Use of In-beams Structures in Shape Relationship-Driven Treatment Planning

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Purpose/Objectives

- The use of dose and shape information from prior patients allows for the predicting of achievable doses for critical structures in future patients.
- Large volumes which extend outside of the beams complicates comparison of similar structures with different beam arrangements.
- The use of an “in-beams” structure allows for more consistent comparison of critical structures between patients with different beam arrangements and anatomical geography.

Materials/Methods

- A database of 35 Pancreas patients treated with IMRT is used for contour generation.
- An in-beams contour is first generated by shaping open beams to the target structures(s) and computing a contour from the 30% isodose line.
- Each in-beams ROI is generated by excluding the portion of the ROI outside of the in-beams contour.
- Dose Volume Histograms (DVHs) and Overlap Volume Histograms (OVHs) are generated for both the inbeams and standard version of each structure.

Results

- The DVHs show noticeable differences due to reduction of low dose regions from each contour.
- The inbeams structure has a higher relative volume receiving dose due to the exclusion of the low dose regions outside of the in-beams structure.

Conclusions

- The OVHs show a decrease in volume distant from the target.
- The inbeams structure shows a shift towards the target.
- The same absolute volume of the structure is within the target.

Table 1: Reduction of volume for inbeams structures compared to original structures.

<table>
<thead>
<tr>
<th>Structure</th>
<th>Avg Diff (cc)</th>
<th>Avg Diff (%)</th>
<th>Std Dev (cc)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liver</td>
<td>512.70</td>
<td>33.2%</td>
<td>270.24</td>
</tr>
<tr>
<td>Bowel</td>
<td>123.51</td>
<td>19.4%</td>
<td>235.02</td>
</tr>
<tr>
<td>Cord</td>
<td>11.51</td>
<td>51.4%</td>
<td>5.76</td>
</tr>
<tr>
<td>Stomach</td>
<td>129.66</td>
<td>28.2%</td>
<td>167.70</td>
</tr>
<tr>
<td>Kidneys</td>
<td>26.96</td>
<td>7.8%</td>
<td>48.99</td>
</tr>
</tbody>
</table>

Figure 1: Example of the inbeams contours. The inbeams structure is in red and the liver is in brown. The blue outline is the liver-inbeams structure defined as the intersection between the liver and inbeams structures.

Figure 2: DVH differences between the liver and liver-inbeams structure with a) normalized and b) absolute volume axes.

Figure 3: OVH differences between the liver and liver-inbeams structure with a) normalized and b) absolute volume axes.

Figure 4: DVH and OVH plots for liver for the database population.

Figure 5: DVH and OVH plots for liver-inbeams for the database population.