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The Harvest4D Consortium consists of research groups specialising in Computer Graphics and Vision.

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Harvesting Dynamic 3D Worlds from Commodity Sensor Clouds

Project context & objectives

The current acquisition pipeline for visual models of 3D worlds is time consuming and costly: The digital model of an artifact (an object, a building, an entire city) is produced by planning a specific scanning campaign, carefully selecting the acquisition devices, performing the onsite acquisition at the required resolution, and then post-processing the acquired data to produce a beautified triangulated and textured model.

However, in the future we will be faced with the ubiquitous availability of sensing devices that deliver different data streams that need to be processed and displayed in a new way, for example smartphones, commodity stereo cameras, cheap aerial data acquisition devices, etc.

We therefore propose a radical paradigm change in acquisition and processing technology: instead of a goal-driven acquisition, in which the position and type of devices and sensors to be used are determined ahead of the process, we let the available sensors (smartphones, stereo scanners, etc.) and resulting incoming data (photos, videos, gps,...) guide and optimize the acquisition process.

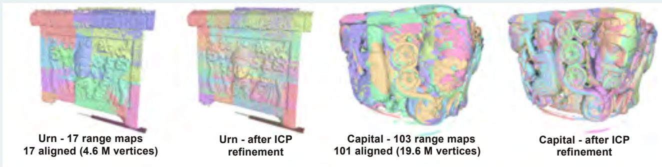
Project vision & expected results

Our vision is that the concept of incidental data capture will lead to a new methodology for 3D world acquisition. We aim at a proof of concept, supported by a prototype implementation, to demonstrate the viability of this approach by the end of this project.

Showcases

Floating Scale Surface Reconstruction: This approach is able to efficiently reconstruct high-quality meshes from acquired sample data even for large and noisy datasets sampled at widely varying scales.

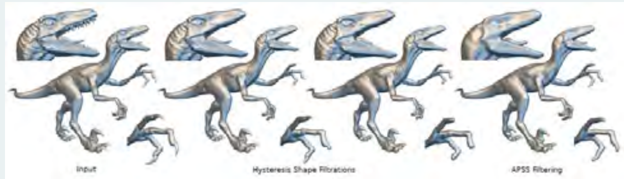
Real-time Views in 3D Virtual Cities: This new technique based on canonical views improves the recognizability of buildings and helps users explore virtual cities more efficiently.



Fast and Simple Automatic Alignment of Large Sets of Range Maps: We developed a system that is capable of aligning sequences of up to hundreds of range maps in a few minutes with minimal error.

Automatic Detection Of Geometric Changes In Time Varying Point Clouds: The core of this algorithm is a module for the geometric comparison of two registered point clouds based on a Moving Least Squares approach.

Large-Scale Point-Cloud Visualization: This two-phase approach produces a high-quality visualization of sampled point-cloud data augmented with photographs.



Point Morphology: Morphological Analysis Framework For 3D Point Clouds: We analyze the morphology of 3D objects based on a single projection procedure operating on unstructured point clouds. We propose applications which benefit from the non-linear nature of morphological analysis and can be expressed as simple sequences of our operators, including medial axis sampling, hysteresis shape filtering and geometry-preserving topological simplification.

Synthesized images of the same material sample demonstrating the large variation under different viewing and illumination conditions.

Material Classification Based on Training Data Synthesized Using a BTF Database: To cope with the richness in appearance variation found in real-world data under natural illumination, we propose to synthesize training data capturing these variations and use them for material classification in incidentally captured data sets.