Passive and Active 3D Reconstruction of Diffuse, Specular, Refractive and Glossy Surfaces

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In this thesis, I propose passive and active methods for estimating the shapes of various reflective surfaces by using stereo cameras. We describe acquisition approaches for different classes of objects.
For diffuse surfaces, I propose passive and active methods. The passive method is a new discriminative method called Supervised Kernel ICA that is used for feature extracting and matching in stereo cameras. On the other hand, the active method uses a projector for matching in stereo cameras.
For specular surfaces, I propose an active method. The method can measure the surface shape of specular surface by using stereo cameras and a display. In stereo cameras, the lights reflected from a common surface point come from different directions, however they share the same surface normal. Using this constraint, we can recover the shape of specular objects.
For refractive surfaces, I propose an active method by using stereo cameras and a display. In transparent refraction, a ray from cameras and a ray from a display will intersect at the front and back surface points of the object. Using this constraint, we can recover the shape of transparent objects.
For glossy surfaces, I propose passive and active methods. The passive method use Kernel ICA for removing the specular components and changing the surfaces to diffuse surfaces. On the other hand, the active method is a hybrid method that incorporates both diffuse and specular components for estimating the shape surfaces by combining a projector and a display.
Each method is evaluated by estimating both planar surfaces and curved surfaces. Future uses for these methods and future research work are also discussed.