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Novel Technique of On-Demand Monitoring of Slider Displacement in Seismic Isolator

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ABSTRACT

Seismic isolation is a common technique used for the protection of structures and equipment from earthquakes. There are several types of devices providing seismic isolation. One of the most popular and commonly used one is a friction pendulum bearing (FPB). The main idea behind a FPB is based on sliding of movable spherical surfaces in respect to those that are fixed. A slider in between the surfaces allows this to be possible. Since there is some friction associated with the slider's performance, the restoring force is not enough to bring the slider to its zero position and, as such, there is a possibility of a residual displacement after a seismic event. Monitoring of these displacements is essential to ensure that the isolation can still accommodate a displacement demand of a future earthquake. A technique of on-demand monitoring of this displacement is developed in this paper. A short range LiDAR is used and the feasibility of the approach is validated by tracking geometric shapes with precisely known displacements. Due to recent explosive developments of LiDAR and laser scanning technologies driven by demand on collusion detection for autonomous car and robotic industries, the cost of these devices is going down quite dramatically. The device utilized in this approach is competitively priced that allows mass installation on all FPBs used in any particular project without a significant cost increase. In addition, the residual displacements can be measured simultaneously on all devices that allow instantaneous assessment of all FRB after an earthquake. The benefits of this approach are validated in the tests conducted on a full-scale FPB with a full stroke of ±81.3 cm. The accuracy of the technique developed herein is compared against more accurate conventional instruments and a terrestrial laser scanner.

Keywords: *Friction Pendulum Bearing, Component Testing, Structural Health Monitoring, On-demand Monitoring, Seismic Isolation, Lidar, Laser scanning*