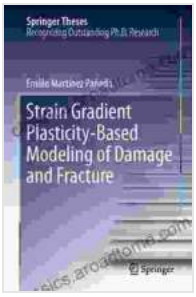
Strain Gradient Plasticity Based Modeling Of Damage And Fracture Springer Theses

Damage and fracture are two of the most important failure mechanisms in engineering materials. They can lead to catastrophic failures, resulting in loss of life and property. Therefore, it is essential to have a good understanding of damage and fracture phenomena in Free Download to design safe and reliable structures.

Traditional continuum damage mechanics (CDM) models have been widely used to predict damage and fracture in engineering materials. However, these models often fail to capture the complex microstructural mechanisms that govern damage and fracture at the material level. This is because CDM models are based on the assumption that the material is homogeneous and isotropic, which is not always the case in real materials.



Strain Gradient Plasticity-Based Modeling of Damage and Fracture (Springer Theses) by Erin Pruckno

4.4 out of 5

Language	: English
File size	: 9850 KB
Text-to-Speech	: Enabled
Screen Reader	: Supported
Enhanced typesetting	: Enabled
Print length	: 176 pages

Strain gradient plasticity (SGP) is a relatively new constitutive theory that can account for the microstructural effects on damage and fracture. SGP

models are based on the assumption that the material is heterogeneous and anisotropic, and that the mechanical behavior of the material is influenced by the strain gradients.

This book presents a comprehensive theoretical and computational treatment of damage and fracture phenomena in ductile materials based on SGP. The book begins with a review of the basic concepts of SGP. The following chapters then develop SGP-based models for damage initiation, damage evolution, and fracture. The book also includes a number of applications of the SGP-based models to engineering problems, including ductile fracture, fatigue crack growth, and stress corrosion cracking.

Strain Gradient Plasticity

SGP is a constitutive theory that extends classical plasticity theory by including the effects of strain gradients. The basic assumption of SGP is that the material is heterogeneous and anisotropic, and that the mechanical behavior of the material is influenced by the strain gradients.

The SGP constitutive equations are derived from a variational principle. The variational principle is based on the assumption that the material is in a state of minimum potential energy. The potential energy is a function of the strain, the strain gradients, and the internal variables.

The SGP constitutive equations are a set of partial differential equations. These equations can be solved using a variety of numerical methods. The most common numerical method used to solve the SGP constitutive equations is the finite element method.

Damage Initiation

Damage initiation is the process by which damage begins to develop in a material. The damage initiation criterion is a function of the stress, the strain, and the strain gradients.

There are a number of different damage initiation criteria that have been proposed in the literature. The most common damage initiation criterion is the maximum principal stress criterion. This criterion states that damage initiates when the maximum principal stress reaches a critical value.

Other damage initiation criteria include the maximum principal strain criterion, the maximum shear stress criterion, and the maximum strain gradient criterion. The choice of damage initiation criterion depends on the material and the loading conditions.

Damage Evolution

Damage evolution is the process by which damage grows and coalesces in a material. The damage evolution law is a function of the stress, the strain, the strain gradients, and the damage state variable.

There are a number of different damage evolution laws that have been proposed in the literature. The most common damage evolution law is the exponential damage evolution law. This law states that the damage state variable evolves exponentially with the plastic strain.

Other damage evolution laws include the linear damage evolution law, the power law damage evolution law, and the Weibull damage evolution law. The choice of damage evolution law depends on the material and the loading conditions.

Fracture

Fracture is the final stage of the damage process. Fracture occurs when the damage state variable reaches a critical value. The fracture criterion is a function of the stress, the strain, the strain gradients, and the damage state variable.

There are a number of different fracture criteria that have been proposed in the literature. The most common fracture criterion is the maximum principal stress criterion. This criterion states that fracture occurs when the maximum principal stress reaches a critical value.

Other fracture criteria include the maximum principal strain criterion, the maximum shear stress criterion, and the maximum strain gradient criterion. The choice of fracture criterion depends on the material and the loading conditions.

Applications

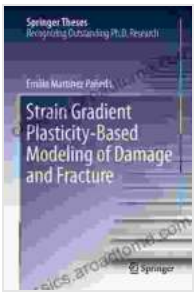
The SGP-based models for damage and fracture have been applied to a variety of engineering problems, including:

* Ductile fracture * Fatigue crack growth * Stress corrosion cracking * Hydrogen embrittlement * Creep damage

The SGP-based models have been shown to provide accurate predictions of the damage and fracture behavior of ductile materials. The models are also able to capture the effects of microstructural features on damage and fracture.

This book presents a comprehensive theoretical and computational treatment of damage and fracture phenomena in ductile materials based on

SGP. The book provides a valuable resource for researchers and engineers in the field of computational mechanics, fracture mechanics, and materials science.



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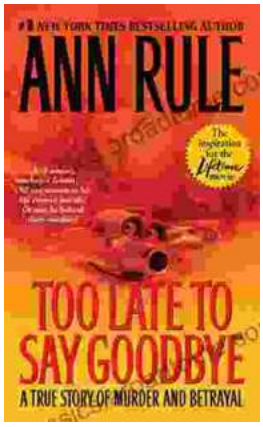

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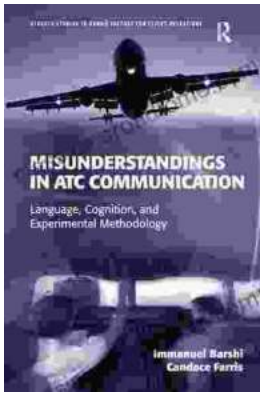

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