Exercise 3. Implicit Surface Reconstruction

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Implicit Surface Reconstruction

- Estimate signed distance function (SDF)
- Evaluate the distances on a uniform grid
- Extract mesh via marching cubes
Exercise 3

- You will be given 3 sets of point clouds
- Implement two popular methods to estimate signed distance function for implicit surface reconstruction:
  - Hoppe distance from tangent planes [Hoppe 92]
  - Triharmonic Radial Basis Functions (RBFs)
Libraries

• OpenGL, OpenMesh
• Generic Matrix Methods (gmm)
  • used for solving linear equation
• IsoEx: marching cubes
Hoppe Distance

- Distance from tangent plane
  - point & normal forms a local tangent plane
  - use distance from closest point’s tangent plane
- \texttt{ImplicitHoppe::operator()} in \texttt{ImplicitHoppe.hh}
- Surface reconstruction from unorganized points.
  [Hoppe et al. ’92]
Results
• Radial Basis Functions (RBFs)
  • Sum of shifted, weighted kernel functions

\[ d(\mathbf{x}) = \sum_i w_i \phi(\|\mathbf{x} - \mathbf{c}_i\|) \]

• Triharmonic RBFs: \( \phi(x) = x^3 \)

• Solve for the weights using on- and off-surface constraints and gmm library

• `ImplicitRBF::ImplicitRBF()` in ImplicitRBF.cc
On- and Off-Surface Constraints

\[ d(x_i + \epsilon n_i) = 1 \]

\[ d(x_i) = 0 \]

\[
\begin{bmatrix}
\phi(\|x_1 - x_1\|) & \cdots & \phi(\|x_1 - (x_n + \epsilon n_n)\|) \\
\vdots & \ddots & \vdots \\
\phi(\|(x_n + \epsilon n_n) - x_1\|) & \cdots & \phi(\|(x_n + \epsilon n_n) - (x_n + \epsilon n_n)\|)
\end{bmatrix}
\begin{bmatrix}
w_1 \\
\vdots \\
w_{2n}
\end{bmatrix}
= 
\begin{bmatrix}
d_1 \\
\vdots \\
d_{2n}
\end{bmatrix}
\]
Results
Submission

- Deadline: **Mar 7, 2017 11:59pm**
- Upload a .zip compressed file named “Exercise3-YourName.zip” to
  - Blackboard
- Include a “read.txt” file describing how you solve each exercise and the encountered problems
Contact

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Thanks!