Real-Time Kymogram Detection from Cardiac Spiral CT Scans

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Purpose

To generate a rawdata-based synchronization signal for cardiac spiral CT scans in real time. The signal may be used as an alternative to the ECG acquired at scan time and as a basis for cardiac phases-dependent on the tube-current-modulation. The already existing offline computed kymogram [1] is taken as the base for these enhancements.

Methods and Materials

The synchronization signal, the motion or kymogram function, is generated by analyzing the periodic temporal variation of the mass distribution m(t) of the current section and correlates to the heart rate. Three different methods are used to generate the kymogram: A two dimensional center-of-mass tracking of the scanned object [1] (Fig. 1), the difference of the projected mass after a half rotation [2] (Fig. 2), and a derivation of the projected mass with respect to the view angle [3] (Fig. 3).

Results

9 of 12 patients showed a high correlation with the ECG to the kymogram where the phase lag value stayed below 25% for all three methods. The best relative result was generated for the derivation of the projected mass with respect to the view angle. The prerequisite of being able to perform in real time was satisfied by all three methods.

Fig. 6 shows examples of coronal CT images using phase-correlated reconstruction. The quality of the different images point out the usability of the different synchronization signals. In contrast Fig. 7 shows coronal CT images with the usage of the predicted sync peaks derived from the different kymograms. Thus it has to be mentioned that the predicted signal will be used for a phase-dependent tube current modulation and not directly for an image reconstruction.

Conclusion

For most patients predicted sync peaks on the basis of a kymogram correlated well with the ECG. We conclude that, a kymogram-based tube current modulation for dose reduction in cardiac CT appears possible.

References


<table>
<thead>
<tr>
<th>Method</th>
<th>σ(kymogram)</th>
<th>σ(prediction)</th>
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<tbody>
<tr>
<td>COM</td>
<td>24.76</td>
<td>31.52</td>
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<tr>
<td>ΔM</td>
<td>32.66</td>
<td>40.57</td>
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<tr>
<td>Δφ</td>
<td>54.55</td>
<td>48.57</td>
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Table 1: Averaged values of σ(%) for L(t) of 12 patients.