

# ECS 277 - Winter 2019 - Final Project Proposal

## Ambient Occlusion for Iso-surfaces Visualization

Ahmed Mahmoud

### Abstract

**Iso-surface.** In volumetric data visualization, the user might be interested in visualization certain iso-surfaces; surface where the density function is constant. For instance, examining the hard tissues (e.g., tooth, bones) in CT or MRI scans on structured grid. Extracting iso-surface can be done using Marching Cube. Efficient data-structure can be used to accelerate such extraction specially for dynamically changing iso-surface (e.g., numerical simulation solutions). Among several, Volumetric Dynamic Grid (VDB) [1] is one of the most successful for representing dynamic sparse volume data. VDB supports arbitrary grid topology, hierarchical signed distance flood-filling, and adaptive sampling.

**Ambient Occlusion.** Global illumination (GI) can be used to improve the visual appearance of iso-surfaces. GI can be done via ray-tracing which is computationally expensive and can be the bottleneck for topology-changing applications when interactive rate is desired. In this project, we choose to implement the ambient occlusion for the iso-surfaces. Ambient occlusion simulates the shadowing caused by objects blocking the ambient light and can improve the visual appearance of the iso-surface greatly. Since ambient occlusion does not depend on the light direction but on the surface topology, it can be pre-computed and stored statically. However, for topology-changing situations, pre-computation is not feasible anymore. Thus, we aim into using the efficient representation of the volume data by VDB to also enhance the visual appearance of the extracted iso-surface.

In this project, we propose a new technique to simulate the ambient occlusion. Using VDB data-structure, a narrow-band (of voxels) can be construct very quickly around the desired iso-surface. To collect the neighbor information for ambient occlusion calculation, we can use flood-fill technique to propagate the sign-distance from which ambient occlusion can be approximated.

### References

- [1] Museth, K. (2013). VDB: High-resolution sparse volumes with dynamic topology. *ACM Transactions on Graphics (TOG)*, 32(3):27.