour (meet at Public Affairs) 6:00p Dinner with Jeff Bauer	23 6:00p Rap Session at Apt	24	25 6:30a SR-71 Takeoff	26 To LA Beach (volleyball competition)
27	28 6:00p Rap Session at Apt	29	30 Ames Academy to Palmdale 9:00a Tour Aero Monrment (Sint Valley) 6:00p Rap Session at Apt	31 Ames Acad @OFFIC 9:00a Tour (Bill Hurley) 1:30p Sim Tour 2:00p Gordon Fullerton 7:00p Evening activity	1 2:30p Shuttle from 2:30p-3:30p 7:00p Dinner - Monterey Bay	2 2:00p Shuttle from 2:00p-3:00p 7:00p Dinner - Monterey Bay

August 1997

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
27	28	29	30	31	1	2
	8:00p Rap Session at Apt		Ames Academy to Redlands 8:00a Tour Auto Movement (Blair Valley) 8:00p Rap Session at Apt	Ames Academy to Fresno 8:00a Tour (2nd Hunting) 1:30p With Day 8:00p Rap Session at Apt 7:00p Evening activity	8:00a Skunk Works 12:00p JPL tour 7:00p Dinner, Beverly Hills	Disneyland or Universal Studios with Ames Academy
Final Barbecue	9:00a Practice Presentations, Code A Conf 8:00p Rap Session at Apt	8:30a Final Oral Presentations, B4840, R113B	8:00p Rap Session at Apt	Andisant to Ames for final ABEE review	End NASA Academy 4:00p Final written reports due	RAE To LAX 5:00p Return Van
10	11	12	13	14	15	16
Andisant to LAX						
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	1	2	3	4	5	6

Appendix 4: Quotes by Research Associates about the NASA Academy



"Get ready for one of the most intense, eye-opening, intellectually and socially stimulating summers of your life!" --Laura A. Thackray

"NASA, the greatest expression of science to millions of people around the world ... Science, something that so many times seems to go against humankind, but from which humanity and love to each other could be, in large scales, developed." --Jessica Gonzalez

"This is your chance to fly, don't hold your wings in. Push yourself past your limits, and redefine who you are. The Academy places you on the edge of infinite opportunity. Believe in yourself, and you will soar." --Joseph Mueller

"The Academy can open up some tremendous opportunities for you. Be sure to give it your best." --Heath Roettig

"Imagination, determination, and inspiration- keys to success. The NASA Academy develops these, while also growing from such qualities. This is the opportunity to fulfill dreams and expand to new dimensions." --Kyle Snyder

Appendix 5: So Where Are they Now (June 1998)



Jessica Gonzalez was married in October 1997 to Luis Santana and is living in the Chicago area (Prospect Heights) and going to graduate school at Northwestern University. e-mail: "Jessica Gonzalez Santana" <lsantana@ameritech.net>

Joe Mueller is a staffer for the Ames Astrobiology Academy during the summer of 1998 and is continuing his undergraduate studies at the University of Minnesota in aeronautics and astronautics. He expects to finish his B.S. in March of 1999. e-mail: "Joseph B. Mueller" <muel0053@tc.umn.edu>

Heath Roettig has recently graduated from Rose-Hulman and accepted a job at the Allison Engine Company in the performance group for small to medium gas turbines in Indianapolis. He is the proud owner of a 1991 BMW M3 land-rocket. e-mail "Heath Roettig" <roettihr@rose-hulman.edu>

Laura Thackrey is continuing her undergraduate studies at the University of Idaho after moving from North Idaho College. After worrying about heat transfer and machine design, she is looking forward to going to Switzerland during the summer of 1998. e-mail: Laura Thackray <thac5864@uidaho.edu>

Kyle Snyder is the Dean of the 1998 NASA Academy in Aeronautics at DFRC. He recently completed his M.S. degree at the University of Tennessee Space Institute and may accept an offer to join the Lockheed-Martin Company in Marietta, Georgia. e-mail: "Kyle T. Snyder" <ksnyder@utsi.edu>

Appendix 6: Notes from the First Dean to the Next Dean



Montecito Apartments worked well but a place within walking distance to food and entertainment would be nicer. The WestWind Townhouses would be great. Kajal Gupta suggested Sunset Apartments.

New dean should try to identify next dean early so that that person can participate and gain experience.

In the last two weeks do not schedule activities or trips.

Have per diem checks ready on the first day. Pay per diem in advance. Students rely on this money and are poorer then expected. Students tend to bank their stipend checks for college and live off the per diem.

Having research associates as licensed drivers is very important so that the Dean does not get too fatigued or board with driving.

The Chevy Astro mini van was fine for five research associates but gas mileage was poor.

A two story townhouse would be preferable to a one story 3-bedroom apartment. Five research associates in one apartment worked well but the added separation of a townhouse would probable be appreciated.

Trips by research associates to Washington/Goddard, Ames and JPL are quite important for the program. One of the great aspects of the program is the association with the other Academies (Ames and Goddard).

Academy research associates should meet Goldin, Whitehead, Szalai, Peterson.

Having research associates prepare their own food worked well and was preferred to eating out. Breakfast must be prior to the 45 minute drive to Dryden.

For meals with dinner guests we purchased food jointly and divided the expenses up six ways. This seemed to work. Make sure to explain this procedure up front. We did it this was because research associates were paid

per diem for every meal of the week. For the Dean to provide a meal would be a double payment to the research associates.

The video conference from the VITS room with the three other Academies is a great idea. It was our only association with the Marshall Academy and was good for them. They were feeling a little cheated, I think because their program was a lot like a summer co-op program. We had this conference in the second to last week as an introduction to the Academy Alumni Association. It should have occurred earlier.

Highlights were the trips to NTPS and Scaled Composites. Shawn Roberts and Burt Rutan were quite impressive. AeroVironment and Paul McReady were impressive as well.

I do not think a group project of a technical nature is a good idea. I think this takes away from the research done for the mentors. Group or individual projects that benefit the Academy are OK, e.g. improvements to the RA manual or home page.

For an out of town Dean a trip to Dryden in about April is a good idea to make arrangements like apartment rental. Meet Ken Szalai on this trip to get a sense of commitment from the top to the program. It may be difficult to get an apartment complex to commit to rent too soon before opening day.

There is the need for an unusual group activity to foster bonding and a sense of team spirit among the research associates. This activity probably should occur on the weekend and should be the only weekend activity paid for by the Academy. Safety of all participants is of paramount importance and risks must be carefully managed. A trip to the back country of Yosemite would serve well. Reservations for a back country permit or cabin must be done about Christmas. For such a trip research associates should be told ahead of time so that they can bring special clothing and gear. They might have some fun organizing this via e-mail prior to the start of the Academy.

The Dean should make arrangements for computer accounts to be authorized prior to opening day and some provision for leaving the accounts active for at least six months after the Academy is over.

The Dean should review the research associate projects with the mentor defining what successful completion looks like. The dean should recommend against projects that are purely educational for the student. There must be some research in every project. What is the question addressed by each project? Do we already know the answer to the question? The Dean should endeavor to get the research associates employed at NASA in some capacity after the Academy is over.

Weekend activities are optional. The only problem I see is if the group splinters to much. A sense of team bonding is desirable and this can be greatly encouraged on weekend activities. Dean judgment is required here if splintering

gets to great. Some research associates went by themselves to visit friends and relatives on weekends. This is OK.

A frustration was when one student has interests and plans too dissimilar to the rest of the group. This may make joint activities difficult.

Patience is the greatest asset of a Dean. The research associates are still a lot like teenagers in some ways. A sense of playfulness in the Dean also helps.

30% research associate workload for Academy activities seems to be about right.

ASEE summer fellowship is not a good way to get salary for the Dean because of their restrictions on additional NASA funding to the Dean during the 10-week ASEE program. The housing, per diem, and transportation allowance provided by the ASEE program is not as generous as are the Academy allowances for the research associates.

Appendix 7: World Wide Web Sites



Where to find information about past and present NASA Academies

NASA Academy at Dryden Flight Research Center
<http://trc.dfrc.nasa.gov/Academy/Academy.html>

NASA Academy at Goddard Space Flight Center
<http://university.gsfc.nasa.gov/SA/academy.html>

NASA Academy at Ames Research Center
<http://astrobiology.arc.nasa.gov/academy/>

Where to find information about the Space Grant Consortia through which students submit their applications)

NASA Space Grant Consortia
<http://calspace.ucsd.edu/spacegrant/>

Indiana Space Grant Consortium
<http://roger.ecn.purdue.edu/v1/isgc/>