

AD-A186 269

RESEARCH IN PROGRAMMING LANGUAGES AND SOFTWARE  
ENGINEERING(U) MARYLAND UNIV COLLEGE PARK DEPT OF  
COMPUTER SCIENCE J GANNON ET AL 24 DEC 85  
AFOSR-TR-87-1243 F49620-85-K-0008

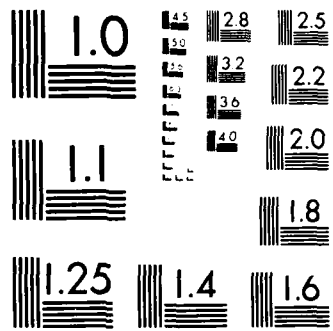
1/1

UNCLASSIFIED

F/G 17/11

NL





MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS 1963-A

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION <b>UNCLASSIFIED</b>		DTIC SELECTED		1b. RESTRICTIVE MARKINGS	
2a. SECURITY CLASSIFICATION AUTHORITY		3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.		4. PERFORMING ORGANIZATION NUMBER(S) <b>CE D</b>	
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE 15 1987		5. MONITORING ORGANIZATION REPORT NUMBER(S) <b>AFOSR-TR- 87- 1243</b>		6a. NAME OF PERFORMING ORGANIZATION University of Maryland	
6b. ADDRESS (City, State and ZIP Code) Dept. of Computer Science College Park, MD 20742		6c. OFFICE SYMBOL (If applicable)		7a. NAME OF MONITORING ORGANIZATION Air Force Office of Scientific Research	
7a. ADDRESS (City, State and ZIP Code) Bolling AFB DC 20332		7b. ADDRESS (City, State and ZIP Code) 310410 Directorate of Mathematical & Information Sciences, Bolling AFB DC 20332		8. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER F49620-85-K-0008	
8a. NAME OF FUNDING/SPONSORING ORGANIZATION AFOSR		8b. OFFICE SYMBOL (If applicable) NM		9. SOURCE OF FUNDING NOS.	
8c. ADDRESS (City, State and ZIP Code) Bolling AFB DC 20332		PROGRAM ELEMENT NO. 61102F	PROJECT NO. 2304	TASK NO. A2	WORK UNIT NO.
11. TITLE (Include Security Classification) RESEARCH IN PROGRAMMING LANGUAGES AND SOFTWARE ENGINEERING					
12. PERSONAL AUTHOR(S) Dr. John Gannon					
13a. TYPE OF REPORT Annual		13b. TIME COVERED FROM 1/1/85 TO 12/31/85		14. DATE OF REPORT (Yr., Mo., Day) 1985, Dec., 24	15. PAGE COUNT 2
16. SUPPLEMENTARY NOTATION					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB. GR			
19. ABSTRACT (Continue on reverse if necessary and identify by block number) During the past year three (3) research papers were written and two (2) published conference presentations were given. Titles of the published research articles are: "A Stochastic Analysis of a Modified Gain Extended Kalman Filter with Applications to Estimation with Bearings only Measurements," "The Modified Gain Extended Kalman Kilter and Parameter Identification in Linear Systems"; and "Maximum Information Guidance for Homing Missiles".					
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT UNCLASSIFIED, UNLIMITED <input checked="" type="checkbox"/> SAME AS RPT <input type="checkbox"/> DTIC USERS <input type="checkbox"/>			21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED		
22a. NAME OF RESPONSIBLE INDIVIDUAL Captain John P. Thomas		22b. TELEPHONE NUMBER (Include Area Code) (202) 767- 5026		22c. OFFICE SYMBOL NM	

*Annual scientific report*

UNIVERSITY OF MARYLAND  
DEPARTMENT OF COMPUTER SCIENCE  
COLLEGE PARK, MARYLAND  
20742

UUCP umcp-es@gannon  
CSNET gannon@umcp-es  
ARPA gannon@maryland  
TELEPHONE (301) 454-5900

December 24, 1985

Captain John Thomas, Jr.  
Air Force Office of Scientific Research  
Bolling Air Force Base  
Building 410  
Washington, D.C. 20332-6448

**AFOSR-TR- 87 - 1 243**

Dear Captain Thomas:

Enclosed is a summary of the research performed under AFOSR Grant F49620-85-K-0008. When I sent the descriptive portion to Dr. Fox in July, I thought that I had satisfied the contract's requirement for a final technical summary. Our Office of Sponsored Programs informed me that your contracting personnel had not received this document so I am submitting another copy. Sorry for this confusion. Thanks for your continued support of this work.

Sincerely,

*John Gannon*  
John Gannon  
Associate Professor



cc: E. Magrum

Accession For	
NTIS CRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distributing	
Availability	
DTIC	
A-1	

## RESEARCH IN PROGRAMMING LANGUAGES AND SOFTWARE ENGINEERING

Victor Basili  
John Gannon  
Marvin Zelkowitz  
Raymond Yeh

Department of Computer Science  
University of Maryland  
College Park, MD 20742

This research program focuses on improving programming productivity through better methodologies and more powerful programming environments. New environments are being developed and evaluated empirically to see that they meet their goals.

The availability of high performance workstations has led to increased research on their use for enhanced programmer productivity. Toward this end the SUPPORT environment has been implemented to investigate such issues. SUPPORT executes on a VAX 11/780 under UNIX 4.2, on SUN Workstations, and on an IBM PC under PC-DOS. SUPPORT is an environment for developing and testing Pascal programs. (Ada and C versions of SUPPORT are also being considered). Issues under study are (1) extended grammars to convey semantic information, (2) workstations with powerful interactive interpreters, (3) multiple windows, and (4) the effectiveness of syntax-directed editing in code production and modification.

Distributed programs promise improved efficiency (through processors executing concurrently) and reliability (through the use of independent processors). Remote procedure call provides users with transparent service, permitting them to call procedures on processors without shared storage just as they would call procedures on the same processor. We have implemented an atomic remote procedure call mechanism as an extension to the C programming language on ZMOB, a 256-processor system. Concurrent procedure calls are mediated by attaching a call graph path identifier to each call message. We have developed conditions on path identifiers that permit calls to proceed concurrently and still be serialized. Each procedure call is a total operation, with associated states of procedures saved on procedure entry and restored in case of procedure crash.

CleanRoom integrates the use of a mathematically-based design methodology, "right-the-first-time" programming methods, and a statistically-based testing strategy. Developers are not allowed to test their own programs. They focus on review techniques, such as code reading, inspections, and walkthroughs, to assert the correctness of their systems. Independent testers then simulate the operational environment of the product with functional testing, record observed failures, and determine an objective measure of system reliability. Fifteen three-person teams, working separately, built 1200-line message systems to compare CleanRoom software development with a more traditional development approach. The results demonstrate the feasibility of complete off-line development (as in CleanRoom) and suggest that such a development approach is superior to a more traditional approach.

Another study compared the strategies of code reading, functional testing, and structural testing in three aspects of software testing: fault detection effectiveness, fault detection cost, and classes of faults detected. Thirty-two professional programmers and forty-two advanced students applied the three techniques to programs. The professional programmers detected more software faults and had a higher fault detection rate using code reading than with functional or structural testing. In both groups, functional testing was generally superior to structural testing.

AFOSR-Supported Work, 1984

V.R. Basili and D. Dunlop. A heuristic for deriving loop functions. *IEEE Transactions on Software Engineering*, (May 1984), 275-285.

V.R. Basili and D. Dunlop. Generalizing specifications for uniformly implemented loops. *ACM Transactions of Programming Languages and Systems*, (January 1985) 137-158.

V.R. Basili and D.H. Hutchens. System structure analysis: clustering with data bindings, *IEEE Transactions on Software Engineering*, (August 1985), 749-757.

V.R. Basili, A. Bailey and F. Youssifi. Optimizing the utilization of human resources: a framework for research, Proceedings of the Second Software Engineering Conference, (June 1984), Nice, France.

V.R. Basili and R.W. Selby, Data Collection and Analysis in Software Research and Management, Proceedings of the American Statistical Association, (July 1984).

J.D. Gannon, R.G. Hamlet, and H.D. Mills. Functional semantics of modules, *Formal Methods and Software Development*, Proceedings of the International Joint Conference on Theory and Practice of Software Development (TAPSOFT), volume 2, Lecture Notes in Computer Science, 186, Springer-Verlag, (March 1985), 42-59. (An earlier version of this paper was presented at the Third International Conference RELCOMEX 84, Poland, May 1984, 321-328.)

G. Lyon, M. V. Zelkowitz, J. Elgot, D. Itkin, B. Kowalchack, M. Maggio. Dialogue mechanisms in a tabletop programming environment. *IEEE Compcn*, (September 1984), Arlington VA, 33-39.

M.D. Weiser, J.D. Gannon, and P.R. McMullin. Comparison of structural test coverage metrics, *IEEE Software* 2, 2, (March 1985), 80-85.

M.V. Zelkowitz. A small contribution to editing with a syntax directed editor. ACM SIGSOFT SIGPLAN Software Engineering Symposium on Practical Software Development Environments, (April 1984), Pittsburgh, PA, 1-6.

END

DATE

FILMED

DEC.

1987