Personalized articulated atlas with a dynamic adaptation strategy for bone segmentation in CT or CT/MR head and neck images

This paper presents a novel segmentation method for the joint segmentation of individual bones in CT- or CT/MR- head&neck images.

It is based on an articulated atlas for CT images that learned the shape and appearance of the individual bones along with the articulation between them from annotated training instances. First, a novel dynamic adaptation strategy for the atlas is presented in order to increase the rate of successful adaptations. Then, if a corresponding CT image is available the atlas can be enriched with personalized information about shape, appearance and size of the individual bones from that image. Using mutual information, this personalized atlas is adapted to a MR image in order to propagate segmentations.

For evaluation, a head&neck bone atlas created from 15 manually annotated training images was adapted to 58 clinically acquired head&neck CT datasets. Visual inspection showed that the automatic dynamic adaptation strategy was successful for all bones in 86% of the cases. This is a 22% improvement compared to the traditional gradient descent based approach. In leave-one-out cross validation manner the average surface distance of the correctly adapted items was found to be 0.68 mm. In 20 cases corresponding CT/MR image pairs were available and the atlas could be personalized and adapted to the MR image. This was successful in 19 cases.

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