

PROJECT ADMINISTRATION DATA SHEET

ORIGINAL REVISION NO. 3

Project No. E-20-630 (R5696-0A0) GTRC/STX DATE 9 / 10 / 86

Project Director: S.N. Atluri School/CE

Sponsor: National Science Foundation

Type Agreement:

Award Period: From To (Performance) (Reports)

Sponsor Amount: This Change Total to Date

Estimated: \$ 10,000 \$ 138,772

Funded: \$ 10,000 \$ 138,772

Cost Sharing Amount: \$ Cost Sharing No: E-20-342

Title:

ADMINISTRATIVE DATA

OCA Contact John Schonk X-4820

1) Sponsor Technical Contact:

2) Sponsor Admin/Contractual Matters:

K. Thirumalai

Shirley A. Woods

National Science Foundation

National Science Foundation

ENG/MSM

DGC/ENG

Washington, DC 20550

Washington, DC 20550

202/357-9542

202/357-9626

Defense Priority Rating: Military Security Classification:

(or) Company/Industrial Proprietary:

RESTRICTIONS

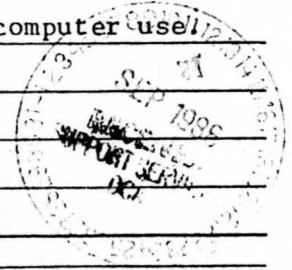
See Attached Supplemental Information Sheet for Additional Requirements.

Travel: Foreign travel must have prior approval - Contact OCA in each case. Domestic travel requires sponsor approval where total will exceed greater of \$500 or 125% of approved proposal budget category.

Equipment: Title vests with

COMMENTS:

Amendment No. 03 adds new funds and makes available 25 hours of supercomputer use



COPIES TO:

SPONSOR'S I. D. NO.

- Project Director
Research Administrative Network
Research Property Management
Accounting

- Procurement/GTRI Supply Services
Research Security Services
Reports Coordinator (OCA)
Research Communications (2)

- GTRC
Library
Project File
Other A. Jones

GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

NOTICE OF PROJECT CLOSEOUT

Closeout Notice Date 03/12/92

Project No. E-20-630 _____ Center No. R5696-0A0 _____

Project Director ATLURI S N _____ School/Lab CIVIL ENGR _____

Sponsor NATL SCIENCE FOUNDATION/GENERAL _____

Contract/Grant No. MSM-8306359 _____ Contract Entity GTRC

Prime Contract No. _____

Title SUPER COMPUTER USAGE _____

Effective Completion Date 870930 (Performance) 871231 (Reports)

Closeout Actions Required:	Y/N	Date Submitted
Final Invoice or Copy of Final Invoice	N	_____
Final Report of Inventions and/or Subcontracts	Y	910304
Government Property Inventory & Related Certificate	N	_____
Classified Material Certificate	N	_____
Release and Assignment	N	_____
Other _____	N	_____

Comments _____

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 Management	Y
Research Security Services	N
Reports Coordinator (OCA)	Y
GTRC	Y
Project File	Y
Other _____	N
_____	N

NOTE: Final Patent Questionnaire sent to PDPI.

GEORGIA TECH RESEARCH CORPORATION

GEORGIA INSTITUTE OF TECHNOLOGY
ATLANTA, GEORGIA 30332-0420

Phone: (404) 894- 4820

Telex: 542507 GTRCOCAATL
Fax: (404) 894-3120

July 15, 1986

bxc: Fennell
Welch
Hardaway
File

Shirley Woods
National Science Foundation
Division of Grants and Contracts
Room 1150
Washington, DC 20550

Subject: Grant No. MEA-8306359

Dear Ms. Woods:

Per your telephone request, I have enclosed attachment from Dr. Atluri discussing progress to date and anticipated research effort for the remainder of the project, if extended. I have also enclosed an estimated budget for funds remaining.

I trust that this information is sufficient, however, please contact me if there is anything further that you need.

Thank you for the help in processing our request.

Sincerely,

John B. Schonk
Contracting Officer

gw

Enclosure: As stated

xc: S.N. Atluri

The main objective of the research underway is a fundamental investigation of the mechanics of crack propagation in ductile materials undergoing inelastic deformation under various loading conditions. The main thrust is an effort to establish the utility of certain path-independent integrals (as measures of crack-tip deformation) to characterize the fracture process in the same way that the J integral characterizes the fracture process under conditions of elasticity or deformation plasticity. The specific topics under study are: (i) the mechanics of crack growth initiation in rate-independent elastic/plastic materials under arbitrary load histories, (ii) stable crack-growth in elastic plastic materials, and (iii) influence of rate-sensitive inelastic behavior on dynamic crack propagation.

Since the initiation of the grant on October 15, 1983, to date, research has been conducted on the mechanics of initiation and crack-growth in rate-independent elastic-plastic materials. The results of this research have been documented in 15 (fifteen) refereed archival publications. A summary of the research accomplished to date has also appeared as two chapters ("Elastic-Plastic Fracture" and "Path-Independent Integrals and Energetic Approaches in Fracture") in a book, "Computational Methods in the Mechanics of Fracture" (Edited by the principal-investigator, S. N. Atluri), to be published by North-Holland Publishers, in September 1986. In addition, the research accomplished, to date, has also been presented in several invited talks at International Conferences, the more notable being (i) a Plenary Lecture at the 6th International Congress on Fracture, ICF-6, December, 1984, in New Delhi, India, (ii) a Plenary Lecture at the IUTAM Symposium on "Thermo-mechanical Couplings in Fracture Solids" Ecole Polytechnic, France, September, 1986.

The research that is yet to be completed involves the study of the high-strain-rate effects on the material behavior near a fast-running crack-tip in a viscoplastic structural steel. Attention is being focused on a new crack-tip integral parameter, T^* , to characterize the fracture process in viscoplastic dynamic fracture. Studies will also be conducted on the influence of the thermo-mechanical coupling induced by the adiabatic heating due to energy dissipation near a fast-running crack-tip on the mechanical behavior near the crack-tip. The progress in this phase of research has been slowed down due to unforeseen difficulties in recruiting qualified Ph.D students and/or post-doctoral research fellows to collaborate with the principal investigator on this research. Only recently such individuals have been identified. These are (i) Mr. Frank Mello, a Ph.D student, and (ii) Dr. S. Y. Im a post-doctoral fellow, with a Ph.D from the University of Illinois at Urbana.

Also, the current research on establishing T^* as a fracture parameter in high-strain-rate dynamic crack-propagation necessitates the heavy use of a supercomputer such as a CRAY. Only recently, the protocol necessary for such long-distance use of the CRAY at Urbana has been established.

Thus, the delays in recruiting the necessary students, and in establishing a link with a supercomputer, as mentioned above, necessitate a no-cost extension of the performance period of the grant to September 30, 1987. We hereby request the cognizant program officials at NSF to grant this extension. Such an extension would enable a successful fulfillment of the original objectives of research in the current grant in a fruitful manner.

Grant No. MEA-B306359
Dr. S.N. Atluri

Budget Estimate

Catagory -----	Funds Remaining (as of 3/31/86) -----
Personnel	\$32,154
Fringe Benefits	5,730
Supplies	417
Travel	1,333
Equipment	18,011
Indirect Costs	25,166
Total	82,811

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

E-20-630
BULK RATE
POSTAGE & FEES PAID
National Science Foundation
Permit No. G-89

P/VPD Name and Address

Dr. S. N. Atluri E-20-630
School of Civil Engineering
Georgia Institute of Technology
Atlanta, GA 30332-0356

NATIONAL SCIENCE FOUNDATION FINAL PROJECT REPORT

PART I - PROJECT IDENTIFICATION INFORMATION	
1. Program Official/Org.	Dr. K. Thirumalai/Solid & Geo-Mechanics Program
2. Program Name	Mechanical Sciences
3. Award Dates (MM/YY)	From: 10/83 To: 9/87
4. Institution and Address	Georgia Tech Research Corporation Georgia Institute of Technology Atlanta, GA 30332-0420
5. Award Number	MSM-8306359
6. Project Title	Mechanical Sciences: Studies in the Mechanics of Inelastic and Dynamic Fracture

**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 Grants Policy Manual Section 677).

Below, or on a separate page, provide a summary of the completed projects and technical information and attach it to this form. 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 starting 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

The energetic approaches in inelastic and dynamic fracture of metals are examined in detail. Dynamic crack propagation in viscoplastic solids is modeled computationally. The problem of temperature rise near a propagating crack-tip in mild steel is studied numerically.

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.

	2/29/92.
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 line* on the envelope.

Do not include in summary Project Report data on individuals at project

The data requested herein are important for the development of a data base profile of the personnel supported by the project and for the preparation of reports to Public Law 75-430 and 49 USC 1951c. All information furnished here is confidential and will be reviewed and disseminated only as authorized by the Privacy Act of 1974.

Part III (Attachment):

S.N. Atluri, "Energetic Approaches and Path-Independent Integrals in Fracture Mechanics" in Computational Methods in the Mechanics of Fracture, (S.N. Atluri, Ed.) pp 122-165, North-Holland, 1986.

F.W. Brust, T. Nishioka, S.N. Atluri and M. Nakagaki, "Further Studies on Elastic-Plastic Stable Fracture Using the T* Integral", Engg. Fracture Mechanics, Vol. 22, pp 1079-1103, 1985.

S.N. Atluri and T. Nishioka, "Numerical Studies in Dynamic Fracture Mechanics" International Journal of Fracture, Vol. 27, pp 245-261, 1985.

S.N. Atluri, "Computational Techniques for Inelastic Stress and Fracture Analyses", Nuclear Engineering & Design, Vol. 116, pp 329-342, 1989.

M. Nakagaki and S.N. Atluri, "Crack-Tip Parameters and Temperature Rise in Dynamic Crack Propagation", Engineering Fracture Mechanics, Vol. 23, No. 2, pp 167-182, 1986.

American Indian or Alaska Native

Asian

Black, Not Hispanic

Hispanic

Pacific Islander

White, Not of Mexican Origin

C. Total, Other than U.S. Citizens

Specify Country

1.

2.

3.

D. Total, All Participants

(A + B)

Blanket?

Do not check this blanket check box if you do not wish to provide this information. If you do, you will be required to return this page with your report.

Temporary: Faculty, post-doctoral fellows, college and pre-college teachers, conference and workshop participants.

This information has been furnished for the ethnic total statistics for all U.S. Citizens and Non-Citizens (with Government Residency if more than 12 months) and the sex category that most closely reflects the person's race/ethnicity (in the community.)

*Persons 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 can check an "other" under the appropriate ethnicity category if they are classified as "Other Non-U.S. Citizens.")

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

ASIAN: A person having origins in any of the original peoples of East Asia, Southeast Asia, the Pacific Islands, or other adjacent islands.

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

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

PACIFIC ISLANDER: A person having origins in any of the original peoples of Hawaii, the U.S. Trust Territory of Guam, American Samoa, or the Northern Mariana; the U.S. Trust Territory of Puerto Rico; the island of New Caledonia; or the Western Islands.

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

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 solicited 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										
B. Total, Permanent Residents										
U.S. Citizens or Permanent Residents²:										
American Indian or Alaskan Native ...										
Asian.....										
Black, Not of Hispanic Origin.....										
Hispanic.....										
Pacific Islander.....										
White, Not of Hispanic Origin.....										
C. Total, Other Non-U.S. Citizens										
Specify Country										
1.										
2.										
3.										
D. Total, All participants (A + B + C)										
Disabled³										

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).

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

²Use 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.)

³A 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.

THIS PART WILL BE PHYSICALLY SEPARATED FROM THE FINAL PROJECT REPORT AND USED AS A COMPUTER SOURCE DOCUMENT. DO NOT DUPLICATE IT ON THE REVERSE OF ANY OTHER PART OF THE FINAL REPORT.