AD-A160 212 MARKOV PROCESSES APPLIED TO CONTROL REPLACEMENT AND SIGNAL ANALYSIS(U) NORTHWESTERN UNIV EVANSTON IL E CINLAR 26 APR 85 AFOSR-TR-85-0828 AFOSR-82-0189 1/1

UNCLASSIFIED F/G 14/4 NL

1.0 1.1 1.25 1.4 1.6 1.8 2.0 2.2 2.5 2.8 3.2 3.6 4.0 4.5 5.0

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Unclas
SECURITY CLASSIFICATION OF THIS PAGE

AD-A160 212

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY UNCLASSIFIED	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE ----------	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) N/A	5. MONITORING ORGANIZATION REPORT NUMBER(S) AFOSR TR- 85-0828
6a. NAME OF PERFORMING ORGANIZATION Northwestern University; 6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION AFOSR
6c. ADDRESS (City, State and ZIP Code) Evanston, IL	7b. ADDRESS (City, State and ZIP Code) Bldg. 410 Bolling AFB, D.C. 20332-6448
8a. NAME OF FUNDING/SPONSORING ORGANIZATION AFOSR; 8b. OFFICE SYMBOL (If applicable) NM	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER AFOSR-82-0189
8c. ADDRESS (City, State and ZIP Code) Bldg. 410 Bolling AFB, D.C. 20332-6448	10. SOURCE OF FUNDING NOS.

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT NO.
61102F	2304	A5	

11. TITLE (Include Security Classification)
Markov Processes Applied to Control, Replacement & Signal Analysis

12. PERSONAL AUTHOR(S)
E. Cinlar

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Yr., Mo., Day)	15. PAGE COUNT
Interim	FROM 01 JUN 83 TO 31 DEC 84	26 April 1985	7

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB. GR.	Reliability of complex devices, random shapes, and deformation of solids
	XXXXXXXXXX		

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

Much of the work has been of an exploratory nature. The main thrust has been on the reliability of complex devices, on the problems of fatigue and fracture, and on the stochastic shapes that arise in manufacturing cylanders and spheres.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT UNCLASSIFIED/UNLIMITED X SAME AS RPT. ☐ DTIC USERS ☐	21. ABSTRACT SECURITY CLASSIFICATION Unclassified

22a. NAME OF RESPONSIBLE INDIVIDUAL	22b. TELEPHONE NUMBER (Include Area Code)	22c. OFFICE SYMBOL
Brian W. Woodruff MAJ, USAF	(202)767-5027	NM

DD FORM 1473, 83 APR EDITION OF 1 JAN 73 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE

AFOSR-TR- 85-0828

PROGRESS REPORT

ON

AFOSR GRANT NO. 82-0189

MARKOV PROCESSES

APPLIED TO CONTROL, REPLACEMENT, AND SIGNAL ANALYSIS

for the period

1 June 1984 - 31 December 1984

Principle Investigator

E. CINLAR

Northwestern University, Evanston, Illinois

This is a report on the work done under grant AFOSR 82-0189 during 1 June 1984 and 31 December 1984.

Much of this work has been of an exploratory nature. The main thrust has been on the reliability of complex devices, on the problems of fatigue and fracture, and on the stochastic shapes that arise in manufacturing cylinders and spheres etc.

A. RELIABILITY OF COMPLEX DEVICES

Reliability of devices with many components has been a difficult problem for probabilists for many years. The difficulty is caused by the dependencies between the lifetimes of the components because of the sameness of the environmental factors they are subjected to. Moreover, it has been difficult to find models that would enable the reliability engineer to estimate the reliability of a device in a mission from data obtained by laboratory experiments.

We have introduced a concept, which we call "intrinsic age" to relate the deterioration level of a component to the level it would have had if the component were kept under certain well regulated laboratory conditions. The concept is introduced axiomatically, and the rules for computing the intrinsic age (from historical and laboratory data) are given. Currently we are working on related problems on the joint evolution of the intrinsic ages of the components.

B. DEFORMATIONS OF SOLIDS

This is a continuation of the work on the nucleation and growth of microcracks. We had modeled this as a measure-valued Markov process, essentially capturing the evolution of the spatial configuration of microcracks. Our work on this is on the first passage time to a critical configuration, which would be (roughly) the useful lifetime of the material. The problem is turning out to be very difficult and we are looking for approximate solutions.

C. RANDOM SHAPES

When we manufacture a circular disk or a cylinder, the outcome is a random shape that is approximately a circle or a cylinder. The deviation from the desired geometric object is called surface roughness and is the cause of much concern in tribology (study of rubbing surfaces, lubrication theory, etc.). We have been working on the modeling of such surfaces. Mathematically, this is the study of stochastic processes whose parameter spaces are circles or cylinders etc. We have a good model for a random circle — it is stationary, reversible, continuous, and is a Gaussian Markov random field. Currently we are working on developing similar axiomatic random shapes for cylinders and circles.

END

FILMED

11-85

DTIC