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Computational Model for Estimation of Deformed Shapes of Beam Structures using 3D Coordinate Information from Terrestrial Laser Scanning

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Summary

This paper presents a computational model to estimate deformed shapes of beam structures using 3D coordinate information from terrestrial laser scanning (TLS). The model is composed of five components: 1) formulation of polynomial shape function, 2) application of boundary condition, 3) inducement of compatibility condition, 4) application of least square method and 5) evaluation of error vector and determination of reasonable polynomial shape function. In the proposed model, the optimal degree of polynomial function is selected based on the complexity of beam structures, instead of using a specific degree of polynomial function. The chosen polynomial function for estimation is forced to satisfy the boundary and compatibility conditions and allows accurate estimation of a beam structure's deformed shapes and displacement. The proposed model is experimentally applied to estimation of deformed shape of a simply supported steel beam subjected to a concentrated load. The performance of the proposed model is investigated by comparing the deflections of the beam estimated from the model and the deflections directly measured from linear variable differential transducers (LVDTs).

keywords: Structural Health Monitoring, Measurement, Deflection, Deformation, Terrestrial Laser Scanning.

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