An Electrostatic Model for Assessment of Joint Space Morphology in Cone-Beam CT

Computer Integrated Surgery II – Project 11

Literature Review
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Overview


Kalinosky et al: Modality

Radiograph  Tomosynthesis  Computed Tomography
Kalinosky et al: Methods

1. **DTS Dataset**
2. **Step 1 - VOI Preparation**
   - a) Manual ROI Selection
   - b) VOI Extraction
3. **Step 2 - Classify Bone Edges**
   - a) Multi-resolution 1D high-pass filter
   - b) Edge classification with connected components
4. **2D JSW Map**
Kalinosky et al: Results
Kalinosky et al: Comparisons

- 2D vs 3D
- Distance Measure: Intuitiveness + Clinical Utility
- Noise & Smoothness
- Computation Time
- Demands on Segmentation
Yezzi et al: Motivation

(a) Endocardium and Epicardium

(b) Coupled Points

(c) Actual Thickness

(d) Skeleton

(e) Calculated Thickness

(f)
Yezzi et al: Methods
Yezzi et al: Methods

\[ \Delta u = 0 \]
\[ u(\partial_0 R) = 0 \text{ and } u(\partial_1 R) = 1 \]

\[ \Delta u = \frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} \]
\[ D_x^+ L = \frac{L[i+1,j,k] - L[i,j,k]}{h_x} \]
\[ D_x^- L = \frac{L[i,j,k] - L[i-1,j,k]}{h_x} \]
\[ D_y^+ L = \frac{L[i,j+1,k] - L[i,j,k]}{h_y} \]
\[ D_y^- L = \frac{L[i,j,k] - L[i,j-1,k]}{h_y} \]
Yezzi et al: Methods

\[ \Delta u = 0 \]
\[ u(\partial_0 R) = 0 \text{ and } u(\partial_1 R) = 1 \]

\[ T^i = \frac{\nabla u}{||\nabla u||} \]
Yezzi et al: Methods

\[ \Delta u = 0 \]
\[ u(\partial_0 R) = 0 \text{ and } u(\partial_1 R) = 1 \]

\[ \hat{T} = \frac{\nabla u}{||\nabla u||} \]

\[ \nabla L_0 \cdot \hat{T} = 1, \quad \text{with } L_0(\partial_0 R) = 0 \]
Yezzi et al: Methods

\[ \Delta u = 0 \]
\[ u(\partial_0 R) = 0 \text{ and } u(\partial_1 R) = 1 \]

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\[ \nabla L_0 \cdot \vec{T} = 1, \quad \text{with } L_0(\partial_0 R) = 0 \]
\[ -\nabla L_1 \cdot \vec{T} = 1, \quad \text{with } L_1(\partial_1 R) = 0 \]
Yezzi et al: Methods

\[ \Delta u = 0 \]
\[ u(\partial_0 R) = 0 \text{ and } u(\partial_1 R) = 1 \]

\[ T^t = \frac{\nabla u}{||\nabla u||} \]

\[ \nabla L_0 \cdot T^t = 1, \quad \text{with } L_0(\partial_0 R) = 0 \]
\[ -\nabla L_1 \cdot T^t = 1, \quad \text{with } L_1(\partial_1 R) = 0 \]

\[ W(x) = L_0(x) + L_1(x) \]
Yezzi et al: Ventricular Wall Thickness
Yezzi et al: Other Applications
Gauss’s Law:
\[ \nabla \cdot \mathbf{E} = \frac{\rho}{\varepsilon_0} \]

Definition of Electric Field:
\[ \mathbf{E} = -\nabla \Phi \]

Equation to be solved:
\[ \nabla^2 \Phi = -\frac{\rho}{\varepsilon_0} \]

Calculation of “\( u \)”(\( \Phi \)) the same. However, boundary topology is not.
Thanks!