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Office of Naval Research High School Traineeship  
at the University of Michigan, Summer 1990

Final Report

Grant: N00014-90-J-1972

Submitted to: Office of Naval Research

Deputy Director: Debra T. Hughes

by Professor Robert Beck and Dr. Neil D. Gerl



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The University of Michigan proposal to participate in the Office of Naval Research High School Apprenticeship Program was organized to reduce the administrative burden on project directors. As a result, the level of participation was excellent and all participants were pleased with the program.

All thirty-five project directors with Navy grants and contracts were given an explanation of the program and were asked to serve as mentors. Fourteen project directors agreed to it with the understanding that they would not be required to administer by the program. Reasons given for non-participation included: safety in the laboratory, subject matter of the research was too complex, and lack of available time to serve as a mentor.

Upon approval of the Office of Naval Research High Traineeship program at the University of Michigan 1990, recruiting efforts began to get the program underway. An introductory letter (Enclosure A) was sent to high schools in or relatively near the Ann Arbor area requesting the nomination of students. Students interested in gaining valuable experience in science, math and engineering-related fields while earning \$1,000 over the summer were encouraged to apply.

Initially, twelve applications were received from nine different high schools. Although this was less than what had been expected (there were 14 \$1,000 stipends), the students who did apply were outstanding; most were at the top of their classes, had near 4.0 grade point averages, and scored above average on standardized tests such as the ACT and the SAT.

To introduce the students to the program, a welcoming meeting was held on June 14, 1990. Neil Gerl, a project representative at the Division of

Research Development and Administration (DRDA) discussed the basic history of Naval research, ongoing research at the University of Michigan, and the type of research that the students would be involved with. The students were also acquainted with the professors and the projects on which they would be working. The professors and students were matched according to qualifications, personal preference, or similar research interest.

All of the participants were hired as temporary employees of the University of Michigan at an hourly wage of \$5.00 (200 hours x \$5.00/hour = \$1,000). Work permits were required as all of the students were under 18 years of age. Within two weeks, each student was at work on his or her project. Payments were scheduled on a bi-weekly basis. All hours were reported to DRDA and paychecks were distributed at the same location.

Although most of the participants' project went smoothly, a few special cases did surface. For instance, one young man from a Detroit high school had been selected but would not have been able to participate because of lack of transportation from Detroit to Ann Arbor. Fortunately, university room and board was made available to him at no cost through another summer program. He was able to fully participate in the ONR program and, in addition, evening activities and supervision were also provided by this other program. This student is now enrolled at the University of Michigan and plans to pursue an engineering degree, something he said he did not believe to be possible before he participated in this program. In another case, a young man, who had been working in a laboratory where he believed there were potentially dangerous chemicals, expressed concern for his own safety and asked to be removed from the project. After an inquiry, the Department Chair confirmed that the

laboratory was safe and the chemicals were controlled in such a way that they were not potentially dangerous. However, the student was assigned to another project where he would feel more comfortable.

The majority of complications occurred in the areas of: publicity, employment, and paychecks. Initially, the introductory letter (Enclosure A) was sent to the principals of the selected high schools. Unfortunately, very few letters were noticed let alone forwarded to the proper individuals in a timely manner. Follow-up calls were made to the counselling offices and response increased considerably. Basic employment processes was an initial problem because of the age of the students. We found that it was in the best interest of the students and the University to "employ" the students rather than give them a grant. The problem with this approach was the university does not hire many employees under the age of 18, and we had to learn by experience.

It is also necessary to note that some of the Office of Naval Research projects that were initially to be supported in the proposal were not actually supported, and, in some cases, Office of Naval Research projects that were not mentioned in the proposal were supported instead. A list of the projects, the project directors, and the high school students that worked on the projects is included (Enclosure B).

The main requirement for the students, apart from actually working on the projects, was that they submit a one page summary of their experience (Enclosures C & D). The summaries received have shown enthusiasm for the program. Not only did this program encourage students to become interested in engineering, it has established further studies for several students including the Detroit high school students and the following student who wrote:

"I think the Navy should offer this program again. Because of this program I am going to do a mentorship with Dr. Meadows during the school year."

This student is also now enrolled at the University of Michigan, pursuing a career in naval architecture and marine engineering.

Another impressive aspect of this program was the amount of responsibility the students were given. Many of the students were involved directly with experiment preparation, data collection and analysis. This type of experience proved to be valuable to students who were interested in finding out exactly what engineers do. It also gave them the confidence to know that they are capable of obtaining a career in the field of engineering.

The "Office of Naval Research High School Traineeship at the University of Michigan Summer 1990" was funded again for the summer of 1991 under a new grant (N00014-91-J-1832) at the same cost. Recruiting efforts began as soon as Navy funding was confirmed. This time, notices were mailed to counselling offices and specific teachers who had been in contact with the program the previous year. Over twenty applications were received and the selection process included the direct input of principal investigators. To date, the program has been very successful and, having learned from previous mistakes, many of the administrative hang-ups were avoided. As before, the summaries received have shown enthusiasm for the program. Not only did this program encourage students to become interested in engineering, it has established further research experience for at least one of the students who wrote:

"This summer was a great experience for me. It increased my computer knowledge and it should me what it would be like to

research a project for a company. I would like to thank you for introducing me to the field of computer technology and engineering. To end this summer on a good note, Professor Williams offered me a year around job to continue helping him with some of his projects."

Based on the success of both "Office of Naval Research High School Traineeship at the University of Michigan 1990 and 1991", it is proposed that this program be continued next year at the same cost.

Project Budget	
Period: April 1, 1992 - March 31, 1993	
•14 Traineeships @ \$1,000 each	\$14,000
•Program Administration (temporary manpower @ \$20/hour x 100)	\$ 2,000
Total Cost:	\$16,000

## ENCLOSURE A

May 3, 1990

The purpose of this letter is to request a nomination from your high school for our "Office of Naval Research (ONR) High School Students Traineeship at the University of Michigan 1990." The University of Michigan and ONR recently established this program as an effort to foster interest among high school students to pursue education and research at the university level.

The traineeship program will introduce high school students to on-going scientific research sponsored by the ONR. The program is to be launched this summer on the Ann Arbor campus. Current year juniors are being recruited from area schools to participate in research activities under the guidance of University scientists. These project directors have agreed to select and supervise one student per research project to assist with the recording of data, calculations, measurements, library searches, observation or research procedures, and general laboratory and/or office tasks. The students will gain concrete experience from the traineeship and from completing brief written reports summarizing their individual involvement.

The final selection will be based on personal interviews with the project directors. The students, preferably current year juniors, should possess some background in math, science, and computers. Each student is expected to work with the assigned project for a total of 200 hours, based on a flexible schedule (hours, full time or part time) to be determined by the researcher. The students will be present from June 20 through the summer, and into the fall term if needed. The ONR is offering a \$1,000 stipend to each student trainee for participation during the work period. A University management office will be responsible for ensuring that the students comply with the traineeship award agreement and for arranging the payment of the stipends.

The letter of recommendation may include information on whether the student is college-bound, has taken science courses, any technical interests, grade point average, etc. A resume and/or transcript may also be submitted along with the nomination.

Just to give you an idea of the research involved here, I am introducing the titles of the 14 on-going ONR research projects at the University of Michigan in which students may participate. The nature of the research has no bearing on the selection of the students who are primarily expected to learn, while assisting the project directors, graduate students, and other researchers.

1. Nonlinear Ship Motions
2. Program for Ship Hydrodynamics
3. On-line Aiding for Human-Computer Interfaces
4. Supersonic Multiphase Mixing Layers

5. Electron Beam Analysis for Cyclotron Harmonic and Free Electron Laser Devices
6. Recombination and Line Coincidence Concepts of X-Ray Lasing
7. Explanation-based Knowledge Acquisition of Electronics
8. Computational Aspects of Mechanics of Nonlinear Composite Materials
9. LeGrangian Velocity Profiles in the Full Scale Wake
10. Modulated Semiconducted Structures
11. Transport in  $\text{SiO}_2$  on the Picosecond and Femtosecond Timescales
12. A Structured Characterization of Real Time Computing Systems
13. Problems in Nonlinear Partial Differential Equations
14. Investigation of New-Time-Frequency Analyses of Acoustic Transients

The deadline for submission of the nomination is May 24. If there are any questions, please do not hesitate to call me at (313)763-6438. Thank you for your support in launching this exciting program!

Sincerely,

Neil D. Gerl, Ph.D.  
Project Representative

NDG:sak

**Application Cover Sheet**  
(please attach to letter of recommendation)

Student's Information

Name: \_\_\_\_\_

Social Security Number: \_\_\_\_\_

Age: \_\_\_\_\_

High School: \_\_\_\_\_

Grade Completing This Year: \_\_\_\_

Home Address: \_\_\_\_\_  
\_\_\_\_\_

Probable College Major(s): \_\_\_\_\_  
\_\_\_\_\_

\* \* \* \* \*

For information only: Sex: female \_\_\_\_\_ / male \_\_\_\_\_  
(optional)

Ethnicity: \_\_\_\_\_

ENCLOSURE B

Student: Eric Banners  
Contract/Grant: N00014-88-K-0628  
Project Director: Robert F. Beck  
Title: "Nonlinear Ship Motions"

Student: Susan Carrara  
Contract/Grant: N00014-89-J-3214  
Project Director: Guy A. Meadows  
Title: "LeGrangian Velocity Profiles in the Full Scale Wake"

Student: James Carson  
Contract/Grant: N00014-89-J-1723  
Project Director: William Williams  
Title: "Investigation of New-Time-Frequency Analyses of Acoustic Transients"

Student: Sarah Devine  
Contract/Grant: N00014-89-J-1199  
Project Director: Gerard Faeth  
Title: "Supersonic Multiphase Mixing Layers"

Student: John Dilligard  
Contract/Grant: N00014-86-K-0684  
Project Director: Robert F. Beck  
Title: "Program for Ship Hydrodynamics"

Student: Aaron Edwards  
Contract/Grant: N00014-88-K-0637  
Project Director: Noboru Kikuchi  
Title: "Computational Aspects of Mechanics of Nonlinear Composite Materials"

Student: Lisa Harwood-Stamper  
Contract/Grant: N00014-88-K-0554  
Project Director: John Laird  
Title: "Integrating Learning of Perception and Cognition in SOAR"

Student: Amy Koenigter  
Contract/Grant: N00014-89-J-3214  
Project Director: Guy A. Meadows  
Title: "LeGrangian Velocity Profiles in the Full Scale Wake"

Student: Eric Lofstrom  
Contract/Grant: N00014-90-J-1065  
Project Director: Ward D. Getty  
Title: "Electron Beam Analysis for Cyclotron Harmonic and Free Electron Laser Devices"

Student: Matt Postiff  
Contract/Grant: N00014-89-J-3183  
Project Director: Gerard Mourou  
Title: "Transport in SiO<sub>2</sub> on the Picosecond and Femtosecond Timescales"

Student: Mark Richardson  
Contract/Grant: N00014-85-K-0122  
Project Director: Kang G. Shin  
Title: "A Structured Characterization of Real Time Computing Systems"

Student: Eric Troesch  
Contract/Grant: N00014-87-K-0740  
Project Director: Jay Elkerton  
Title: "On-line Aiding for Human-Computer Interfaces"

Amy Koengeter

The job program I have participated in this summer I have found to be very beneficial. During the course of my 200 hours I have done and learned many things. I started out by working in the tow tank for a week and a half. The first thing I worked on was the Midland project. The purpose of this project was to discover the best way to load a barge. I created graphs on the computer and did calculations that were used in the making of these graphs. In the tow tank just before I left we were calibrating wave probes used to measure the wave height.

After this I went to the Ocean Engineering Lab and have worked here the remainder of the 200 hrs. I have been working on a variety of projects and the one I mainly worked on is for the proposed harbor in Cross Village, Mi. I have done many things to find out if this proposed harbor will change the environment and if so how. I have measured the distance from shore to different contours of depth, and looked at the depth in different areas of water near the shoreline. I have taken this information along with other information given and have inserted them into data tables which in turn I used to calculate the wave height, angle, and period. Later someone will insert all of this information into a program which will show if it is alright to build the harbor.

This program was especially beneficial to me because it gave me the opportunity to work on different computers. I did not have a very vast computer knowledge and most of the things I did involved a computer so now I know a lot more about computers and how to operate them.

I think the Navy should offer this program again because of this program I am going to do a mentorship with Dr. Meadows during the school year. I don't think I would have ever thought of doing a mentorship in this field but because of this program I am.

## Susan Carrara

Of the five weeks I spent working in the Office of Naval Research, one and a half were spent at the Ship Hydrodynamics Laboratory, and three and a half at the Ocean Engineering Laboratory.

While at the Ship Hydrodynamic Laboratory, I spent most of my time in the Tow Tank, observing the experiment already going on, and later helping to set up and calibrate equipment for the next experiment. In addition, I spent a day moving information from disks to tapes, and another day in the Engineering Library looking for information on certain topics.

During the majority of my time at the OEL, I made graphs from the data collected in an experiment. A line of bubbles had been made across the bottom of the Tow Tank. These bubbles were let off in several separate runs at varying pressures and created a current. A laser laid down hot spots across the row of bubbles. The experiment was filmed with an infrared camera. By following the progress of the hot spots and finding the speed at which they were moving, one could find out how fast the current moved.

To do this, I first had to record portions of the video tape on to an optical disk player. The optical disk player can send single frames into the computer. With a program made by the person who went through part of the data before, I found out where the hot spots were on a coordinate plane. Another program calculated the velocities between the points and averaged them. Finally, I used the numbers and another program to make the graphs.

I found this experience valuable mainly because I had the opportunity to use computers a lot, and not only for word processing. While here, I have used an IBM on occasion, but the majority of what I have done has been on a Macintosh. It is coincidentally helpful in that most of the computers at my school are Macintoshes.