GEORGIA INSTITUTE OF TECHNOLOGY — OFFICE OF CONTRACT ADMINISTRATION

PROJECT ADMINISTRATION DATA SHEET

[x] ORIGINAL [ ] REVISION NO. _____

Project No. E-20-634 DATE 10/9/81

Project Director: Dr. S.N. Atluri School/Lab Civil Engineering

Sponsor: Naval Research Laboratory

Type Agreement: Contract No. N00014-81-C-2364

Award Period: From 9/1/81 To 10/31/81 (Performance) 11/30/81 (Reports)

Sponsor Amount: $6,900 Contracted through: GTRI/GIT

Cost Sharing: N/A

Title: "Stable Crack Growth in Electric - Plastic" Material

ADMINISTRATIVE DATA

OCA Contact Faith G. Costello

1) Sponsor Technical Contact:

Scientific Officer
ATTN: Code 6381, I. Chang
Naval Research Laboratory
Washington, D.C. 20375

2) Sponsor Admin/Contractual Matters:

Ann Peare
Contracting Officer
Naval Research Laboratory
Washington, D.C. 20375
ATTN: Code 1232.AP

Defense Priority Rating: none

Security Classification: none

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 GIT if cost is less than $1,000. However, none proposed.

COMMENTS:

Continuation of E-20-670

COPIES TO:

Administrative Coordinator
Research Property Management
Accounting
Procurement/EES Supply Services
Research Security Services
Reports Coordinator (OCA)
Legal Services (OCA)
~~Library~~
EES Public Relations (2)
Computer Input
Project File
Other _____

FORM OCA 4:781

GEORGIA INSTITUTE OF TECHNOLOGY OFFICE OF CONTRACT ADMINISTRATION

SRA21 16 2-

SPONSORED PROJECT TERMINATION SHEET

Date 1/19/82

Project Title: Stable Crack Growth in Electric-Plastic Material"

Project No: E-20-634

Project Director: Dr. S. N. Atluri

Sponsor: Naval Research Laboratory

Effective Termination Date: 10/31/81

Clearance of Accounting Charges: 10/31/81 (perf.)
11/30/81 (rpts.)

Grant/Contract Closeout Actions Remaining:

- [x] Final Invoice and Closing Documents
- [ ] Final Fiscal Report
- [x] Final Report of Inventions
- [ ] Govt. Property Inventory & Related Certificate
- [ ] Classified Material Certificate
- [ ] Other _____

Assigned to: Civil Engineering (School/~~Laboratory~~)

COPIES TO:

Administrative Coordinator	Research Security Services	EES Public Relations (2)
Research Property Management	Reports Coordinator (OCA)	Computer Input
Accounting	Legal Services (OCA)	Project File
Procurement/EES Supply Services	~~Library~~	Other _____

FORM OCA 10:781

Final Report
of
Research on

"Stable Crack Growth in Elastic-Plastic Materials"

Supported by
NRL Contract No. N00014-81-C-2364

Submitted by

Michihiko Nakagaki
Center for the Advancement of Computational Mechanics
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Presently at

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Washington, DC 20375

STABLE CRACK GROWTH IN ELASTIC-PLASTIC MATERIALS

A two-dimensional finite element methodology is developed for studying stable crack growth and instability in ductile materials. The analysis is employed to compare and assess several crack growth parameters including the J-integral, crack opening angle (COA), crack-tip opening angle (CTOA), available energy rate (G*), and generalized energy release rate (G_Γ).

An assumed displacement hybrid finite element model with the proper crack-tip singularity is employed in the numerical analysis. Crack growth is simulated by shifting the crack-tip core elements an arbitrary distance in the direction of crack growth. Although the geometry of the crack-tip elements is uniformly translated as the crack advances, stress and plastic strain variables are reinterpolated incrementally to account for history-dependent constitutive behavior. Thus, assuming an incremental theory of plasticity, the global stiffness of the cracked body is properly updated. Tractions on the new crack surfaces are proportionally unloaded in several steps until they monotonically converge to zero. An iterative procedure is employed to assure that the (sequentially) reinterpolated stress field is equilibrated with respect to the far field state.

The computational procedure is employed to simulate stable crack growth experiments performed on A533B steel compact tension specimens. The crack growth parameters are examined and their utility is determined by investigating the dependence of the associated resistance curves on initial crack size and computational crack extension step size a.

A procedure for predicting the instability condition for various loading cases is demonstrated using the G* crack growth parameter. Loading conditions examined include: (i) prescribed load, (ii) prescribed displacement, and (iii) a prescribed displacement condition in which a compliance is inserted in the load system.