Computer vision for focus calibration of photo-polymerization systems

Photopolymerization by mask projection allow for rapid construction of extremely detailed and intricate objects, such as hearing aids. The Technical University of Denmark has long had an interest in applying computer vision systems to additive manufacturing systems to increase quality. To obtain the optimal quality for photopolymerization systems, it is paramount that the focal plane is exactly at the build plane. Manually finding the position with optimal focus is an arduous and time-consuming task. Previous attempts at implementing an automatic procedure for finding the optimum focus has failed [1].

In this paper we present an autofocusing solution for mask projection based photopolymerisation systems (MPPS), with ease-of-use equivalent to the autofocus known from an ordinary DSLR-camera. The autofocusing solution has been implemented and tested on the experimental MPPS (Figure 1) at Technical University of Denmark, Department of Mechanical Engineering using a PointGrey Blackfly S BFS-U3-51S5M-C industrial CCD-camera, no lens and pixel size of 3.45μm. The MPPS is built using a Visitech Luxbeam RapidSystem projector of LRS-WQ-HY, with a micromirror size of 7.5μm and depth-of-focus range of ±50μm for the 1:0 magnification filter and ±200μm for the 2:0 magnification filter [2], [3]. The lateral movement of the projector is designed with a motorized projector mount to have a minimum step size of 1.56μm. By projecting an image from the projector up onto the glass plate where the camera is mounted and moving the projector laterally, we are able to implement autofocus. Our autofocus solution allows researchers faster and easier access to building on the MPPS, requiring no training in using calibration software or printer operating procedure outside the standard.

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