Abstract: Automatic Plane Adjustment in Surgical Cone Beam CT-Volumes

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Cone beam computed tomography (CBCT) is used intra-operatively to assess the result of surgery. Due to limitations of patient positioning and the operating theater in general, the acquisition usually cannot be performed such that the axis-aligned multiplanar reconstructions (MPR) of the volume match the anatomically oriented MPRs. This needs to be corrected manually, which is a time-consuming and complex task and requires the surgeon to interact with non-sterile equipment. To this end, this study investigates a fully-automatic solution to directly regress the standard plane parameters from a CBCT volume of the calcaneus and ankle regions. A PoseNet convolutional neural network (CNN) is adapted and trained, comparing a 6D-, Euler angle- and quaternion-based approach to represent the plane rotation [1]. In addition, a cost function is optimized to incorporate orientation constraints.

The best-performing CNN – which uses the 6D representation – estimates the plane normal with a median accuracy of 5 °, the in-plane rotation with a median accuracy of 6 °, and the position with a median accuracy of 6 mm. The inference time is less than 0.05 s.

References

1. Martin Vicario C, Kordon F, Denzinger F, et al. Automatic plane adjustment of orthopedic intraoperative flat panel detector CT-volumes. Springer; 2020. p. 486–495.