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Mixed Reality using a Lidar and a 4D Studio

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Abstract for demonstration

***Abstract*—In this demo we present a system for creation and visualization of mixed reality by combining the spatio-temporal model of a real outdoor environment with the models of people acting in a studio. We use a LIDAR sensor to measure a scene with walking pedestrians, detect and track them, then reconstruct the static scene part. The scene is then modified and populated by human avatars created in a 4D reconstruction studio.**

I. Introduction

Real-time reconstruction of outdoor dynamic scenes is essential in intelligent surveillance, video communication, mixed reality and other related applications. In contrast to 2D video streams, a reconstructed 4D scene can be viewed and analysed from any viewpoint, and it can be virtually modified by the user. However, building an interactive 4D video system is a challenging task that requires processing, understanding and real-time visualization of a large amount of spatio-temporal data.

II. The i4D System

Two research laboratories of MTA SZTAKI have built an original *integrated 4D* (i4D) system for spatio-temporal (4D) reconstruction, analysis, editing, and visualization of complex dynamic scenes. The i4D system [1] efficiently integrates two very different kinds of information: the outdoor 4D data acquired by a rotating multi-beam LIDAR sensor, and the dynamic 3D models of people obtained in a 4D studio. This integration allows the system to understand and represent the visual world at different levels of detail: the LIDAR provides a global description of a large-scale dynamic scene, while the 4D studio builds a detailed model, an avatar, of an actor (typically, a human) moving in the studio.

In our project, a typical scenario is an outdoor environment with multiple walking people. As shown in Fig. 1, the LIDAR measures the scene from a fixed or moving position and yields a time-varying point cloud. This data is processed to build a 3D model of the static part of the scene and detect and track the moving people. Each pedestrian is represented by a sparse, moving point cluster and a trajectory. A sparse cluster is then substituted by an avatar created in our 4D studio [2]. This results in a reconstructed and textured scene with avatars that follow in real time the trajectories of the pedestrians.

Sample results of the 4D reconstruction and visualization process are shown in Fig. 2. The pedestrian trajectories are obtained by motion-based segmentation and tracking in the dynamic point cloud. Each avatar follows the prescribed 3D trajectory. Its orientation and rotation to the proper direction are automatically determined from the trajectory.

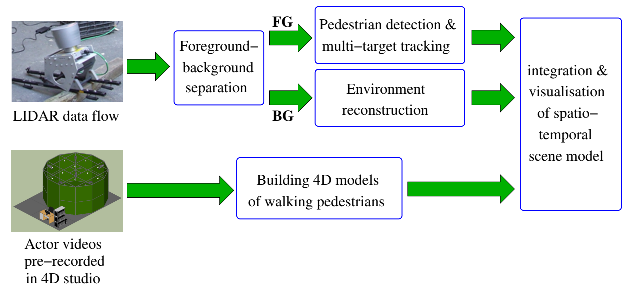

Fig. 1. Flowchart of the i4D system. **BG** is background, **FG** foreground.

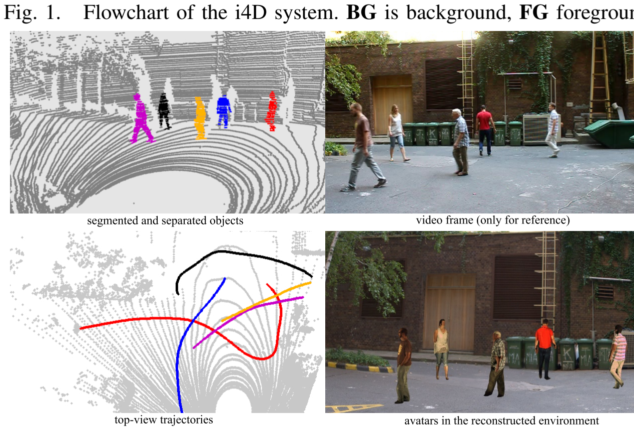

Fig. 2. Results of object tracking and integrated dynamic scene reconstruction

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