**Creation of Ultrasonic Digital Twin for Structure Qualification**

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ABSTRACT

This work addresses the need for accurate digital models of assets and structures requiring routine monitoring and qualification. A digital twin is a virtual model of a real-world object updated continuously over time or for different object versions. Most existing digital twins mainly use geometric model information; current digital twins do not incorporate data from the ultrasonic nondestructive evaluation (NDE). In this work, we aim to develop a framework for digital twin creation from ultrasonic testing (UT) data, termed an ultrasonic digital twin (UDT). The framework for UDT creation will have the potential for structure qualification, ensuring that assets meet the desired specifications of manufacturers and operators. The UDTs created in this work will capture UT data features such as backscatter energy, ultrasonic attenuation, and transmission coefficients, with the potential for data fusion of datasets collected with alternative methods such as structured light or 3D scanners, which will be used to develop a framework for part qualification. The physical properties measured using UT will be spatially recorded in three-dimensional data structures known as voxels, which store secondary datasets linked to a volume of the digital twin. The voxel volume is directly related to the spatial resolution of the digital twin. Developing a UDT framework leads to more efficient and effective structural health monitoring and qualification. While this work intends to focus on conventionally manufactured structures, future works can explore UDTs created in situ from non-conventional manufacturing methods such as additive manufacturing.

**Keywords:** digital twin, ultrasonic testing, nondestructive evaluation