

NOVEL METHOD FOR THREE-DIMENSIONAL VELOCITY AND ACCELERATION DETECTION WITH FBG ARRAYS

Lunwei Zhang^{*a)}, Haifeng Wei, Guobiao Yang

School of Aerospace Engineering and Applied Mechanics, Tongji University, Shanghai 200092, China

Summary A novel approach and experimental prototype for three-dimensional 3D velocity and acceleration detection are proposed. The SDM/WDM FBG sensor net is suitable for the discrete spatial velocity and acceleration field real time detection. Their principle, system set-ups and experimental results are discussed in details.

PRINCIPLE ON SPACIAL SHAPE/ORIENTATION/ VELOCITY AND ACCELERATION SENSING

The real-time measurement of velocity and acceleration is very important but difficult in civil engineering and mechanical engineering. A novel measurement method on three-dimensional velocity and acceleration of a flexible rod is presented. The principle is shown in Fig.1, a Fiber Bragg Grating (FBG) sensor device is designed to capture the real-time three-dimensional shape, orientation, velocity and acceleration of a slim SMA rod with the detection of its surface curvatures. The sensing device comprises a plurality of FBG sensor arrays mounted on the body of the flexible rod.

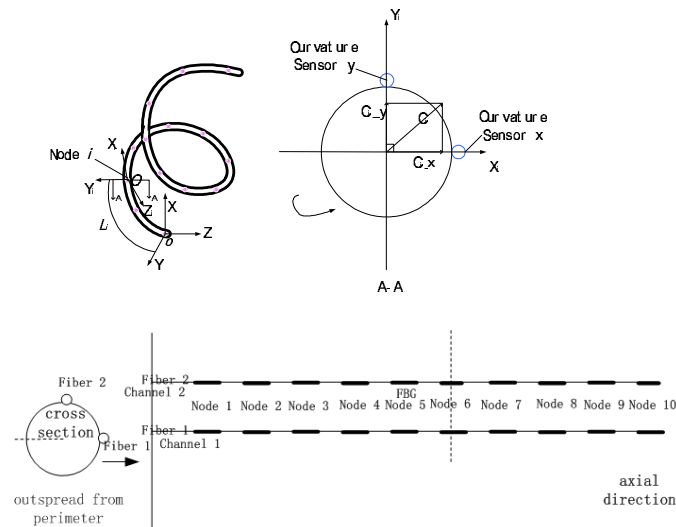


Fig.1 FBG Sensor Network for curvature sensing (SDM/WDM: 2×10 FBG)

EXPERIMENTAL PROTOTYPE, RESULT AND ERROR ANALYSIS

The FBG sensor arrays capture deformation of the sensor rod, and reconstruct its 3D shape in real time. Based on the coordination information, velocity and acceleration are calculated by the data analysis in time domain. Figure 2 shows the configuration of experimental system. Experimental results, the definition and components of the reconstruction error are also given in Figure 3 and Figure 4. After the successful building of the real-time sensing system, temperature influence and compensation is studied. The software interface for real-time computing and visual display of velocity and acceleration is also introduced.

^{a)} Corresponding author. Email: lwzhang@tongji.edu.cn

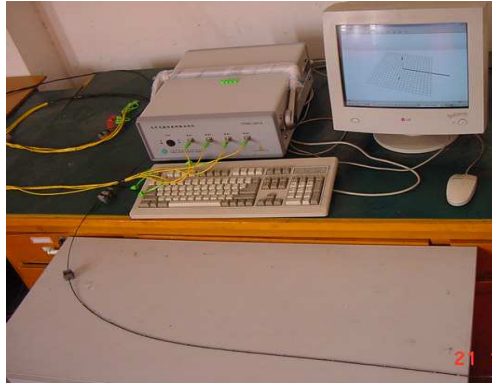


Fig.2 Experimental system setup

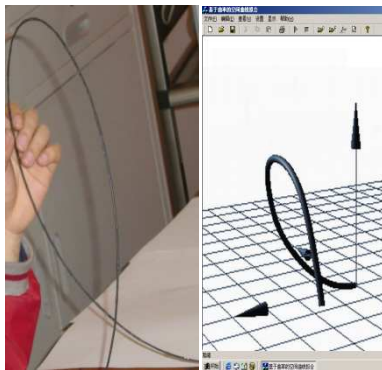


Fig.3 Shape and orientation reconstruction result

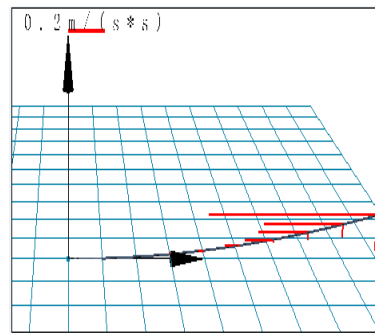


Fig.4 Interface of acceleration detection

CONCLUSIONS

A novel approach and experimental prototype for three-dimensional 3D velocity and acceleration are proposed. The SDM/WDM FBG sensor net is suitable for the discrete spatial curvature field real-time detection with a sampling frequency of 2000Hz. Experiments are undergoing to prove the validity of the sensing system. (The paper will include 8 figures and 2 tables)

References

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