

2

AD-A234 841

- 1 -

FINAL TECHNICAL REPORT

Office of Naval Research Contract Number: N00014-88-K-0084

"Chaotic and Bifurcating Nonlinear Systems Driven by Noise with Applications to Laser Dynamics."

1 December 1987 through 31 October 1989

No Fund Extension: 1 November 1989 through 31 March 1990

Principle Investigator:

Frank Moss
Department of Physics
University of Missouri at St. Louis
St. Louis, MO 63121

phone: 314 553-6150

Table of Contents

I. Summary of Work Accomplished	2
II. Index of Technical Reports	2
III. Index of Publications	3
IV. Form DD 882: Report of Inventions and Subcontracts	5

I. Summary of Work Accomplished

One aspect of the research work was focused on the effects of noise as a driving force in various nonlinear dynamical systems. Effects studied were postponements of bifurcations^{1,12}, state dependent diffusion², a mean first passage time in a system with both random temporal forcing in a random potential³, a mean first passage time problem with colored noise⁴.

A second aspect involved studies on switching properties of nonlinear systems in the presence of noise⁵, and a special application of the results to a noise quenched, correlated, spontaneous emission laser⁷.

A third major effort was devoted to studies on stochastic resonance (SR), with a remark on the theory⁸, a long work on the use of analog simulations in studies of SR^{9,11}, a study on order and disorder in SR¹⁰.

At this point, a study was done on noise induced topological transitions in the two-dimensional stationary probability density of an archetypal bistable system¹³.

Finally, a new quantity was introduced to general studies on SR: the escape time probability distribution, wherein the theory, digital and analog simulations were accomplished¹⁴. These new studies hold great promise for applications in a number of fields, including the creation of a deeper understanding of how noise assisted information is transmitted in biological neurons.

The superscripted citation numbers above refer to the Index of Publications listed in III below.

II. Index of Technical Reports

No technical reports were published during this period.

✓
Rec AD-A207132

A-1

III. Index of Publications

The following is a list of scientific papers published with support from this contract. This technical report is comprised of all papers cited below.

1. "Swept parameter induced postponements and noise on the Hopf bifurcation,"
Phys. Rev. A. 36 1492 (1987) (with Fronzoni and McClintock).
2. "Analog simulation of a simple system with state dependent diffusion,"
J. Stat. Phys. 54, 1411 (1989) (with K. Sinha)
3. "Mean First Passage Time in Random Fields", Phys. Rev. A
38 571 (1988) Rapid Communications (with A. Engel)
4. Comment on First Passage Time Calculations for Colored Noise Driven
Bistable Systems," Phys. Lett. A. 131, 322 (1988) (with F.
Marchesoni)
5. "Switching in the Presence of Noise: The Decay of an Unstable State,"
Phys. Rev. A 38, 4690 (1988) (with M. James, P. Hanggi and
C. Van der Broeck)
6. "Giorgio Careri: The Early Years and the Birth of Low Temperature
Physics in Italy", invited biographical sketch, J. Molec. Liquids,
41, 1 (1989) Special Issue in Honor of G. Careri.
7. "Noise Quenching in the Correlated Spontaneous-Emission Laser as a
Multiplicative Noise Process: The Role of Colored Noise",
Phys. Rev. A 41, 3950 (1990) (with James, Habiger, Risken and
Schleich).
8. "Remark on Stochastic Resonance", Phys. Rev. A 39, 4323 (1989)
(with Debnath and Zhou)
9. "The Use of Analog Simulation in Studies on Noise Driven Nonlinear
Dynamical Systems", Invited Review, Proceedings of the 10th Intern.
Conference on Noise in Physical Systems, Budapest, Hungary August
1989 (Akademiai Kiado, Budapest 1990)
10. "Stochastic Resonance: How Increasing the Noise Can Result in More
Order", Proceedings of the 10th Intern. Conference on Noise in
Physical Systems, Budapest, Hungary, August 1989 (Akademiai Kiado,
Budapest 1990)
11. "Analog Simulations of Stochastic Resonance", Phys. Rev. A 41,
4255 (1990) (with Zhou)
12. "The influence of colored noise on Hopf-bifurcating systems", in
Irreversible Processes and Selforganization, Teubner-Texte zur
Physik, band 23, edited by W. Ebeling and H. Ulbricht, Teubner-
Verlag, Leipzig, 1989 (with Schmera and Schimansky-Geier).

13. "Holes in the two-dimensional probability density of strongly colored noise driven bistable systems" Phys. Rev. A **42**, 703 (1990) (with Debnath, Leiber, Risken and Marchesoni)
14. "Escape time distributions of a periodically modulated bistable system with noise" Phys. Rev. A, **42**, 3161, 1990 (with Zhou and Jung)

REPORT OF INVENTIONS AND SUBCONTRACTS

Pursuant to "Patent Rights" (Contract Clause) (See Instructions on Reverse Side.)

FORM APPROVED
OMB NO. 0704-0016

1a. NAME OF CONTRACTOR SUBCONTRACTOR	2a. NAME OF GOVERNMENT PRIME CONTRACTOR	c. CONTRACT NUMBER	3. TYPE OF REPORT (check one)
UNIV. OF MO.		N00014-88-K-0084	☐ INTERIM ☒ FINAL
1b. ADDRESS (include Zip Code)	b. ADDRESS (include Zip Code)	d. AWARD DATE (YYMMDD)	4. REPORTING PERIOD (YYMMDD)
Dept. of Physics UMSL ST. LOUIS, MO. 63121			FROM: DEC 1987 TO: 31 MARCH 1990

SECTION I - SUBJECT INVENTIONS

5. SUBJECT INVENTIONS REQUIRED TO BE REPORTED BY CONTRACTOR/SUBCONTRACTOR (If "None", so state)		c. DISCLOSURE NO., PATENT APPLICATION SERIAL NO. OR PATENT NO.		d. ELECTION TO FILE PATENT APPLICATIONS		e. CONFIRMATORY INSTRUMENT OR ASSIGNMENT FORWARDED TO CONTRACTING OFFICER	
b.				UNITED STATES		FOREIGN	
NAME OF INVENTOR(S) (Last, First, M.I.)		TITLE OF INVENTION(S)		YES	NO	YES	NO
No INVENTIONS							
1. EMPLOYER OF INVENTOR(S) NOT EMPLOYED BY CONTRACTOR/SUBCONTRACTOR.							
2. NAME OF INVENTOR (Last, First, M.I.)		9. ELECTED FOREIGN COUNTRIES IN WHICH A PATENT APPLICATION WILL BE FILED.					
11. NAME OF EMPLOYER		i. TITLE OF INVENTION		ii. FOREIGN COUNTRIES OF PATENT APPLICATION			
13. ADDRESS OF EMPLOYER (include Zip Code)		iii. ADDRESS OF EMPLOYER (include Zip Code)					

SECTION II - SUBCONTRACTS (Containing a "Patent Rights" clause)

6. SUBCONTRACTS AWARDED BY CONTRACTOR/SUBCONTRACTOR (If "None", so state)		d. "PATENT RIGHTS"		e. DESCRIPTION OF WORK TO BE PERFORMED UNDER SUBCONTRACT(S)		f. SUBCONTRACT DATES (YYMMDD)	
a.		b.		c.		AWARD	
NAME OF SUBCONTRACTOR(S)		SUBCONTRACT NO. (S)		CLAUSE NO.	DATE (YYMM)	ESTIMATED COMPLETION	
No SUBCONTRACTS							

SECTION III - CERTIFICATION

7. CERTIFICATION OF REPORT BY CONTRACTOR/SUBCONTRACTOR. Not required if ☐ Small Business or ☐ Non Profit organization. Check appropriate box.	
8. NAME OF AUTHORIZED CONTRACTOR/SUBCONTRACTOR OFFICIAL Last, First, M.I. MOSS, FRANK. E	I certify that the reporting party has procedures for prompt identification and timely disclosure of "Subject Inventions" that such procedures have been followed and that all "Subject Inventions" have been reported
9. TITLE PROFESSOR OF PHYSICS	SIGNATURE OF AUTHORIZED CONTRACTOR/SUBCONTRACTOR OFFICIAL Frank E. Moss
	DATE 91 MAR 22 (YYMMDD)