RGB-TOF 3D Calibration

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Abstract:

This paper presents an RGB TOF 3D calibration method and a dedicated 3D calibration tool that enable accurate alignment between RGB cameras, Time of Flight (ToF) depth sensors and, optionally, MEMS micromirror systems. The proposal targets systems that generate RGB images and depth maps, typically used in augmented reality, 3D reconstruction and AI based human face analysis. Existing calibration approaches such as Herrera based cuboids, checkerboards and spheres suffer from a limited number of exploitable features or from features that are not easily detectable simultaneously in RGB and depth domains. The proposed solution introduces a colored 3D tool, based on pyramidal shapes, that provides a rich set of features easily detectable in both RGB images and depth maps. This facilitates robust and automatic feature extraction and association and allows the reuse of standard stereo calibration functions originally designed for two RGB cameras. The method is applicable not only to ToF based depth sensors but also to other depth map generation technologies such as Kinect type devices. A potential application scenario is AI-assisted UV-LED tanning systems, where precise 3D information and face segmentation are required to safely control localized irradiation.

Keywords:

RGB D calibration, depth registration, alignment, Time of Flight, MEMS mirrors, UV LED tanning, 3D reconstruction, augmented reality.