Six-component Seismometer Based on Optical Fiber Bragg Grating

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We have invented a new device to record seismic signals using optical fiber Bragg grating (hereafter, FBG). The wavelength of the reflected optical signals from FBG is sensitive to stress(es) being loaded or thermal change, etc. The vessel of the instrument, being rectangular hereafter, has a small weight in the central position. The weight is suspended with optical fiber segments from the six inner walls of the vessel. Each fiber segment from the wall to the weight has FBG section in the middle part. For keeping uniform and tight connection between the wall and the weight, we must apply some additional tensional stress to all of the fiber segments.

The vertical componet of translational acceleration can be estimated from the difference between two reflected optical signals from oppositely settled vertical fiber segments which sustain the weight in the upper and lower vertical directions. Similarly, the other components of translational acceleration can be calculated. We can extract the horizontal component of rotational acceleration using reflected optical signals from at least four horizontally settled fiber segments around the weight. In this case the horizontal fiber segments are obliquely stretched from the inner wall to the weight in order to perceive the change of horizontal rotational torque. The other components of rotational acceleration are similarly calculated. Using the optical reflected data of the device to record the rotational acceleration, we can again estimate the translational acceleration.

Thus, the device can simultaneously observe both the tree independent components of translational acceleration but also of rotational acceleration, after compensating the effect of the thermal change etc. The Japanese patent directly related to the device is 'seismometer' (no. 3360257).