THU.3.B.4

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TITLE: LASER-BASED FREE-FORM SURFACE MODELLING FOR NDT AND SHM

ABSTRACTS

Laser-based nondestructive testing (NDT) plays an important role in understanding the mechanical behaviors of various structures. And geometry-based deformation monitoring is gaining increasing attention, where the measured point cloud data is parameterized by means of surface models such as polynomial, cylinder, B-spline, etc., so that the real structure is described in an analyzable 3D surface form. High-accuracy assurance of surface modeling is extremely critical for reliable deformation analysis. One main issue in this field is parameter selection which determines complexity of the models, where improper model complexity could result in under-fitting the real structure shape or over-fitting data noises, and thus a failure of the deformation analysis.

In order to determine the optimal surface model and enhance the high-accuracy modelling in the deformation analysis, we combine terrestrial laser scanning (TLS) and laser tracker (LT) technologies where a multi-sensor system could integrate advantages of different sensors and improve the quality of mission completed. The innovation of this paper is that the B-spline surface model is validated and optimized with high-accuracy points measured by LT corner cube reflectors. And hypothesis testing is adopted to select the optimal parameter model by judging most consistency of TLS and LT in various epochs. In the B-spline surface modeling, instrumental and computational uncertainties are considered through variance-covariance matrix and law of variance-covariance propagation. We construct the instrumental uncertainty model based on laser intensity value, as well as computational uncertainty model based on Gauss Markov model. Additionally, a sampling strategy is proposed to avoid data gaps and obtain even distributed data points.

KEYWORDS

NDT | Surface Modeling | Laser Tracker | B-spline approximation | Terrestrial Laser Scanning |