UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

(2)

REPORT DOCUMENTATION PAGE

DTIC FILE COPY

1a	AD-A189 355
1b. RESTRICTIVE MARKINGS	
2a	
2b	
3. DISTRIBUTION/AVAILABILITY OF REPORT	Approved for public release; distribution unlimited.
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	
5. MONITORING ORGANIZATION REPORT NUMBER(S)	ARO 22356.12-MA
6a. NAME OF PERFORMING ORGANIZATION: Center for Mathematical System Theory-University of Florida	6b. OFFICE SYMBOL (If applicable):
7a. NAME OF MONITORING ORGANIZATION: U. S. Army Research Office	
6c. ADDRESS (City, State, and ZIP Code): 226 Larsen Hall, Gainesville, FL 32611	7b. ADDRESS (City, State, and ZIP Code): P. O. Box 12211, Research Triangle Park, NC 27709-2211
8a. NAME OF FUNDING/SPONSORING ORGANIZATION: U. S. Army Research Office	8b. OFFICE SYMBOL (If applicable):
9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER: DAAG29-85-K-0099	
8c. ADDRESS (City, State, and ZIP Code): P. O. Box 12211, Research Triangle Park, NC 27709-2211	10. SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)

RESEARCH IN APPLIED MATHEMATICS RELATED TO IDENTIFICATION OF NOISY SYSTEMS (Unclassified)

12 PERSONAL AUTHOR(S)
Kalman, Rudolf Emil

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Final Report	FROM 04/01/85 TO 09/30/87	1988 January 12	5

16 SUPPLEMENTARY NOTATION
The view, opinions and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation.

17. COSATI CODES		
FIELD	GROUP	SUB-GROUP

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
Applied Mathematics; Noisy Systems; Noisy Analysis; Static Systems.

19 ABSTRACT (Continue on reverse if necessary and identify by block number)

The research program for noisy analysis and noisy realization theory is only about half-way complete. An extensive amount of data analysis by computer was performed during the past two years, supplementing spot-checks in 1981-1984 on real data. These previous data analyses were important in showing that new research is needed. The empirical analysis of real data is related to the present build-up of the Center's own computer facilities and serves as a check on the programs being developed. The results of the theoretical and computer investigations on the identification of static systems (linear relations) will appear soon in the research monograph KALMAN [1988] that has been in preparation for several years. The objective of the monograph KALMAN [1988] is not only to explain the facts of life but also to enable the reader to duplicate the quite sophisticated data analysis procedures which we have developed. In short, the objective of the monograph is not polemical but tutorial.

20 DISTRIBUTION/AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION
☐ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	Unclassified
22a NAME OF RESPONSIBLE INDIVIDUAL	22b TELEPHONE (Include Area Code) / 22c. OFFICE SYMBOL

DD FORM 1473, 84 MAR — 83 APR edition may be used until exhausted. All other editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE
UNCLASSIFIED

Research in Applied Mathematics Related to Identification of Noisy Systems

Final Report

January 1988

R. E. Kalman
Principal Investigator

April 1, 1985 through September 30, 1987

U. S. Army Research Office
Grant Number DAAG29-85-K-0099

Center for Mathematical System Theory
University of Florida

Approved for public release;
distribution unlimited.

THE VIEW, OPINIONS, AND/OR FINDINGS CONTAINED IN THIS REPORT ARE THOSE OF THE AUTHOR(S) AND SHOULD NOT BE CONSTRUED AS AN OFFICIAL DEPARTMENT OF THE ARMY POSITION, POLICY, OR DECISION, UNLESS SO DESIGNATED BY OTHER DOCUMENATAION.

The grant period reported here (1985-1987) was, in many respects, a transitional one. Many of the publications listed below refer to work continued (or completed) from earlier grant periods. Two of the authors---BIRGET and EMRE---were postdoctoral fellows at the CENTER FOR MATHEMATICAL SYSTEM THEORY; their publications reflect continuing research at other universities, under support other than ARO-Durham.

The publications of BIRGET and EMRE belong, broadly speaking, to algebraic system theory. This direction of research is still active at the Center, but the main emphasis has shifted since 1985 to the analysis and theory of systems observed via noisy data.

Since the research program for noisy analysis and noisy realization theory is only about half-way complete, the number of publications reporting results of this phase of the grant are, at the moment, rather limited. (There are a number of internal unpublished lecture notes which are not available for general distribution.) See, however, two papers by the Principal Investigator, KALMAN [1985, 1987], which present the organizing ideas of the current investigation.

An extensive amount of data analysis by computer was performed during the past two years, supplementing spot-checks in 1981-1984 on real data (for example, the published data on the so-called Tintner meat-market problem). These previous data analyses were important in

showing that new research is needed. The empirical analysis of real data is related to the present build-up of the Center's own computer facilities and serves as a check on the programs being developed.

The results of the theoretical and computer investigations on the identification of static systems (linear relations) will appear soon in the research monograph KALMAN [1988] that has been in preparation for several years. There is a great deal of confusion in the literature about what the scientific issues of identification are. A coherent presentation of the results is almost impossible without a certain amount of tutorial material. The objective of the monograph KALMAN [1988] is not only to explain the facts of life but also to enable the reader to duplicate the quite sophisticated data analysis procedures which we have developed. In short, the objective of the monograph is not polemical but tutorial.

As soon as the Center computer facilities are fully operational and tested, we would be very interested in looking at real-data problems of Army Research Laboratories, not only to help them but to explore the potential breadth and applicability of the new methods.

References

R. E. KALMAN

[1987] "The problem of prejudice in scientific modeling", (to appear).

[1988] IDENTIFICATION, research monograph, Springer, (to appear).

PUBLICATIONS SUPPORTED BY THE GRANT

J. C. BIRGET

[1986] "Stability and j-depth of expansions", accepted by Bulletin of Australian Mathematical Society.

[1986] "The synthesis theorem for finite regular semigroups, and its generalization", 115 pages, accepted by Journal of Pure and Applied Algebra.

[1987] "Concatenation of inputs in a two-way automaton", 24 pages, submitted to Theoretical Computer Science.

[1987] "Two-way automaton computations", 34 pages, submitted to RAIRO, Informatique Theorique.

E. EMRE and J. H. SEO

[1987] "A realization theoretic solution of two analytic matrix equations with application to stabilization of infinite dimensional systems", November 1986, 20 pages, to appear in the Proceedings of the International Symposium of Mathematical Theory Networks and Systems, Arizona, 1987.

[1987] "A realization theoretic solution of two analytic matrix equations with application to stabilization of infinite dimensional systems", 33 pages, submitted to IEEE Transactions on Automatic Control.

E. EMRE, H. TAI, and J. H. SEO

[1987] "Transfer matrices, polynomial fractions and realization of continuous-time linear time-varying systems", 10 pages, to appear in Proceedings of the Allerton Conference, October 1987.

[1987] "Transfer matrices, realization and control of continuous-time linear time-varying systems via polynomial fractional representations", 37 pages, submitted to IEEE Transactions on Automatic Control.

J. HAMMER

[1987] "Assignment of dynamics for nonlinear recursive feedback systems", 41 pages, to appear in the Journal of Control.

PERSONNEL SUPPORTED UNDER THE GRANT

(a) Regular Personnel

Dr. R. E. Kalman, Principal Investigator

(b) Visitors

Short-term visitors for 1985/87

Dr. A. Lindenmayer, University of Utrecht, THE NETHERLANDS

Dr. Y. Rouchaleau, (now of Ecole Nationale Superieure des Mines de Paris, FRANCE)

Dr. J. Waldvogel, University of South Florida, Tampa, FL

Long-term visitors for 1985/87 (one month or more)

Dr. J.-C. Birget, (now on faculty of University of Nebraska)

Dr. E. Emre, (now on faculty of Texas Technical University)