Purpose: The use of structure overlay on setup DRRs can aid the image alignment procedure for daily image-guided setup procedures. However, the accuracy of a 3D region-of-interest (ROI) projected on a 2D digitally reconstructed radiograph (DRR) has rarely been evaluated quantitatively. The goal of this study is to test the accuracy of two commercial treatment planning systems (TPS) in producing overlay structures on setup DRRs.

Method and Materials: We designed a novel method to identify landmarks which were on the boundary of the projected ROI on a DRR. The 3D ROI volume is composed of a stack of 2D curves. We first mathematically project each 2D curve onto a beams-eye-view (BEV) plane. Next, we detect the boundary points of the projected curves. Those boundary points serve as landmarks. Finally, we project the binary mask of the 3D ROI volume using ray tracing method onto the BEV plane. This projected binary mask is used to exclude the false landmarks. Once those landmarks are detected, we compute the distance between the landmarks and ROI outlines from the TPS.

Results: We applied our validation method to 13 ROIs from a lung patient and 4 simulated ROIs on 2 BEV DRRs for two different TPS (Eclipse and Pinnacle). Average distance between the landmarks and ROI outlines was 0.5mm for both Eclipse and Pinnacle approaches, which is close to the pixel resolution of the DRR. The maximum distance and average maximum distance was 2mm and 1mm, respectively, for both TPS. The maximum distance occurred at points where the ROI curve has a sharp change between slices.

Conclusion: The accuracy of Eclipse and Pinnacle ROI projection method seems to be acceptable to within 1mm although projection error can be as large as 2mm when structure shape has a sharp variation from one slice to the next.