15:18:38 OCA PAD INITIATION - PROJECT HEADER INFORMATION 05/10/90

Active

Project #: E-21-F67 Cost share #: E-21-373 Rev #: 0
Center # : 10/24-6-R6946-0A0 Center shr #: 10/22-1-F6946-0A0 OCA file #:
Work type : RES
Contract#: ECS-9007778 Mod #: Document : GRANT
Prime #: Contract entity: GTRC

Subprojects ? : N
Main project #:

Project unit: EE Unit code: 02.010.118
Project director(s):
TAYLOR D G EE (404)894-8910

Sponsor/division names: NATL SCIENCE FOUNDATION / GENERAL
Sponsor/division codes: 107 / 000

Award period: 900601 to 911130 (performance) 920228 (reports)

Sponsor amount	New this change	Total to date
Contract value	20,810.00	20,810.00
Funded	20,810.00	20,810.00
Cost sharing amount		10,405.00

Does subcontracting plan apply ?: N

Title: LABORATORY EQUIPMENT FOR APPLIED ELECTROMECHANICS RESEARCH

PROJECT ADMINISTRATION DATA

OCA contact: David B. Bridges 894-4820

Sponsor technical contact

GERALD T. HEYDT
(202)357-9618

NSF
1800 G STREET
WASHINGTON, DC 20550

Sponsor issuing office

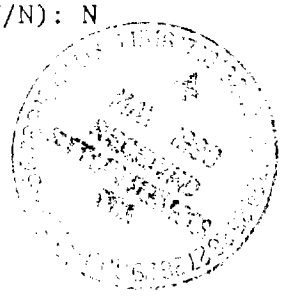
THOMAS G. NOEL

(202)357-9602
SAME

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

Administrative comments -
PROJECT INITIATION, EQUIPMENT GRANT FOR $20,810 (C/S $10,405);
NOTE: TERMINATION DATE 11/30/91, FINAL REPORTS DUE 2/28/92;

2



GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

NOTICE OF PROJECT CLOSEOUT

Closeout Notice Date 03/09/92

Project No. E-21-F67_____ Center No. 10/24-6-R6946-0A0_

Project Director TAYLOR D G_____ School/Lab ELEC ENGR_____

Sponsor NATL SCIENCE FOUNDATION/GENERAL_____

Contract/Grant No. ECS-9007778_____ Contract Entity GTRC

Prime Contract No. _____

Title LABORATORY EQUIPMENT FOR APPLIED ELECTROMECHANICS RESEARCH_____

Effective Completion Date 911130 (Performance) 920228 (Reports)

Closeout Actions Required:	Y/N	Date Submitted
Final Invoice or Copy of Final Invoice	N	
Final Report of Inventions and/or Subcontracts	Y	920228
Government Property Inventory & Related Certificate	N	
Classified Material Certificate	N	
Release and Assignment	N	
Other _____	N	

CommentsBILLING VIA LINE OF CREDIT; 98A SATISFIES "PATENT REPORTING"_____
REQUIREMENT._____

Subproject Under Main Project No. _____

Continues Project No. _____

Distribution Required:

Project Director	Y
Administrative Network Representative	Y
GTRI Accounting/Grants and Contracts	Y
Procurement/Supply Services	Y
Research Property Managment	Y
Research Security Services	N
Reports Coordinator (OCA)	Y
GTRC	Y
Project File	Y
Other _____	N
_____	N

NOTE: Final Patent Questionnaire sent to PDPI.

OMB Number 345-0058

NATIONAL SCIENCE FOUNDATION
1800 G STREET, NW
WASHINGTON, DC 20550

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POSTAGE & FEES PAID
National Science Foundation
Permit No. G-69

PI/PD Name and Address

David G. Taylor
Electrical Engineering
Georgia Institute of Tech
Atlanta GA 30332

NATIONAL SCIENCE FOUNDATION
FINAL PROJECT REPORT

PART I - PROJECT IDENTIFICATION INFORMATION

1. Program Official/Org.	NAME UNAVAILABLE; ADDRESS TO A/O FOR ECS
2. Program Name	ENGINEERING SYSTEMS PROGRAM
3. Award Dates (MM/YY)	From: 06/90 To: 11/91
4. Institution and Address	GA Tech Res Corp - GIT Administration Building Atlanta GA 30332
5. Award Number	9007778
6. Project Title	Engineering Research Equipment: Laboratory Equipment for Applied Electromechanics Research

This Packet Contains
NSF Form 98A
And 1 Return Envelope

NSF Grant Conditions (Article 17, GC-1, and Article 9, FDP-II) require submission of a Final Project Report (NSF Form 98A) to the NSF program officer no later than 90 days after the expiration of the award. Final Project Reports for expired awards must be received before new awards can be made (NSF Grant Policy Manual Section 677).

Below, or on a separate page attached to this form, provide a summary of the completed project and technical information. Be sure to include your name and award number on each separate page. See below for more instructions.

PART II - SUMMARY OF COMPLETED PROJECT (for public use)

The summary (about 200 words) must be self-contained and intelligible to a scientifically literate reader. Without restating the project title, it should begin with a topic sentence stating the project's major thesis. The summary should include, if pertinent to the project being described, the following items:

- **The primary objectives and scope of the project**
- **The techniques or approaches used only to the degree necessary for comprehension**
- **The findings and implications stated as concisely and informatively as possible**

See attachment

PART III - TECHNICAL INFORMATION (for program management use)

List references to publications resulting from this award and briefly describe primary data, samples, physical collections, inventions, software, etc. created or gathered in the course of the research and, if appropriate, how they are being made available to the research community. Provide the NSF Invention Disclosure number for any invention.

See attachment

	2/27/92
Principal Investigator/Project Director Signature	**Date**

IMPORTANT:
MAILING INSTRUCTIONS
Return this *entire* packet plus all attachments in the envelope attached to the back of this form. Please copy the information from Part I, Block I to the *Attention block* on the envelope.

PART IV — FINAL PROJECT REPORT — SUMMARY DATA ON PROJECT PERSONNEL

(To be submitted to cognizant Program Officer upon completion of project)

The data requested below are important for the development of a statistical profile on the personnel supported by Federal grants. The information on this part is solic ed in response to Public Law 99-383 and 42 USC 1885C. All information provided will be treated as confidential and will be safeguarded in accordance with the provisions of the Privacy Act of 1974. You should submit a single copy of this part with each final project report. However, submission of the requested information is not mandatory and is not a precondition of future award(s). Check the "Decline to Provide Information" box below if you do not wish to provide the information.

Please enter the numbers of individuals supported under this grant.
Do not enter information for individuals working less than 40 hours in any calendar year.

	Senior Staff		Post-Doctorals		Graduate Students		Under-Graduates		Other Participants[1]	
	Male	Fem.	Male	Fem.	Male	Fem.	Male	Fem.	Male	Fem.
A. Total, U.S. Citizens	1				3					
B. Total, Permanent Residents										
U.S. Citizens or Permanent Residents[2]:										
American Indian or Alaskan Native ...										
Asian ...										
Black, Not of Hispanic Origin ...					1					
Hispanic ...										
Pacific Islander ...										
White, Not of Hispanic Origin ...	1				2					
C. Total, Other Non-U.S. Citizens					2					
Specify Country										
1. Iran					1					
2. Saudi Arabia					1					
3.										
D. Total, All participants (A + B + C)	1				5					
Disabled[3]										

☐ Decline to Provide Information: Check box if you do not wish to provide this information (you are still required to return this page along with Parts I-III).

[1]Category includes, for example, college and precollege teachers, conference and workshop participants.

[2]Use the category that best describes the ethnic/racial status for all U.S. Citizens and Non-citizens with Permanent Residency. *(If more than one category applies, use the one category that most closely reflects the person's recognition in the community.)*

[3]A person having a physical or mental impairment that substantially limits one or more major life activities; who has a record of such impairment; or who is regarded as having such impairment. *(Disabled individuals also should be counted under the appropriate ethnic/racial group unless they are classified as "Other Non-U.S. Citizens.")*

AMERICAN INDIAN OR ALASKAN NATIVE: A person having origins in any of the original peoples of North America, and who maintain cultural identification through tribal affiliation or community recognition.

ASIAN: A person having origins in any of the original peoples of East Asia, Southeast Asia and the Indian subcontinent. This area includes, for example, China, India, Indonesia, Japan, Korea and Vietnam.

BLACK, NOT OF HISPANIC ORIGIN: A person having origins in any of the black racial groups of Africa.

HISPANIC: A person of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish culture or origin, regardless of race.

PACIFIC ISLANDER: A person having origins in any of the original peoples of Hawaii; the U.S. Pacific Territories of Guam, American Samoa, or the Northern Marianas; the U.S. Trust Territory of Palau; the islands of Micronesia or Melanesia; or the Philippines.

WHITE, NOT OF HISPANIC ORIGIN: A person having origins in any of the original peoples of Europe, North Africa, or the Middle East.

Laboratory Equipment for Applied Electromechanics Research: Final Report for Grant ECS–9007778

David G. Taylor

Georgia Institute of Technology
School of Electrical Engineering
Atlanta, Georgia 30332–0250

February 27, 1992

1 Introduction

This is the final report for the one-year Research Equipment Grant ECS–9007778 entitled "Laboratory Equipment for Applied Electromechanics Research." The grant enabled the purchase of a variety of equipment now available in the Electromechanical Systems Laboratory of the School of Electrical Engineering at Georgia Tech. The grant also indirectly supported the research of several Ph.D. students (Richard Wallace, Alireza Khayatian, Kenneth Shouse, Gregory Martin, Mohammed Al-Numay). The cost sharing arrangement with Georgia Tech was favorable, boosting the value of the NSF portion by another 50%. By the way, due to an REU Supplement from NSF (on another grant), four undergraduates (Lynn East, Jeff Kemp, Michele Linihan, Shih-Cheng Wang) were employed for approximately one year to help with laboratory work, and therefore made use of the equipment purchased with the grant funds. Due to successful negotiation with certain vendors, both the quality and quantity of equipment purchased were better than anticipated.

The remainder of the report is organized as follows. First, the research publications which have benefited from this research equipment expenditure are listed below. Second, a list of the major items of equipment purchased is included. The equipment list includes items purchased with the Georgia Tech matching funds. The details of the research accomplishments are not provided in this report, but are included in the research publications.

2 Publications Referencing Grant

2.1 Published Journal Papers

1. D.G. Taylor, "An experimental study on composite control of switched reluctance motors," *IEEE Control Systems Magazine*, vol. 11, no. 2, pp. 31–36, February 1991.

2. R.S. Wallace and D.G. Taylor, "Low torque ripple switched reluctance motors for direct-drive robotics," *IEEE Transactions on Robotics and Automation*, vol. 7, no. 6, pp. 733–742, December 1991.

3. D.G. Taylor, "Pulse-width modulated control of electromechanical systems," to appear in *IEEE Transactions on Automatic Control.*

4. R.S. Wallace and D.G. Taylor, "A balanced commutator for switched reluctance motors to reduce torque ripple," to appear in *IEEE Transactions on Power Electronics.*

2.2 Submitted Journal Papers

1. R.S. Wallace and D.G. Taylor, "Design of switched reluctance motors for reduced torque ripple," *IEEE Transactions on Industrial Electronics*, December 1990.

2. A. Khayatian and D.G. Taylor, "Feedback control of linear continuous systems by pulse-width modulation," *IEEE Transactions on Automatic Control*, September 1991.

3. K.R. Shouse and D.G. Taylor, "A sampled-data approach to observer-based controller design for nonlinear singularly perturbed systems," *IEEE Transactions on Automatic Control*, February 1992.

2.3 Non-refereed Papers

1. R.S. Wallace and D.G. Taylor, "An approach to torque ripple analysis," *Systems and Controls Technical Memorandum* #TMDT–01–89, Georgia Institute of Technology, Atlanta, September 1989.

2.4 Invited Conference Presentations

1. D.G. Taylor, "Electrically actuated mechanical systems: An integral manifold approach," *Abstracts from NSF-UC-NASA Workshop on Nonlinear Control*, University of California, Santa Barbara, California, p. 27, April 1990.

2. R.S. Wallace and D.G. Taylor, "A balanced commutator for three-phase switched reluctance motors to minimize torque ripple," *Proceedings of the IEEE International Conference on Systems Engineering*, Pittsburgh, Pennsylvania, pp. 597–600, August 1990.

3. K.R. Shouse and D.G. Taylor, "Multirate sampled-data composite control of nonlinear singularly perturbed systems," to appear in *Abstracts from NSF-WU Workshop on Nonlinear Control*, Washington University, St. Louis, Missouri, May 1992.

4. K.R. Shouse and D.G. Taylor, "Observer-based control of permanent-magnet synchronous motors," to appear in *Proceedings of the 18th IEEE Conference on Industrial Electronics*, San Diego, California, November 1992.

2.5 Refereed Conference Presentations

1. D.G. Taylor, "Composite control of direct-drive robots," *Proceedings of the 28th IEEE Conference on Decision and Control*, Tampa, Florida, pp. 1670–1675, December 1989.

2. R.S. Wallace and D.G. Taylor, "Torque ripple reduction in three-phase switched reluctance motors," *Proceedings of the 1990 American Control Conference*, San Diego, California, pp. 1526–1527, May 1990.

3. D.G. Taylor, "Improved pulse-width modulated control of switched reluctance motors," *Proceedings of the 1990 American Control Conference*, San Diego, California, pp. 2083–2088, May 1990.

4. R.S. Wallace and D.G. Taylor, "Three-phase switched reluctance motor design to reduce torque ripple," *Proceedings of the International Conference on Electrical Machines*, Cambridge, Massachusetts, pp. 783–787, August 1990.

5. D.G. Taylor, "Slow and fast manifolds of singularly perturbed systems," *Proceedings of the 29th IEEE Conference on Decision and Control*, Honolulu, Hawaii, pp. 3582–3587, December 1990.

6. A.B. Frazier, J.W. Babb, M.G. Allen and D.G. Taylor, "Design and fabrication of electroplated micromotor structures," *Proceedings of the ASME Winter Annual Meeting*, Atlanta, Georgia, pp. 135–146, December 1991.

7. D.G. Taylor, "Adaptive control design for a class of doubly-salient motors," *Proceedings of the 30th IEEE Conference on Decision and Control*, Brighton, United Kingdom, pp. 2903–2908, December 1991.

8. A. Khayatian and D.G. Taylor, "Feedback control of linear continuous systems by pulse-width modulation," to appear in *Proceedings of the 1992 American Control Conference*, Chicago, Illinois, June 1992.

9. A. Khayatian and D.G. Taylor, "Feedback control of linear discontinuous systems by pulse-width modulation," submitted for review to *31st IEEE Conference on Decision and Control*, Tucson, Arizona, December 1992 (submitted February 1992).

10. G.A. Martin and D.G. Taylor, "Discretization of nonlinear systems with delayed inputs," submitted for review to *31st IEEE Conference on Decision and Control*, Tucson, Arizona, December 1992 (submitted February 1992).

11. G.A. Martin and D.G. Taylor, "Sampled-data control design for nonlinear systems with delayed inputs," submitted for review to *31st IEEE Conference on Decision and Control*, Tucson, Arizona, December 1992 (submitted February 1992).

.12. K.R. Shouse and D.G. Taylor, "On the commutivity of singular perturbation decomposition and discretization for linear systems," submitted for review to *31st IEEE Conference on Decision and Control*, Tucson, Arizona, December 1992 (submitted February 1992).

13. K.R. Shouse and D.G. Taylor, "Discrete time observers for singularly perturbed continuous time systems," submitted for review to *31st IEEE Conference on Decision and Control*, Tucson, Arizona, December 1992 (submitted February 1992).

3 Equipment Purchased

3.1 Microcomputer Hardware

1. IBM Model 30 8086/87 8 MHz Microcomputer (1)
2. IBM Model 80 80386/387 20 MHz Microcomputer (1)
3. Gateway 2000 80486 33 MHz Microcomputer (3)
4. 115 MB Hard Disk Drive (replacement) (1)
5. 6 MB Memory Upgrades (for Model 80s) (3)
6. HP LaserJet IIP Plus Laser Printer (1)

3.2 Microcomputer Software

1. Intel 386/486 C-Code Builder
2. Mathematica 386/387 2.0 for Windows
3. Matlab 386/387 with Control System Toolbox
4. Norton Utilities 6.0
5. Corel Draw 2.0
6. Microsoft Word for Windows
7. Microsoft Excel for Windows

3.3 DSP Development Systems

1. TI XDS-500 Development Board for TMS320C30
2. Development Software for TMS320C30
3. Spectrum TMS320C30 Processor Board
4. Spectrum 32-channel Analog Input Board
5. Spectrum 16-channel Analog Output Board

3.4 Miscellaneous

1. Flexible Shaft Couplings
2. Electronic Components
3. Intelligent Printer Switchbox