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# Failure process in heterogeneous materials with randomly oriented fibers

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**Abstract:** Our aim in this paper is to investigate the failure process in heterogeneous materials with randomly oriented fibers. In this system, the fiber bundle model assumes that the all fibers are randomly oriented in all directions according to the vertical one. Our calculations are done in the framework of the local load-sharing rule (LLS) where the applied load of the broken fiber is only redistributed to its neighboring ones. The results show that this system presents a greater resistance than the classical one where the fibers are arranged parallel to the applied load. We found that the density of broken fibers exhibit a power law and a linearly one respectively with applied load and temperature. However, the results show that the failure process of the considered system is characterized by an avalanche phenomenon with two different regimes. We have also studied the crossover behavior of lifetime of the materials versus both applied load and temperature. We focus on the comparison of these results with those obtained in the classical model.

*Keywords:* avalanche phenomenon; classical fiber bundle model; terminal noise; local load sharing rule, random orientation

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## 1- Introduction

Composites materials are ones of heterogeneous materials which have been used extensively in several surveys areas such as space and aeronautical application, in marine and transportation [1]. On the other hand, In spite of not being used in some industries, composites materials are just now becoming a primary material of choice. The application fields of composites materials are growing rapidly. In additional, they have a great specific strength and stiffness, good resistance to fatigue, stability and lightweight. The study of damage and fracture process has attracted an intensive research over the past decades by both theoretical and experimental means. One of the first theoretical approaches to study this problem is the fiber bundle model (FBM) introduced by Peires in 1927 to understand the strength of cotton yarns [2]. Daniels and *al*. provided the probabilistic formulation of the model and carried out a comprehensive study of bundles of threads assuming equal load sharing after