

Layered Surface Detection in Micro-CT Tetra Pak Data

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Data 00 Results

Perspective

Layered Surface Detection in Micro-CT Tetra Pak Data Vedrana Andersen Dahl, DTU Compute Industrial CT scanning Erfa-group meeting, 7. October 2014

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Perspective

Focus on...

- ▶ Image analysis. Principles, challenges, opportunities...
- One surface detection algorithm

Data ●0

Data collection

Carsten Gundlach, DTU Physics

Three settings

- Objective: LFOW, Pixel size: 21.2 μm
- Objective: 4X
 Pixel size: 4.7 μm
- Objective: 10X
 Pixel size: 1.9 μm

Voltage 40 kV Power 10 W Filter AIR Exposure: 5 s, 5s, 25 s. Results

Perspective



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Data ●0

Data collection

Carsten Gundlach, DTU Physics

Three settings

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Perspective



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Perspective

The nature of data

- Data is noisy, including projection data. Reconstruction data cannot be less noisy without assumptions.
- ▶ All image/volume segmentation is based on assumptions.
- Our interpretation of data depends on assumptions made under analysis also in cases where those assumptions are implicit.

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Surface detection, initial analysis

Example slice, volume dimensions $980 \times 984 \times 1004$ voxels





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Surface detection, initial analysis

Thresholding aluminium foil - ok





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Surface detection, initial analysis

Thresholding plastic membrane - noisy





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Surface detection, initial analysis

Relaxed plastic membrane response





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Surface detection, initial analysis

Averaged relaxed plastic membrane response - a useful contribution





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Surface detection, initial analysis

Edge response – a useful contribution





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Surface detection, initial analysis

- ▶ Challenges: data size, presence of noise.
- Conclusion: We need to choose a model, including an appearance model and a geometric model.

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Surface detection, suggested geometric model



► Terrain-like surfaces

$$z = f(x, y)$$

Smoothness

$$|f(x+n,y) - f(x,y)| < \Delta$$
$$|f(x,y+n) - f(x,y)| < \Delta$$

Optimality

$$\min\sum_{x,y} c(x,y,f(x,y))$$

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 Initial focus on three surfaces: aluminium foil, lowest edge, highest edge.

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Surface detection, suggested appearance model



- Aluminium foil:
 - binary aluminium foil response
- Lowest and highest edge, a weighted sum of four contributions:
 - relaxed plastic membrane response
 - edge response
 - repulsion from aluminium foil (limited range)

cumulative term (first strong occurrence)

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Surface detection, pipeline



Ordering

- 1. aluminium foil
- 2. lowest plastic edge and highest plastic edge in sampled images
- 3. plastic edge transformed back

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Surface detection, pipeline



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Surface detection, pipeline



Ordering

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Surface detection, results





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Surface detection, results





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Surface detection, results





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Surface detection, results





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Surface detection, results





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Surface detection, results





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Results ○● Perspective

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Results



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Surface detection, possible improvements

- ▶ Improvements: accuracy, boundary effect
- ▶ Extensions: multiple layers, inside regions

Data 00 Analysis

Results

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