6.838 Final Project Proposal

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March 8, 2017

A local rigid motion invariant representation of surface meshes is useful for many geometric processing applications, such as surface deformation, and editing. This project aims to examine the method proposed by [Y.Wang, B.Liu and Y.Tong 2012], to represent surface meshes by the edge lengths and dihedral angles. Obviously, such a representation preserves local geometry of the surface, and is invariant to rotation and translation. The paper further developes a theory to describe the condition for an arbitrary set of edge lengths and dihedral angle to admit a surface embedding, and an algorithm to reconstruct the embedding by solving a sparse linear system.

The proposed plan for this project consists of three main steps: First, to carefully follow the mathematical derivation of the descrete fundamental theorem of surface in the paper, and to read the closely related papers (such as [Y. Lipman et al. 2005]) to understand the advantages of the proposed method compared to existed ones; Second, to implement the algorithm described in the paper, that reconstructs a surface embedding from the edge length and dihedral angle representatoin, to fully understand the details and engineering decisions included in the algorithm; Finally, to experiment with several modifications of the algorithm, such as the potential energy function being optimized, as suggested in the paper, and comapre the results, and to try improving and extending the methods for some new applications.

The implementation step will include a working demo that applies the method to surface editing, as demonstrated in the paper. And the final step will produce a written summary of progress on the original contributions to the method from this project.

References

[1] Y. Wang, B. Liu, and Y. Tong. *Linear Surface Reconstruction from Discrete Fundamental Forms on Triangle Meshes*. Computer Graphics Forum, 31(8), pp. 2277-2287 2012.

[2] Y. Lipman, O. Sorkine, D. Levin, and D. Cohen-Or. *Linear Rotation-invariant Coordinates for Meshes*. ACM Trans. Graph. 24(July 2005), pp. 479-487, 2005.