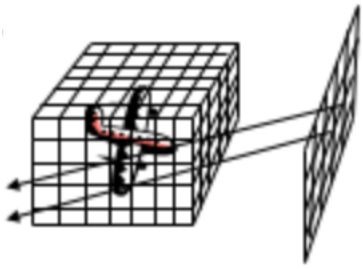
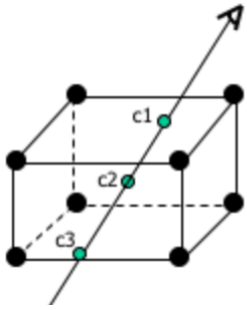
DS-GA-3001.017/.018
Special Topics: Scientific Visualization

Topics and Ideas for Final Projects

1. **Direct Volume Rendering for isosurface visualization via ray-casting.**

   Just compute the intersection of the ray with the isosurface and color the pixel accordingly using a light source.

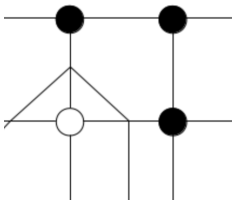


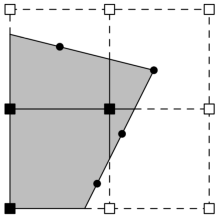


   Function values are defined on the corners of each voxel. Interpolate the values along discretized points on the ray and find the intersection with the isosurface. A light source can be used to improve the quality of the rendering.

   - Livnat, Yarden, and Charles Hansen. "View dependent isosurface extraction." In *Proceedings of the conference on Visualization'98*, pp. 175-180. IEEE Computer Society Press, 1998.
   - Parker, Steven, et al. "Interactive ray tracing for volume visualization." *ACM SIGGRAPH 2005 Courses*. ACM, 2005.

2. **Comparing the Dual Contouring and Marching Cubes in 2D**

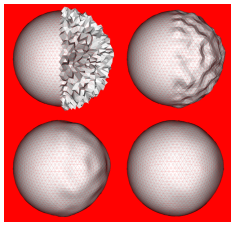




   Implementing 2D marching cubes (marching squares) and dual contouring and compare the quality or the resulting contours, mainly in the presence of sharp edges.

   - Ju, Tao, et al. "Dual contouring of hermite data." *ACM transactions on graphics (TOG)*. Vol. 21. No. 3. ACM, 2002.

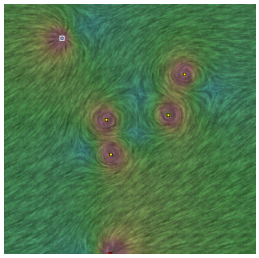
3. Signal Processing Approach for Triangle Mesh Smoothing

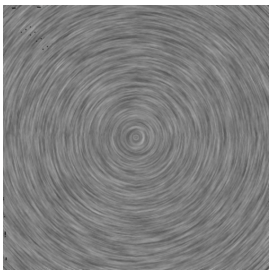


Implementing the generalization, signal processing inspired, Laplacian smoothing proposed by Gabriel Taubin.

- Taubin, Gabriel. "A signal processing approach to fair surface design." *Proceedings of the 22nd annual conference on Computer graphics and interactive techniques*. ACM, 1995.

4. Visualizing 2D Vector Fields with LIC





Implementing the method Line Integral Convolution.

- Cabral, Brian, and Leith Casey Leedom. "Imaging vector fields using line integral convolution." *Proceedings of the 20th annual conference on Computer graphics and interactive techniques*. ACM, 1993.