Ultrasonic Assessment and model validation of composite material damage

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1 Summary

Understanding the material interaction for induced damage in composites has become paramount because of the widespread use of composite materials in structural systems. This project combines experimental study with model validation for accurate health monitoring with predictive methods based on iterative updating.

As a group of three students you will:

- Learn ultrasonic theory and current practice
- Perform ultrasonic scans and interpret their results
- Learn composite material theory
- Perform composite material testing
- Understand the basics of the finite element (FE) method
- Complete an Abacus FE model with damage elements
- Validate the model using experimental updates

2 Description

The ultrasonic and model validation of composite materials is a comprehensive project that involves learning background theory, performing experimental tests, and using computer tools to model and evaluate the extent of damage within a composite. The initial damage initiation test will have been completed prior to the summer. An instrumented graphite epoxy plate is impacted with a steel projectile accelerated through a gas gun at fractional ballistic velocities to induce delamination. The plate is then cut into coupons.

An image scan of the post event coupons permits the identification of specific inter-ply failures and the boundaries of delamination. A pulse-echo ultrasonic system is employed to detect these invisible flaws and generate the image. The next step is to load the composite coupons under a regulated compression test to grow the region of delamination. After the loading, another ultrasonic test will experimentally validate the regions of delamination. An Abaqus model of the coupons is then compared to the ultrasonic images and loading test results in order to observe the mechanics of damage growth for updating an Abaqus finite element model. An updated model is used to predict the increase in delamination prior to a final compression test. A report detailing the experiments and models as well as the effectiveness of the prediction is then written for submission to an international conference.

3 References

Ultrasonics

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