Data Localization on A Digital Twin Model to Enable Remote Assessment: Implementation on a full-scale Ship Engine

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The study focuses on Engineering Soft-Power, a subset of automated visual analytics within the broader field of visual analytics. It introduces a method for generating digital representations of a multi-storied ship's engine using Structure-from-Motion (SfM), a technique that estimates the geometric relationship between images and the physical location in 3D space, which generates a 3D point cloud. This representation forms the basis for creating a digital twin, which is a dynamic model updated in real-time with new information obtained through sensors, simulation, machine learning, and other reasoning capabilities to aid decision-making. The process in this study involves four main steps: Image Acquisition (important because higher-quality images return better results), Model Creation using SfM techniques (done using computer vision and can be very computationally intensive), ROI Generation (allowing user-selected areas for detailed inspection), and Information Synchronization (for continuous updating of images for structural health monitoring applications). This method combines the digital representation with a Region of Interest (ROI) locator which collects all the images containing the desired region and displays them for the user. This combination enables user-driven input for monitoring specific areas of the model, providing a comprehensive approach to Structural Health Monitoring Digital Twins. This method was tested using a real ship engine proving its usefulness and viability with current technologies.