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The Estimation Method of Stress Distribution for Beam Structures Using the Terrestrial Laser Scanning

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Abstract : This study suggests the estimation method of stress distribution for the beam structures based on TLS (Terrestrial Laser Scanning). The main components of method are the creation of the lattices of raw data from TLS to satisfy the suitable condition and application of CSSI (Cubic Smoothing Spline Interpolation) for estimating stress distribution. Estimation of stress distribution for the structural member or the whole structure is one of the important factors for safety evaluation of the structure. Existing sensors which include ESG (Electric strain gauge) and LVDT (Linear Variable Differential Transformer) can be categorized as contact type sensor which should be installed on the structural members and also there are various limitations such as the need of separate space where the network cables are installed and the difficulty of access for sensor installation in real buildings. To overcome these problems inherent in the contact type sensors, TLS system of LiDAR (light detection and ranging), which can measure the displacement of a target in a long range without the influence of surrounding environment and also get the whole shape of the structure, has been applied to the field of structural health monitoring. The important characteristic of TLS measuring is a formation of point clouds which has many points including the local coordinate. Point clouds is not linear distribution but dispersed shape. Thus, to analyze point clouds, the interpolation is needed vitally. Through formation of averaged lattices and CSSI for the raw data, the method which can estimate the displacement of simple beam was developed. Also, the developed method can be extended to calculate the strain and finally applicable to estimate a stress distribution of a structural member. To verify the validity of the method, the loading test on a simple beam was conducted and TLS measured it. Through a comparison of the estimated stress and reference stress, the validity of the method is confirmed.

Keywords : structural healthcare monitoring, terrestrial laser scanning, estimation of stress distribution, coordinate transformation, cubic smoothing spline interpolation
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