Improvement of Testing Methods for Composites at Intermediate Strain Rates

Sanghyun Yoo¹, Nathalie Toso¹, Giuseppe Catalanotti², Yves Toso¹, and Heinz Voggenreiter¹

¹ Institute of Structures and Design, German Aerospace Center (DLR), Stuttgart, Germany
² Advanced Composites Research Group (ACRG), School of Mechanical and Aerospace Engineering, Queen’s University Belfast, Belfast, UK

New dynamic testing set-up

Introduction

Motivation

- Reliable material properties are essential to support simulations.
- Experimental challenge on dynamic testing: to suppress spurious signals due to system ringing induced by the inertial effect of involved experimental devices.

Aim

- To develop new test procedures for the reliable and accurate material characterisation of Fibre Reinforced Plastics (FRP) composite at intermediate strain rate.

Working plan

- Analyse the dynamic interaction between test machine and test specimen.
- Develop a new test device with support of numerical simulations.
- Optimise test configuration and geometries of specimens.

Results

Evaluation of a new test device

- Purpose: to investigate the capabilities of a newly developed slack adapter and assess the dynamic interactions.
- Aluminium alloy 2024 T-3, which is known as strain-rate insensitive at intermediate strain rates, is selected as material to evaluate the test method.
- Dynamic tensile testing was carried out at 5 strain rate levels up to 400 s⁻¹.

Carbon/Epoxy composites

- Purpose: to evaluate a new test protocol for FRP composites incorporating a clamping method using specific adaptors and adhesives to reduce inertial effect-induced oscillations in measured force signals.
- To assess strain rate dependence of carbon/epoxy composites (Hexply® IM7/8552) at intermediate strain rates up to 200 s⁻¹ with/without damping materials.

Conclusions

- Test procedures are improved with the newly developed slack adapter and an adhesive bond clamping method.
- The use of damping material is crucial to obtain reliable dynamic properties.
- Dynamic material properties of carbon/epoxy composites at intermediate strain rates up to 200 s⁻¹ are available. The in-plane shear tests show a clear rate-dependent behaviour with increasing strain rates.

Potential Impact

- Test protocol/standardised procedures to perform the dynamic testing at intermediate strain rates.
- Reliable mechanical material data to support certification by simulations of crash events.
- Cost-effective design process through a combination of coupon level testing and simulation analysis at sub-component up to full-scale levels.

Contact
Sanghyun Yoo
Department of Structural Integrity
Institute of Structure and Design
E-mail: Sanghyun.Yoo@dlr.de

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