FULLY AUTOMATED HIGHLY ACCURATE 3D RECONSTRUCTION FROM MULTIPLE VIEWS

Thomas Ebner, Oliver Schreer, Ingo Feldmann
Fraunhofer Institute for Telecommunications, Heinrich Hertz Institute, HHI

(1) Introduction
- Highly accurate 3D reconstructions of real-world objects are more and more important in various fields of application, e.g. for realistic scenes of architectural sites in virtual museums
- Algorithmic pipeline from input images to output 3D model
- Core component: dense depth based 3D surface reconstruction
- Main objective: high degree of automation and reconstruction accuracy

(2) Fully automated pipeline
- Input: set of images capturing the object from different views
- Initial 3D point cloud and calibration parameters by applying VisualSFM[1] and SIFT on GPU[2]
- Automatic pairwise camera pre-selection for robust depth estimation by considering the constraints Compactness, Suitability, and Coverage
- Initial depth map generation by extracting visibility information from SFM output
- Depth refinement by applying the highly accurate Patch-Sweeping algorithm[3]
- Depth map fusion by applying the visibility-driven patch group generation[4]
- Output: high-resolution 3D model

(3) Reconstruction results
- Verification of the reconstruction quality using several reference data sets, e.g. fountain-P1[5]
- Comparison of the reconstruction quality with several reference methods, e.g. the Patch-based Multi-view Stereo Software (PMVS)[6]
- Significant improvement of visual quality and geometric details compared to PMVS method

(4) Comparison with state-of-the-art software
- Evaluation of several professional tools available on the market
- Individual pros and cons regarding automation and performance

Autodesk ReMake[7]
- supports only JPEG images
- + visual quality of reconstructed object
- – coarse geometry, details mainly through texture
- + meshes usually watertight
- + fully automated
- + easy-to-use workflow
- + good background segmentation
- – manual parameter adjustments not possible

Our Approach
+ supports several image formats
+ visual quality of reconstructed object
+ highly accurate and dense geometry
+ meshes usually watertight
+ fully automated
+ easy-to-use workflow
+ good background segmentation
+ manual parameter adjustments possible

Agisoft PhotoScan[8]
+ supports several image formats
+ visual quality of reconstructed object
+ highly accurate and dense geometry
+ meshes often contain holes
+ semi-automated
+ complicated workflow
+ manual masking recommended
+ manual parameter adjustments possible

Comparison of most significant Pros (+) and Cons (-)