

NeRF Generated Digital Twin Model for a Real-Time, Perspective-Free Visual Analytics

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Traditional structural inspections are often intrusive and disruptive to structures, and significantly hinder the productivity of the system. As the demand for more efficient and non-destructive inspection methods using digital twins arise, there is a need for more advanced computer graphics and simulation technique to achieve highly detailed modeling of structures. This paper introduces a method for non-intrusive structural inspections through the use of NeRF generated Digital Twin. NeRF (Neural Radiance Fields) is a specialized neural network technique used to create a photorealistic Digital Twin with accurate 3D modeling and ROI. By strategically placing cameras within structures, numerous features can be matched to generate a sparse point cloud. Subsequent training of the network allows for the generation of a Digital Twin that mirrors the structure's current state. This method becomes particularly useful in locations where physical access of human inspectors may be limited, or dangerous. The model, at any given timeline, can be exported to Unity, allowing for panning, rotation, and zooming, facilitating more detailed examinations. This real-time high-fidelity simulation allows instantaneous insights of professionals with remote access. Furthermore, post-processing machine learning techniques can be incorporated for automated visual diagnosis, alerting inspectors when needed. This approach of NeRF Generated Digital Twin based Non-Intrusive Inspection takes advantages of the newest computer graphics techniques to Structural Health Monitoring, minimizes risks, inspection time to enhance overall quality of the infrastructure assessments.