Failure behavior of unidirectional Carbon Fiber-Reinforced Composite (CFRP): Experimental investigation and comparison with an existing failure criterion

Background

Composite materials offer an extremely wide range of tailorable properties for specific applications and therefore a need for extensive mechanical characterization as well as efficient mechanical behavior modeling arises. Although composite materials have been studied for decades, only a limited amount of reliable experimental load cases exist and several studies show that failure criteria perform better depending on the load case applied.

Motivation

Taking advantage of a reliable automated testing system, a large database of tensile experiment has been created using off-axis unidirectional lamina specimen. This specimen uses the material anisotropy to create different stress states inside the lamina by changing the angle between the fiber and the tensile direction. The results of these experiments show a poor fitting between experimental data and theoretical failure criteria at low off-axis angle, leading to possible premature failure of the composite structure.

Thesis Objectives

This work is aimed at enlarging the failure database already created with data extracted from compressive tests. Several mechanical tests will be performed on a uniaxial compression machine. The tests will be post-processed and data extracted will be added to the existing database. The experimental data should be compared with several failure criteria in an attempt to assess them. The best failure criterion is to be implemented in an Abaqus Subroutine and validated using the experimental data. Other CFRP could be used to validate the failure criteria.

Tentative Timeline

The tentative timeline presented corresponds to 6 weeks of full-time work but can be adapted according to the student's preferences.

Week	Topic
1	Literature review + Existing database presentation
2	Experimental Testing
3	Post-processing
4	Database + FE Simulation
5	Failure criteria definition + FE Simulation
6	Writing

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