Deep learning for medical image segmentation and registry-based analysis of dose-effect for normal tissue damage in radiotherapy.

PhD Project Report: Abraham George Smith

The RootPainter3D deep learning segmentation software was developed and an experiment was conducted as part of a collaboration with persimune where the software was used to contour 933 hearts from X-ray CT scans. The software uses user corrections of model predictions to train a U-Net model for semantic segmentation, resulting in continuous reductions in contouring time. Our results indicate contouring can be over twice as fast as the current manual methods (Figure 1) with a strong correlation between the doses obtained from the model predicted and expert corrected heart delineations (Spearman's ρ >0.99).

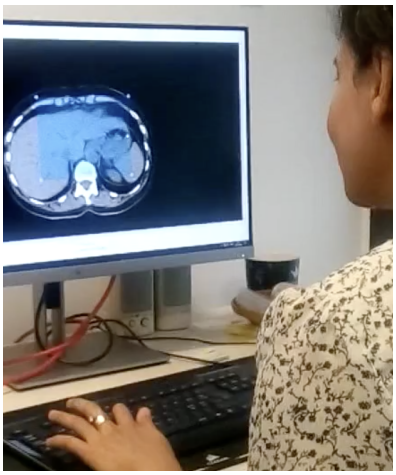

Figure 2: Software user interface

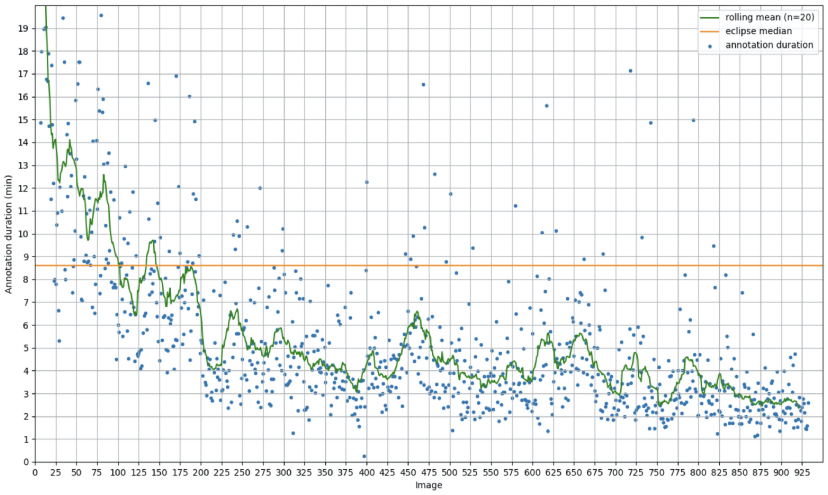

Figure 1: Contouring speed increases as more organs are contoured.

The work was presented at the DCCC Annual Scientific Meeting. The initial manuscript is a work in progress to be published early next year, when we also plan to conduct studies to improve fully automatic contouring efficiency by eliminating the requirement of a user specific bounding box (Figure 2) and evaluate multi-organ delineation tasks in more clinically realistic settings.

In collaboration with Jeppe Kanstrup Jørgensen from the University of Copenhagen a video was produced to communicate our work using artificial intelligence and user interface development to improve the efficiency and efficacy of the radiotherapy planning procedure via faster and more consistent contouring software.
The produced video was shared via Facebook, Twitter and Youtube.