Ultrasound Probe Movement Analysis Using Depth Camera with Compact Handle Design for Probe Contact Force Measurement

Khemwutta Pornpipatsakul[1]
Apirat Chenviteesook[1] and Ronnapee Chaichaowarat[1]
[1] Chulalongkorn University

The real-time information of the ultrasound probe movement and contact force during scanning is helpful for improving skill of medical professionals. This paper presents an affordable technique using an RGB-depth camera with the MediaPipe Hands framework for capturing the hand gesture to estimate the position and orientation of the ultrasound probe. The method does not require any additional marker which can interfere the motion and the feeling of handheld operation. The tracking accuracies of position and orientation were evaluated experimentally at different camera angles. The 3D printed handle was inserted into the grids of the XYZ plate and the tilt plate. Although the camera angle and the spatial position affect the accuracies, the maximum errors are always less than 7.5 mm and 10 degrees. The custom designed handle consisting of the inner and outer shells allows installation of the small three-axis force sensor for probe contact force measurement while scanning. The design is easy to assemble with an ultrasound probe without requiring any modification. The results of this work can be applied as a guideline for monitoring ultrasound training.