

As part of the EPSRC's Made Smarter Innovation project, Drone Video-based 3D Generation is a cutting-edge technique that enables fast and accurate 3D reconstruction of real-world environments from drone-captured video footage.

This innovative approach supports real-time monitoring, analysis, and decision-making within AI-enabled digital twin systems, particularly in the manufacturing process. By providing precise, up-to-date 3D models, this technology enhances the efficiency and responsiveness of digital twin systems, enabling smarter, data-driven decisions and process optimizations in dynamic industrial environments.

Motivation	3D Model: Drone + AI	Results
Human Scanning Time-consuming; Inconsistency	Sensor on Drone	3D Model Accuracy with CAD (mm)
Automatic Sensor Cost; Calibration	Distributed Stations	3D Model Accuracy with CAD (mm)
Multi-view AI Data Collection; Computation	Large Structures	3D Model Accuracy with CAD (mm)
		<p>(1) Car Door (Video by M3T Drone)</p> <p>(2) Car Door (Video by Mobile) Size: 1300 mm (width), 1400 mm (height), 10 - 170 mm (thickness)</p>

DV-3DGS Framework

Drone Video-based 3D Gaussian Splatting (DV-3DGS) is a novel rendering technique designed to efficiently represent 3D scenes using **Gaussian blobs**. This approach enables fast, scalable, and high-quality rendering of complex geometries and textures derived from drone-captured video footage. DV-3DGS consists of two main stages: **Structure from Motion (SfM) Initialization** and **Optimization of 3D Gaussian Splatting**, making it a powerful tool for industries reliant on drone-based visual data.

Stage 1: Initialization SfM

Stage 2: Optimization of 3D Gaussian Splatting

AI-Enable Digital Twin System

Key Challenges:

- Data silos
- Data privacy/security
- Limited data availability
- Difficulty in labelling
- Costly in CAD model
- Real-time defect control
- Complex 3D dynamic scene construction

User-defined upload **local** data (signal, video...)

AI-Enabled Digital Twin:

- Comprehensive Data/AI Model Integration
- Real-Time Quality Control
- Advanced Root Cause Analysis
- 3D Virtual Environment Construction
- Predictive Maintenance
- Optimized Performance and Efficiency

3D Object Model, Quality Analysis Report, Performance Optimization Suggestions, Predictive Maintenance Alerts, ...

Aerospace (Aircraft Component Manufacturing)

Shipbuilding (Hull Welding and Assembly)