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Damage characterisation of fibre reinforced polymers using modal analysis

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Introduction

Composites, especially long glass fibre reinforced composites are getting more and more importance in aircraft applications and so in aeronautics. Since the applications needed to be lightweight optimized, they are highly mechanically loaded. These loads are a combination of static and cyclic load leading to a loading scenario of load amplitudes with a certain amount of mean load. During a lifetime of a component, damage occurs. Damage detection and characterisation is important for preventing failure of components. This is done by optical inspections of micro cracks on the aircraft skin. Another possibility to get an idea about the damage is by measuring the stiffness. This is done during cyclic tests and captured with different moduli (e.g. tangent modulus). A stiffness measurement method, which is the main topic of this thesis, can be done by modal analysis [1].

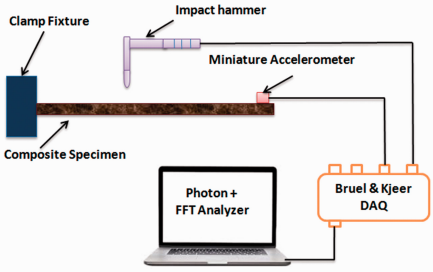

Figure 1: Principle of test setup [2]

Content

Basically composites are tested with different layups to get the bearable lifetime and the damage during the loading.

Tasks

- Literature studies composites and acoustic
- Test setup preparation
- Quasi-static tests
- Cyclic tests
- Modal analysis for damage characterisation
- Validation by digital image correlation (DIC)
- Validation by acoustic emission signals (AE)

Information

The work will be done in the Lab as well as on the computer.
Start: January 2024
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References

[1] M. Y. Abdellah, M. K. Hassan, A. F. Mohamed, K. A. Khalil, A novel and highly effective natural vibration modal analysis to predict nominal strength of open hole glass fiber reinforced polymer composites structure, Polymers 13 (8) (2021). doi:10.3390/polym13081251.

[2] Y. S. Munde, R. B. Ingle, I. Siva, A comprehensive review on the vibration and damping characteristics of vegetable fiber-reinforced composites, Journal of Reinforced Plastics and Composites 38 (17) (2019) 822–832. doi:10.1177/0731684419838340.

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