Introduction

- Motion during acquisition leads to blur unless compensated for.
- How to compare motion-compensated reconstructions?
- Non-linear, object-dependent reconstruction precludes MTF measurements.
- Typical approach: Estimate edge sharpness from line profile.

Materials and Methods

- Problems with manual placement of a single profile line:
  - Susceptibility to Noise
  - Susceptibility to Artifacts

<table>
<thead>
<tr>
<th>Placement Bias</th>
<th>Mismatch Desired/Measured Entity</th>
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  - Proposed: Semi-automatic evaluation of the whole edge using an ensemble of profile lines (Fig. 1).
    - Robust sharpness measure computed as median of profiles’ least-square slope estimates:
      \[
      \xi^* = \text{median}[\xi_0, \xi_1, \ldots, \xi_{M-1}],
      \]
      \[
      \xi_i = \frac{\text{cov}[s_i, I_i]}{\text{var}[s_i]} = \frac{\sum(s_{i0} - \bar{s}_i)(I_{i0} - \bar{I}_i)}{\sum(s_{i0} - \bar{s}_i)^2}.
      \]
      \[s_i, I_i\] are distances and intensities along profile line \(i\).
  - Alternatively, compare improvement visually (Fig. 2).
- Experiments:
  - Simple validation on a synthetic phantom (Fig. 3).
  - Cardiac motion-compensated C-arm CT of porcine models [1, 6] (Fig. 4).
  - Respiratory motion-compensated whole-heart coronary MRI of volunteers [2] (Fig. 5).
- Implementation available on our website:
  - [http://www5.cs.fau.de/research/software/](http://www5.cs.fau.de/research/software/)

Results and Discussion

- Phantom study results (table in Fig. 3): Influence of noise and artifacts reduced considerably.
- Comparison with expert scores (N=7, scale from 0 to 4) for CT and MRI data (tables in Figs. 4 and 5): Agreement with visual impression.
- Limitation: Reconstruction methods enforcing sharp edges.
- Potential for improvement: Spline representation of edges, automatic edge pre-selection, different per-profile estimators.

Contact

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References