DroneOpticStudio

Dense Reconstruction of a Moving Dynamic Actor

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Goal: Dense 3D reconstruction of a moving actor in natural environments with flying cameras

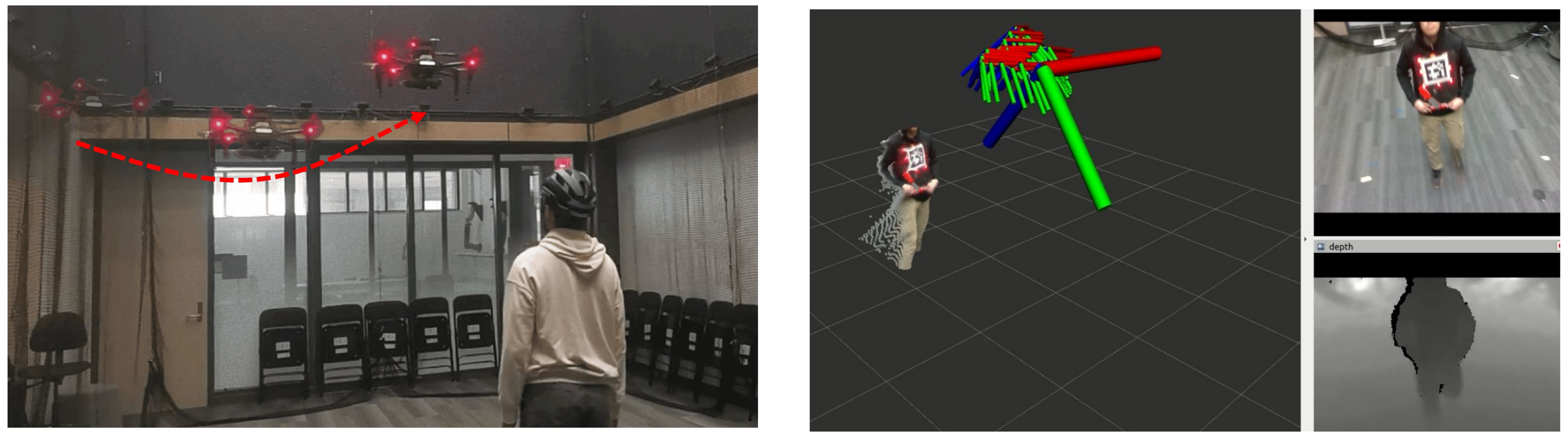
Input: Images acquired from sparse cameras surrounding a subject.

Output: A comprehensive, high-fidelity 3D reconstruction of the subject.

Challenges: (1) Obtaining adequate coverage through an optimal camera configuration around the subject;
(2) Creating a complete 3D reconstruction necessitates fusing the 3D predictions from multiple views into a canonical space.

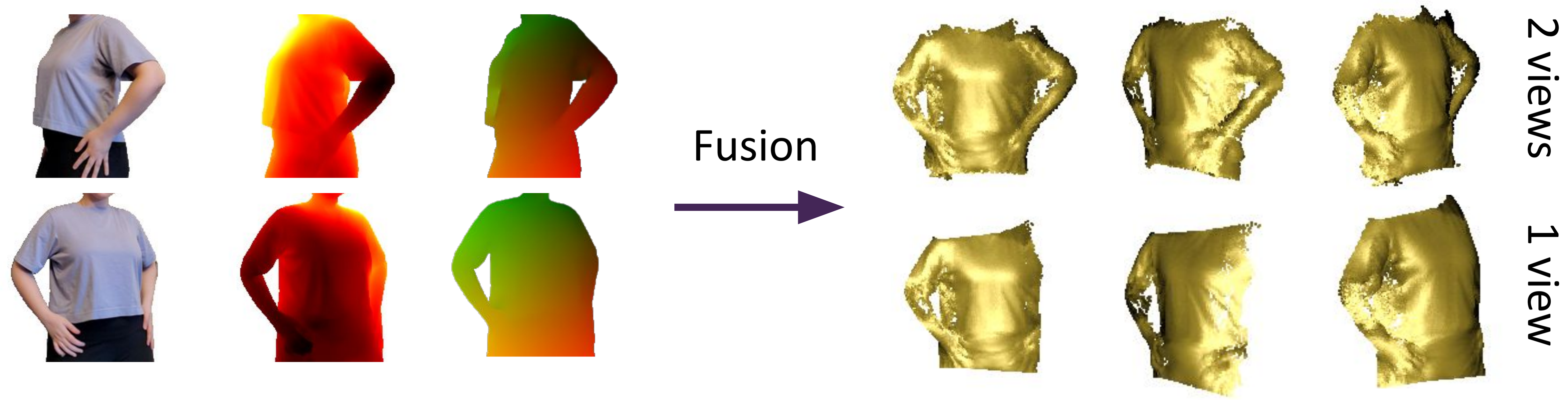
Solution: (S1) Using a view quality metric to select the optimal camera pose (good view selection);
(S2) Fusing the depth predictions from multiple views through a multi-view, high-fidelity UV prediction.

(S1) What is a 'good' view to reconstruct a dynamic human?



We use **geometric representation** (a set of patches with normals) to model a dynamic human. We propose a view quality metric (**Pixels-Per-Area: PPA**) which considers the **viewing angle** and the **viewing distance** for each patch. And we plan views by **optimizing the PPA metrics** during the flight for better 3d reconstruction quality [4].

(S2) How to reconstruct a dynamic human?



We propose a novel method to reconstruct high-fidelity 3D models from multiple views, by fusing single-view detailed depth maps [1,2] via multi-view UV maps [3]. The UV map preserves the **isometry** with the underlying 3D surface and the depth estimation make use of **social media dance videos** to address the availability of ground truth data limitation in a **self-supervised manner.**

[1] Jafarian, Yasamin, et al. "Learning high fidelity depths of dressed humans by watching social media dance videos." CVPR 2021.
[2] Jafarian, Yasamin, et al. "Self-supervised 3D Representation Learning of Dressed Humans from Social Media Videos." TPAMI 2022.
[3] Jafarian, Yasamin, et al. "Normal-guided Garment UV Prediction for Human Re-texturing." CVPR. 2023.
[4] Jiang, Qingyuan, et al. "Onboard View Planning of a Flying Camera for High Fidelity 3D Reconstruction of a Moving Actor." (Submitted)

Impacts:
- Entertainment industry Autonomy
- AR/VR technology 3D reconstruction
- Human activity/cultural study in 3-D

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