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MARKOV PROCESSES APPLIED TO CONTROL REPLACEMENT AND
SIGNAL ANALYSIS(U) NORTHWESTERN UNIV EVANSTON IL
E CINLAR 26 APR 85 AFOSR-TR-85-0028 AFOSR-82-0189

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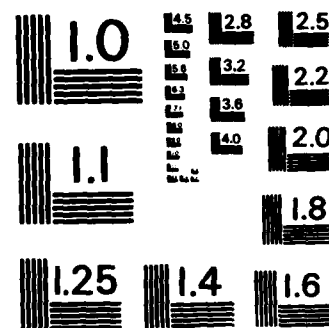
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Much of the work has been of an exploratory nature. The main thrust has been on the reliability of complex devices, on the problems of fatigue and fracture, and on the stochastic shapes that arise in manufacturing cylinders and spheres.

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Brian W. Woodruff MAJ, USAF

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(202)767-5027

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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



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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.

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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.

Division

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

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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.

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