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Fiber Optic Sensing Technology Based on Fabry-Perot Interferometry and its Application in Settlement Monitoring of Pumped Storage Power Stations

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Abstract

The sensing principles mainly used for dam structure health monitoring include the vibrating wire principle, the differential resistance principle, the Fabry-Perot interference principle, the fiber Bragg grating principle, the vacuum laser collimation principle, and the distributed optical fiber principle, etc. In the structural safety monitoring of pumped storage power stations, manual observation still accounts for a large proportion. Currently, the Beidou positioning, vacuum laser collimation measurement, vibrating wire sensors, and fiber Bragg grating sensors have all been applied. However, there are still problems such as insufficient environmental adaptability to harsh climates and complex geological conditions, vulnerability to vibration, large temperature differences, lightning strikes or electromagnetic interference, and the need to further improve accuracy and stability. To better solve the problems of sensor fatigue resistance and low-temperature drift, this study uses a fiber Fabry-Perot sensor. Through nanometer-level high-precision measurement of the interference cavity length, it achieves high-precision monitoring of the displacement, strain and settlement of the pumped storage power station dam. It has been confirmed that this new type of settlement sensor has the advantages of high precision, simple structure, high sensitivity and automatic temperature compensation.