Photo realistic 3D reconstruction and rendering using high resolution images

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Digitalization of objects has a vast field of application including conservation of cultural heritage, quality control and reverse engineering. We are developing a new scanning device together with algorithms for capturing shape, color and reflectance properties of objects. A major goal of this project is a high quality of the reconstructions. Key for a faithful reconstruction is the precise capturing of shape and appearance.

The precision of reconstructed 3D information highly depends on the quality of the input data. Input images are always affected by certain amounts of sensor noise and nonlinear intensity mappings. The reconstruction quality of all image based approaches however depends heavily on a consistent pixel information available in each image. We aim for the development of new techniques that provide an increased robustness with respect to a larger variety of different material types [1].

For a photo realistic rendering additionally the appearance of the object surface has to be captured and reconstructed. This is usually done by simulating different lighting situations. Current techniques therefore utilize large sets of input images with different lighting conditions in order to fit parametric BRDF models [2]. We will evaluate these methods and will try to reduce the required image count in order to accelerate the image acquisition process. Further, parametric methods are known to provide faithful appearance only for a small set of materials. Especially if the object consists of several different material types, current methods often are not able to provide sufficient results anymore.

Additionally current high resolution reconstructions can have arbitrary size. Complex data often cannot be rendered in real-time anymore. We are therefore going to parameterize [3] the 3D meshes in order to append information in the 2D domain. This information can be colors, normals, height offsets or compressed material information. Combined with data simplification we believe that we can achieve a real-time rendering performance without a noticeable visual difference with respect to the original high resolution data.

References

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