

A Comparison of Strain Measurement Systems in a Tensile Experiment

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SUMMARY

This paper shows an experimental comparison of Fiber-Bragg-Grating (FBG) strain gauges, electrical strain gauges and the photogrammetric strain systems IView and ARAMIS in a tensile test according to DIN EN ISO 527-1. Electrical strain gauges and photogrammetric strain measurement systems are commonly used for experimental and monitoring applications. An enhancement of these systems are fiber optical strain (FOS) gauges like the FBG sensor. The benefits of FOS strain sensors are low weight and the option to integrate the sensor in or on many different materials. Distances up to several hundred meters between the interrogator and the sensor, as well as the option to connect many independent sensors on one canal of the interrogator and high registration rate are ideal parameters for complex monitoring systems. The FOS sensor is nonsensitive of electromagnetic waves and can be used almost at any environment conditions.

All investigated systems were installed on a sample body consisting of a Fibre Reinforced Polymer (FRP) composite. The specimen was cut from a Pultruded FRP (PFRP) hollow section. PFRP shapes consist of E-Glass fibre reinforcement (layers of longitudinal rovings with woven and complex mattings) in a thermoset resin based matrix. For the photogrammetric systems a stochastic pattern was put on the backside of the sample body. Three experimental tensile procedures in the given strain range of the FGB sensor and a final procedure above the given strain maximum were taken.

The measured strain values from the different systems were compared and analyzed. Problems by the system comparison were detected and possible solutions were discussed. The effect of temperature changes over the time of measuring was the biggest error source and needed to be compensated. Techniques were used to reduce this error by a priori and a posteriori measurements with a FGB sensor and simultaneous temperature measurements with a second FBG sensor.