Metal artifact reduction in computed tomography at head and neck region

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Content

• Introduction

• Material and method

• Result

• Conclusion
CT for radiation therapy

• Organ delineation

• Dose calculation
Artifact

- Artifacts are significant problem in CT
  - Streak artifact
  - Motion artifact
  - Ring artifact

Sprawls P. 1995
Popilock R et al. 2008
Artifact

- Artifacts are significant problem in CT
  - *Streak artifact*
  - Motion artifact
  - Ring artifact

*Sprawls P. 1995*
*Popilock R et al. 2008*
Metal artifact

• Source: Metal implant
  • Dental implant
  • Surgical clip
  • Coils, wires
  • Orthopedic hardware

• Metal streak artifacts occur because *filtered back projection*
OMAR

• O-MAR = Metal Artifact Reduction for Orthopedic Implants

• O-MAR is a commercial product available from Philips Healthcare which implements a robust and efficient algorithm to mitigate artifact caused by metal objects in CT images

*Philips Healthcare, 2012*
OMAR in radiation therapy

<table>
<thead>
<tr>
<th>Region</th>
<th>Image quality (% Noise)</th>
<th>Dosimetric evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral cavity</td>
<td>61.5</td>
<td>44.4</td>
</tr>
<tr>
<td></td>
<td>3.7</td>
<td>100%</td>
</tr>
</tbody>
</table>

*Oonsiri S. et al. 2014*
Research objective

• To develop the method for metal artifact reduction in oral cavity computed tomography image using MATLAB
Material and method
Material and method

• **Philips Brilliance CT**
  • Big Bore Oncology
  • OMAR

• **MATLAB**
  • New algorithm

• **Phantom**
  • CTDI head phantom
  • Alderson-Rando phantom
Fill the blank region by
- Interpolation
  - Linear interpolation
  - Non-linear interpolation
- Average value
- Weighted average value
- Substitution
Phantom test

• With and without *metallic* inserts
  • 120 kVp
  • 3 mm slice thickness
  • Vary mA over clinical range (100-250)
Result
Homogeneous phantom without metallic

FBP

OMAR

New algorithm
Homogeneous phantom with metallic

FBP

OMAR

New algorithm
### Noise of homogeneous phantom (HU)

<table>
<thead>
<tr>
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<th></th>
<th>With metallic</th>
<th></th>
</tr>
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<td></td>
<td>FBP</td>
<td>OMAR</td>
<td>New algorithm</td>
<td>FBP</td>
</tr>
<tr>
<td>100 mAs</td>
<td>10.2</td>
<td>9.7</td>
<td>10.0</td>
<td>52.6</td>
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<tr>
<td>150 mAs</td>
<td>7.6</td>
<td>7.6</td>
<td>7.5</td>
<td>30.9</td>
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<tr>
<td>200 mAs</td>
<td>6.3</td>
<td>6.4</td>
<td>6.4</td>
<td>17.6</td>
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<tr>
<td>250 mAs</td>
<td>6.3</td>
<td>6.5</td>
<td>6.4</td>
<td>17.6</td>
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</tbody>
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Alderson-Rando phantom without metallic

FBP

OMAR

New algorithm
Alderson-Rando phantom with metallic

**FBP**

**OMAR**

**New algorithm**
## Noise of Alderson-Rando phantom (HU)

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Discussion

• Metal artifact reduction techniques cannot eliminate metal artifacts totally but it can suppress the metal artifact and improve the image quality in the CT images

• The overall dose distribution difference in the clinical application was within 2%

Oonsiri S. et al. 2014
Conclusion

• Metal artifact reduction techniques reduce metal artifacts 20-40% in CT images of the treatment planning system
Future work

- Further analysis with phantom
- Implement to the patient CT image
- Improve performance of new algorithm
Thank you for your attention