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10/06/93

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Project unit: ECE Unit code: 02.010.118  
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JOKERST N ECE

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Contract value	140,112.00	306,778.00
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Cost sharing amount		152,797.00

Does subcontracting plan apply ? : N

Title: DEPARTMENT OF EDUCATION GAANN PROPOSAL

PROJECT ADMINISTRATION DATA

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WASHINGTON, DC 20202-4838

Security class (U,C,S,TS) : U ONR resident rep. is ACO (Y/N): N  
Defense priority rating : supplemental sheet  
Equipment title vests with: Sponsor GIT

Administrative comments -  
MODIFICATION 1 ADDS \$140,112 TO PROJECT.

**Final Report**  
**Graduate Assistants in Areas of National**  
**Need (GAANN)**  
**Fellowship Program at Georgia Tech**  
**1992-1995**

Submitted by

Mary Ann Ingram, Bonnie Heck and Nan Marie Jokerst  
School of Electrical and Computer Engineering

To

The United States Department of Education

# Contents

<b>1</b>	<b>Introduction</b>	<b>2</b>
<b>2</b>	<b>Evaluation of Recruitment Procedure</b>	<b>2</b>
<b>3</b>	<b>Evaluation of Retention</b>	<b>4</b>
3.1	Impact of GAANN on School Enrollments . . . . .	4
3.2	Status of Students . . . . .	4
3.2.1	Huy Cat . . . . .	5
3.2.2	Carrie Carter-Coman . . . . .	7
3.2.3	Parag Doshi . . . . .	7
3.2.4	Suzanne Fike . . . . .	8
3.2.5	Anne Collier . . . . .	8
3.2.6	Tina Hudson . . . . .	9
3.2.7	Peter Bergstrom . . . . .	10
<b>4</b>	<b>Professor Reports</b>	<b>11</b>
4.1	Prof. Scott Wills . . . . .	11
4.2	Prof. Steve Deweerth . . . . .	11
4.3	Prof. Laskar . . . . .	12
4.4	Prof. Ingram . . . . .	12
4.5	Prof. Heck . . . . .	12
<b>A</b>	<b>Recruiting Flyer</b>	<b>14</b>
<b>B</b>	<b>Example of Recruiting Letter</b>	<b>16</b>
<b>C</b>	<b>Application Form</b>	<b>19</b>

# GAANN Final Report

## 1 Introduction

This Fellowship Program provided ten Ph.D. fellowships in the School of Electrical and Computer Engineering of the Georgia Institute of Technology, for the past three years. These fellowships allowed ten students to enter our Ph.D. program in addition to the enrollment that we would have had without the GAANN program. The ten students were selected through an extensive recruitment and application process that was designed by the three authors of the original GAANN proposal. Special effort was made to inform women, minorities and students with non-traditional backgrounds about the Fellowship and to encourage them to apply. The rewards were made based on merit and the probability of success in graduate school.

This report is organized as follows. Section 2 evaluates our recruitment procedure. We breakdown the applications received by gender and ethnic background, and discuss how this breakdown relates to our recruitment efforts. Section 3 gives our retention data, and includes the present status of each student currently classified as a GAANN student. This section also discusses the impact that the GAANN program had on School PhD enrollments.

## 2 Evaluation of Recruitment Procedure

We used many different recruiting tools, and based on the applications we received, we observed that each tool had an impact. We sent flyers to more than 100 Electrical Engineering Departments in the country, as well as the historically black colleges. The flyer we used is in Appendix I. We mailed more than 3000 letters to Georgia Tech alumni with degrees in science, engineering and mathematics. An example of the letter is in Appendix II. The mailing list was sorted into many categories, in particular, all combinations of EE vs. non EE, male vs. female, and white vs. minority, allowing us to tailor the letters to each group. In addition, we advertised the fellowship through the traditional channels available at Georgia Tech.

We received 44 applications. The application form is shown in Appendix

Description	Number
Male	32
Female	12
African American*	4
American Indian*	1
Non Traditional	2
Presently at Tech	12
Tech Alumni	18
Non-EE Alumni	7
Not from Ga. Tech	14

Table 1: Profile of GAANN Applicants. \*There were six applicants that did not indicate their ethnic backgrounds.

III. Table 1 displays the profile of the applicants. The fact that we had 14 applicants from other schools indicates that our flyers were seen. Seventeen of the alumni were not at Georgia Tech or any other school at the time we recruited, so we surmise that they responded to the alumni letters. Seven of the alumni were not from EE backgrounds.

Of the applicants, ten were ineligible. Three applicants were already in the PhD program. Three had been at Georgia Tech for over nine quarters without passing the preliminary exam, which meant that they could not enter the PhD program. Two had questionable citizenship and two had grade point averages that were too low.

After the application deadline of April 30, 1992, we ranked the applications based on merit and probability of success in graduate school. Although we strongly recruited women and minorities, we did not consider gender or race in our award decisions. We made awards to ten students. The awardees included five females, one African American, two Asian males and two white males. Three of these came from other universities, four were Georgia Tech alumni, and three were presently in graduate school at Georgia Tech when the awards were made. All held EE degrees except one from University of Central Florida that had a bachelor's degree in Computer Engineering.

Although we expected more than 44 applications, we feel that our flyers and letters to alumni were effective in that we ultimately made awards to

several students from other universities and several Georgia Tech alumni.

### **3 Evaluation of Retention**

Of the ten original GAANN Fellows, seven are still in the Ph.D. program. This retention rate of 70% compares with the overall retention rate of 74% for students who started their Ph.D. in ECE in 1992. The retention rate of the original women GAANN Fellows is 60% which is similar to the school average of 62% for female Ph.D. students in 1992. The three original GAANN Fellows who left the Ph.D. program all graduated with Master's Degrees in ECE. Two of these students were female and left the Ph.D. program to get married. The other student consistently did not satisfy the minimum grade point average requirement for the Ph.D. program and was dropped from the program. This student was counseled on several occasions before he was dropped. Of the four additional students who were funded by the GAANN program, one has graduated with a Ph.D. and the other three are still here. Table 2 below shows all of the students that were supported by the GAANN grant and the dates that they were enrolled in the program. For these statistics, we are counting Andrew Gardner as an original GAANN Fellow. He was actually first on our original alternate list and replaced a student who was named as a GAANN Fellow but never enrolled in our program.

#### **3.1 Impact of GAANN on School Enrollments**

The GAANN program had the most impact on the enrollment of females in the PhD program in the School of Electrical Engineering. The GAANN program began with the 92-93 school year. As shown in Figure 1, the enrollment of females jumped from 30 to 33 at that time. The five female GAANN Fellows accounted for 15% of the total PhD female enrollment in 92-93. The one African American GAANN Fellow also contributed to the increase in enrollment of underrepresented minorities.

#### **3.2 Status of Students**

Several of the GAANN Fellows supplied us with their accomplishments while in this program. The PhD program at the School of Electrical and Computer

Name	Dates of GAANN Fellow
Peter D. Bergstrom Jr.	September 1992 - present
Carrie A. Carter	September 1992 - present
Huy Hoang Cat	September 1992 - present
Anne Forrest Collier	September 1994 - present
Patricia L. Dantzcher	September 1992 - December 1993
Parag Doshi	September 1992 - present
Nicole Evers	January 1995 - present
Suzanne M. Fike	September 1992 - present
John D. Finney	September 1993 - March 1995
Andrew Gardner	January 1993 - present
Tina A. Hudson	September 1992 - present
Christopher A. Lee	January 1993 - March 1995
Amie Jo Pendleton	September 1992 - March 1994
Houfeng Wen	January 1995 - present

Table 2: Students that have been supported by the GAANN grant and the dates of their enrollment.

Engineering includes four hurdles: the preliminary exam (a written exam on compulsory undergraduate material), a qualifying exam (a one-month library research project intended to show if the student has the search and analytical skills to do research), the proposal exam, and the defense. All of the students have passed the preliminary exam, and most have passed the qualifying exam.

### 3.2.1 Huy Cat

Since my first quarter at Georgia Tech, I have been involved with research in the Pica Research Group where Dr. Scott Wills is the Principal Investigator. There, I developed my research focus in the area of parallel processing architectures. In particular, I investigated MIMD (Multiple Instruction stream, Multiple Data stream) and SIMD (Single Instruction stream, Multiple Data stream) parallel architectures. I passed my qualifying exam in Summer 1994.

In the first two years under GAANN, I worked on the Pica architecture. I assisted in developing an instruction level simulator and initiated the design

of the assembly language assembler for the Pica architecture. I have also been instrumental in many aspects of the Pica design and co-authored a number of papers, in particular, I am first author on two conference papers and co-author on two journal and two conference papers. I continue to be involved in the development of the Pica architecture.

Using this experience, I began to design a new parallel architecture named SIMPil (SIMD Pixel Processor). The instruction set architecture, assembler, and simulator was designed and developed. Many students are now using the simulator to develop image processing applications for the SIMPil architecture. The SIMPil architecture uses some of the ideas from the Pica architecture to illustrate new ideas in focal plane processing. This requires cooperation with other research groups headed by Dr. Nan M. Jokerst and Dr. Martin Brooke. Recently, the groups have finished the implementation of the prototype for the SIMPil architecture. This implementation was designed using the Magic VLSI layout editor and submitted to Mosis for fabrication. It is due back from Mosis in January 1996. Leading up to this design submission was the submission of many smaller functional units of the SIMPil system. Many of these functional units have been tested and helped in the design of the SIMPil prototype. Many of these functional units will also be incorporated in the prototype of the Pica architecture. The details of the SIMPil system are described in papers listed below.

With the completion of the SIMPil prototype, I will begin to develop my thesis. The title has not yet been determined but the SIMPil architecture will be the center of my thesis. My thesis advisor will continue to be Dr. Scott Wills. Other members of the thesis committee are Dr. Martin Brooke, Dr. David Schimmel, and Dr. Sudhakar Yalamanchili.

### **3.2.2 Carrie Carter-Coman**

I have two thesis advisors, Dr. April Erown and Dr. Nan Marie Jokerst. I passed the Qualifying Exam in February 1995. In the last year, I have been working on the research that will compose my thesis, specifically, I have been studying how to use compliant substrates in compound semiconductors to extend the conventional critical thickness and lower the defect density in grown strained layers. So far this work has resulted in two conference presentations and one journal article. Two other articles have been submitted. I have attended three conferences, including the two at which I presented papers. I



expect to present my proposal in early 1996.

### **3.2.3 Parag Doshi**

My thesis advisor is Professor Ajeet Rohatgi. I passed the Qualifying Exam in February 1995; it was entitled, "Fabrication, Modeling, and Characterization of High-Efficiency Silicon Solar Cells Made by Low-Cost Rapid Thermal Processing (RTP) and Plasma-Enhanced Chemical Vapor Deposition (PECVD)." The PhD program has proven to be an excellent and rewarding experience for me. I enjoy my research and believe I can make significant contributions in the area of silicon photovoltaics. I have four conference articles and three journal articles. One of the conference articles had a poster presentation that received an award. One of the journal articles was invited.

### **3.2.4 Suzanne Fike**

My thesis advisor is Professor Nan Marie Jokerst, and my thesis topic is the Design and Integration of Photodetector Arrays using Epitaxial Lift-off. I have presented a conference paper and I have a journal article. I am grateful for the Fellowship and the leeway it has given me. Georgia Tech has great facilities for my work (e.g. cleanroom, test equipment and computers). I would not have come back for my PhD without the GAANN fellowship. The GAANN discretionary funds enabled me to purchase a computer and attend a conference.

### **3.2.5 Anne Collier**

My Ph.D. experience under the support of the GAANN program has been an extremely fulfilling and rewarding opportunity. My progress to date during my graduate academic career at the Georgia Institute of Technology (Georgia Tech) can be summarized in the following time table:

September 1992 - Began Ph.D. program in Electrical Engineering at Georgia Tech with a graduate research assistantship at the Georgia Tech Research Institute in the Countermeasures Development Division

March 1993 - Passed the Ph.D. Preliminary Exam

Summer 1993 - Mary Ann Ingram agreed to be my PhD advisor

September 1993 - co-authored a paper and attended first technical conference: J.S. Goldstein, M.A. Ingram, P.D. Anderson, A.D. Forrest, "The Efficiency of Orthogonal Transform Domain Adaptive Array Processing", in Proc. USAF Symposium on Antenna Applications, Monticello, IL, Sept. 1993.

June 1994 - Received Masters of Science in Electrical Engineering from Georgia Tech and began support under the GAANN program

December 1994 - Completed Course requirements and Minor requirements for PhD program

June 1995 - Edward Kamen agreed to be my PhD co-advisor

Over the past year and a half of support on the GAANN program, I have had the opportunity to explore a wide variety of possible thesis topics. These have included modeling action potential propagation along the membrane of biological neurons, the use of analog VLSI circuits to model biological neuronal networks, using artificial neural networks in estimation and detection problems, and the general use of artificial neural networks in communications and signal processing applications. Through the Georgia Universities' System of cross registration, I was able to attend graduate level biology classes at Emory University in the neuroscience area in order to learn about the latest biological developments in modeling neurons. I believe that the time spent learning about neural modeling from a biologist's perspective was invaluable to my pursuits in applying artificial neural networks. Currently, my anticipated thesis topic is estimation and detection using artificial neural networks in applications of target tracking, radar and adaptive array signal processing. The GAANN program has given me the opportunity to fully concentrate my time and effort on these research topics. Otherwise, I would have been obligated spend time working on a sponsored contract as a graduate research assistant or teach a class as a graduate teaching assistant. The GAANN program also provided funds to purchase books, publications, and computer upgrades to assist in my research efforts. I expect to complete my next PhD degree requirement, the Qualifying exam, during the next quarter. Overall, the PhD program in electrical engineering at Georgia Tech has been a valuable experience. The faculty are outstanding and require that students understand the fundamental practical engineering issues. The competitive

nature of the Georgia Tech environment prepares students for a competitive business environment. I have enjoyed the continual learning process of the PhD research experience at Georgia Tech and look forward to learning and creating new techniques to improve signal processing and telecommunication performance in the future.

### **3.2.6 Tina Hudson**

I began my research under Prof. DeWeerth in modeling biological color vision using analog very-large-scale-integrated (VLSI) circuits. We found that there was not enough knowledge in the neuroscience community to adequately model this phenomenon and that the required circuit technology was not available. Then I began studying the modeling of neuronal control of muscles and spinal circuits using analog VLSI circuits. I just passed my Qualifying Exam, and I have some preliminary results in this area. I acquired my minor in neuroscience from Emory University, a university also in Atlanta that has a nationally renowned medical school. I was the first Georgia Tech student to do this, and I set up the way for others to do the same. We anticipate collaborations with researchers at Emory. I have enjoyed the variety of courses that the quarter system offers and I find my research very interesting and unique.

### **3.2.7 Peter Bergstrom**

I am now in my fourth year of graduate school as a PhD student at Georgia Tech. Over the past three years, I have made substantial progress toward getting my degree. I have completed all course work, and passed my Qualifying Exam, titled "Architectures and Performance Analysis of Optical Switches." In addition, I have developed an expertise in the area of packet switching architectures for optical networks. My thesis advisor is Dr. M.A. Ingram, whom I have worked with for these past three years. I also have a thesis co-advisor, Dr. J.L.A. Hughes, whom I have been working with for the past year and a half. The three of us also work with an Adjunct professor, Dr. A.J. Vernon, an employee of BellSouth. With the advice of this group, I have developed a discrete-event simulation of a certain optical packet switch, with and without channel grouping. The goal is to predict packet loss and throughput. I am currently attempting to model this switch using a Markov

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As part of the research in optical packet switching, I have attended the Optical Fiber Communications (OFC) conference. I have also attended the International Conference on Communications (ICC) in order to learn about current research in computer communications. I did not present papers at either of these conferences, but did attempt to submit papers to the OFC conference.

I have enjoyed my graduate experience at Georgia Tech. I am also appreciative of the benefits that I received as being a GAANN fellow. The compensation was very reasonable, especially considering the discretionary funds. I am enjoying my research at Tech, but hope to finish within the next

year so as to move on in the next step of my career.

## 4 Professor Reports

This section contains reports from several of the thesis advisors of the GAANN students.

### 4.1 Prof. Scott Wills

Huy Cat, a GAANN fellow, has participated in my group since September 1992. At that time, I had just started at Georgia Tech and I was trying to get a research program initiated. Having a fully funded student at this time helped me get some early results that I used to pursue additional funding. Huy is an exceptional student. He has developed simulators and designed test chips for the group. The GAANN Fellowship has allowed Huy to select his research area based on his interest, rather than being restricted to groups with available funding. Working with Huy, through the GAANN program has significantly leveraged my research effort during a critical period.

### 4.2 Prof. Steve Deweerth

Tina Hudson has been a valuable member of my research group during the past two years while she was funded under the GAANN Fellowship. During that period, Tina has demonstrated that she is a strong team player with much initiative and insight, all qualities that are very important in my desired development of a cross-disciplinary research program. She has begun to develop very solid research in the area of neuromorphic analog VLSI systems. She has demonstrated both an understanding of circuits and of their applications to the modeling of neurobiological systems. She has also contributed to our research group in the development of a design environment for analog VLSI systems and in the configuration of equipment for testing the resulting chips. In many ways, Tina's most outstanding contribution to the success of our research group has been in the coordination of our group with the computational neuroscience research and teaching programs at Emory University. She has coordinated the enrollment of a number of ECE students at Georgia Tech in the neuroscience courses at Emory, and has worked

for novel optical devices. Peter's fellowship allowed me to meet that goal. In particular, his fellowship allowed me to collaborate with two of my Georgia Tech colleagues on a fascinating optical switch project, even though I was not involved with them when they first received their ARPA funding (so I did not have any of that funding). Anne has worked on a number of different projects with me as we searched for her thesis topic. She has settled in now on a solid topic and anticipates taking her Qualifying Exam soon.

#### 4.5 Prof. Heck

Two of my Ph.D. students, John D. Finney and Houfeng Wen, were supported by the GAANN grant. Mr. Finney was supported for 1 1/2 years while Mr. Wen was supported for 3/4 years. Mr. Finney was an outstanding student who completed his Ph.D. and is now a Senior Engineer at ABB Power T&D Company. He wrote several papers while working with me under the GAANN program. Mr. Wen has recently begun his Ph.D. under my direction and is making satisfactory progress. He had two Master's degrees prior to coming to Georgia Tech, but was in need of financial assistance to pursue a Ph.D. Both students benefited greatly by the availability of the GAANN Fellowship. Their success at Georgia Tech helped my research program immensely, especially during the critical pre-tenure period.

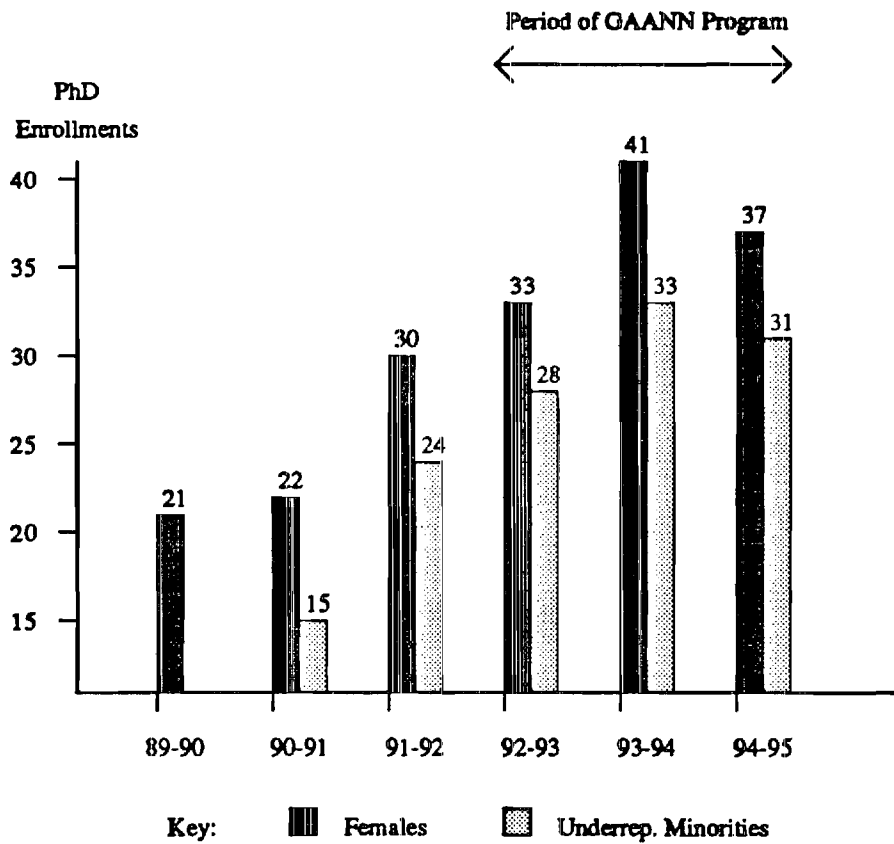


Figure 1: Female and Minority PhD Enrollment in the School of Electrical and Computer Engineering

## **A Recruiting Flyer**



# **Fellowships for Graduate Study in Electrical Engineering**

## ***School of Electrical Engineering Georgia Institute of Technology***

**The School of Electrical Engineering at Georgia Tech is offering Fellowships for students pursuing a Ph.D. beginning in Fall, 1992. These Fellowships provide five years of guaranteed funding including tuition, fees and \$16,000 per year stipend. To be eligible, you must:**

- intend to pursue a Ph.D. in Electrical Engineering**
- satisfy admission requirements for the graduate program in Electrical Engineering at Georgia Tech**
- intend to pursue a research or teaching career**
- have a high scholastic record (undergraduate GPA of 3.0 or graduate GPA of 3.5)**
- demonstrate financial need**
- demonstrate U.S. citizenship, permanent residency or evidence from the U.S. Immigration and Naturalization Service confirming intent to become a citizen or permanent resident**

**These fellowships will be determined based on scholastic record, personal statement, letters of recommendation, work experience, extracurricular activities, GRE scores (if available) and an interview of finalists. These fellowships will be awarded without regard to race, color, national origin, gender, age or handicapping condition. However, members of underrepresented groups in engineering such as women, minorities and the disabled are strongly encouraged to apply. Nontraditional students such as those who have been working in industry or those whose undergraduate degrees are in science, mathematics or engineering fields other than electrical engineering are also strongly encouraged to apply.**

**The deadline for applications is April 30, 1992; the first offers will be made by May 15, 1992. To receive an application for this fellowship, contact:**

**Dr. Nan Marie Jokerst  
School of Electrical Engineering  
Georgia Institute of Technology  
Atlanta, Georgia 30332-0250**

## **B Example of Recruiting Letter**



GEORGIA INSTITUTE OF TECHNOLOGY  
SCHOOL OF ELECTRICAL ENGINEERING  
ATLANTA, GEORGIA 30332

March 10, 1992

Dear Georgia Tech Alumna,

Here's a surprise: instead of asking you for money, we would like to give some to you! As a result of special funding from the U.S. Department of Education, the Georgia Tech School of Electrical Engineering (EE) will award fellowships to support ten students to pursue a Ph.D. degree. If you graduated with a grade point average of at least a 3.0 as an undergraduate or a 3.5 as a Masters, and if you are interested in getting a doctorate degree, we would like for you to apply for these fellowships.

Seven of the fellowships guarantee full payment of tuition, fees, and a \$16,000 per year stipend for up to five years. The other three fellowships will provide full payment of tuition, fees, and a \$16,000 per year stipend for up to six years. These latter three fellowships are designed for students who have undergraduate degrees in mathematics, science, or other engineering disciplines, or who have been away from college level studies for some time. These three fellowships provide an extra year for these students to study undergraduate material that will "bring them up to speed" with their peers who have recently obtained electrical engineering bachelor's degrees.

If you have industry experience, you will probably be able to make decisions more easily than those who have not worked in industry about what kind of research you would like to do. In some cases, a student's thesis research involves his or her former employer. In other cases, the Ph.D. gives the individual an opportunity to change fields.

The School of EE at Georgia Tech is an excellent place to obtain a Ph.D. degree. We currently rank in the top fifteen EE schools in every published ranking and we have the second largest faculty (79) in EE. To the student, this means a large selection of research areas to choose from, and exciting research on the "cutting edge." Please see the enclosure that explains our graduate program.

The female student will also note that the School of EE ranks very highly among other EE schools nationally in terms of the number of graduate degrees granted to women. The 1990 national average for female EE Ph.D.s was 7%; the Georgia Tech School of EE average was 10.7%. We also have four female faculty members. This means that members of this so-called "underrepresented group" are not so underrepresented at our School, and that you will know you can succeed because you will see others like you doing it.

In addition, three female faculty members are administering this fellowship program. These faculty members will meet regularly with the fellowship students to help them plan their studies and will take an active interest in their well-being.

We hope we have stimulated your interest in this program. If you wish to apply, please fill out the enclosed "Request for Application Material and Financial Statement" and mail it along with a self-addressed, stamped envelope to the address given below as soon as possible. We will immediately send you the Full Application and instructions. The *Full Application* must be received by us by April 30, 1992. The fellowships will be awarded based on scholastic record, personal statement, letters of recommendation, GRE scores (if available) and an interview of finalists. The fellowships will be awarded without regard to race, national origin, gender, age or handicapping condition. Only U.S. citizens, permanent residents or international students applying for permanent resident status are eligible for these fellowships. Members of groups that are underrepresented in engineering, such as women, minorities and the disabled, are strongly encouraged to apply. These fellowships begin Fall Quarter of 1992 which starts on September 21, 1992.

Sincerely,

Dr. Mary Ann Ingram

Please mail your Request for Application to:

Prof. Nan Marie Jokerst  
Electrical Engineering School  
Georgia Institute of Technology  
Atlanta, GA 30332-0250

2 enclosures

## **C Application Form**

School of Electrical and Computer Engineering  
Georgia Institute of Technology

APPLICATION FOR GAANN FELLOWSHIP

---

1. Name: \_\_\_\_\_ Social Security # \_\_\_\_\_

2. Legal Address: \_\_\_\_\_  
\_\_\_\_\_ Citizenship: \_\_\_\_\_

3. Mailing Address: \_\_\_\_\_  
\_\_\_\_\_ Telephone No.: \_\_\_\_\_

4. Desired starting date for appointment: \_\_\_\_\_ Fall, \_\_\_\_\_ Winter

5. Ga Tech Degree Objective: \_\_\_\_\_ MS, \_\_\_\_\_ PHD  
Area of Special Interest: \_\_\_\_\_

6. EDUCATIONAL BACKGROUND (College Level Only)

School attended	city and state	dates attended	degree	major field
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

Undergraduate Standing (if undergraduate program is not complete, give current status):

Grade-point average: \_\_\_\_\_ out of a possible \_\_\_\_\_ Class rank: \_\_\_\_\_

Grade-point average for graduate study, if any: \_\_\_\_\_

7. Honors, Membership in honor societies: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

8. Publications: \_\_\_\_\_

\_\_\_\_\_

9. If your previous degree is not electrical engineering, explain why you are choosing electrical engineering for your doctoral study: \_\_\_\_\_

\_\_\_\_\_

10. Discuss relevant research or industrial experience: \_\_\_\_\_

\_\_\_\_\_

11. Career Interest: \_\_\_\_\_ Teaching, \_\_\_\_\_ Research, \_\_\_\_\_ Professional Practice.

Elaborate briefly: \_\_\_\_\_

\_\_\_\_\_

12. Supplementary remarks regarding financial requirements: \_\_\_\_\_

\_\_\_\_\_

Signed \_\_\_\_\_ Date \_\_\_\_\_