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Exploring the chaotic behavior of quasistatic strength and fatigue tests for structural laminates of composite materials

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Abstract

Carbon-fiber-reinforced epoxy polymers (CFRP), a high-performance composite material, have been extensively studied. The initiation damage and progression process in strength and fatigue tests for these materials and the definition of strength and final failure are poorly understood since many considerable effects are disregarded under necessary hypothetical simplifications during simulations. This work investigates the behavior of CFRP under quasistatic tests, utilizing numerical simulations to explore physical phenomena through the explicit integration of finite element models. Various experimental modeling and evaluation tests were carried out, and many phenomena typical of chaotic dynamic systems were observed. Clear evidence is presented for the chaotic behavior of even a simple, physically discrete lumped element mass model chosen as a

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The Journal

minimalistic simplification of such laminates. The null hypothesis of a nonchaotic case is tested and confirmed using Student's t-test.

Keywords

chaos theory, dynamical systems, mechanical engineering, composite materials

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