

Non-contact Testing of Large Concrete Structures for Voids and Delaminations

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Concrete is the most used construction material for civil engineering structures, as it is reliable, cost-efficient, and long lasting. Infrastructure made of reinforced concrete can be used for many decades, provided that maintenance is rigorous. The necessary periodic checks are typically manual tasks, including visual inspection for defects on the outside and hammering to find internal voids and imminent spalling. In this paper, a non-contact system for automated inspection is presented. Two parallel lasers are used with a scanning head on a mobile platform to cover large areas. The first laser emits a high energy pulse, igniting plasma on the surface and subsequently inducing a shock wave into the structure. The second laser measures the resulting vibration. Signal analysis of individual measurement points give a first indication about the presence of faults. Unsupervised learning and visual computing are used to find and narrow down damaged areas in the scanning data with higher probability. After systematic testing in the laboratory, measurements were conducted recently in two tunnels with concrete linings. This paper provides an overview of the developed hardware and signal analysis techniques. Furthermore, the recent verification results are presented for the first time. In future, the proposed method can be combined with geometric scans and automated optical inspection of the surface to offer a holistic inspection approach and relieve the authorities that are responsible for operation and maintenance of the growing number of aging infrastructures.