FIBRE OPTIC SAGNAC INTERFEROMETER AND REKATED SENSING DEVICES FOR ROTATIONAL SEISMOLOGY AREA OF APPLICATIONS

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Rotational Seismology is a wide, rapidly growing scientific discipline for research of all rotational ground movement aspects generated by earthquakes, explosions and ambient vibrations. Its development has been induced by the observations of atypical, torsional deformation of structural objects. In its interest one can distinguish two application fields: seismological and engineering. Seismological application contains investigation associated with broadband seismology, strong-motion seismology, earthquake, seismic hazards, seismotectonics, geodesy as well as physicists using Earth-based observatories for detecting gravitational waves. While engineering application includes research of an impact of rotational ground motion on engineering constructions. It should be underlined that rotational components with low frequencies can provide a total rotation of building support even with overturning motion. The generated in this case vibrations increase as the high and stiffness of building increase. Both application fields forced strict technical requirements regarding rotational seismometers. First of all the rotational sensors should have high sensitivity of the order of 10-8 rad/s/Hz1/2 as well as should be completely insensitive to linear movements in order to do not disturb recordings by seismic waves distinguished by classical seismology (body and surface waves). The lecture presents a review of existing technologies of rotational seismometers with their parameters confronted with Rotational Seismology technical requirements. One can point out mechanical, electrochemical, magnetohydrodynamical as well as optical technologies of rotational seismometers. The performed analysis has emphasised that optical solution uses Sagnac interferometer is the most appropriate technology for rotational seismometer design but only this optimized to measure rotation rate not angle changes. It assures completely sensitivity to linear motions, direct measurement of rotation as well as mobility. The lecture presents advantages of the FOSREM - Fiber–Optic System for Rotational Events & Phenomena Monitoring which is constructed in order to meet all technical requirements forced by Rotational Seismology applications. It uses the Sagnac effect in an special electrooptical configuration wide use in fiber-optic gyro. FOSREM allows to measure rotational movements in a wide range of signal amplitude (2·10-8 rad/s to 10 rad/s) as well as frequency (DC – 328 Hz). It can be mounted in any place due to its remote control module via Internet and an independent power supply. The presented laboratory experiments as well as its test at seismic table during real earthquakes simulation, confirmed its parameters and suitability for Rotational Seismology measurements. The applied a mechanical housing printed on the 3D Printer MakerBot guarantees mechanical resistance which was confirmed during vibration test on an orbital shaker. The thermal stability of FOSREM has been verified in a climatic chamber, an obtained signal instability less than 0,03 %/oC. Finally the comments for recent data obtained during FOSREM uses in seismological laboratory in Książ, Poland are also presented.