Progression mesh compression with guarantees

Luca Castelli Aleardi (Ecole Polytechnique, LIX)

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Internship Advisor: Luca Castelli Aleardi (`amturing@lix.polytechnique.fr`)
Expected Knowledge of the Student: programming, algorithms/data structures, discrete math.
Related material: for more details please visit the internship webpage

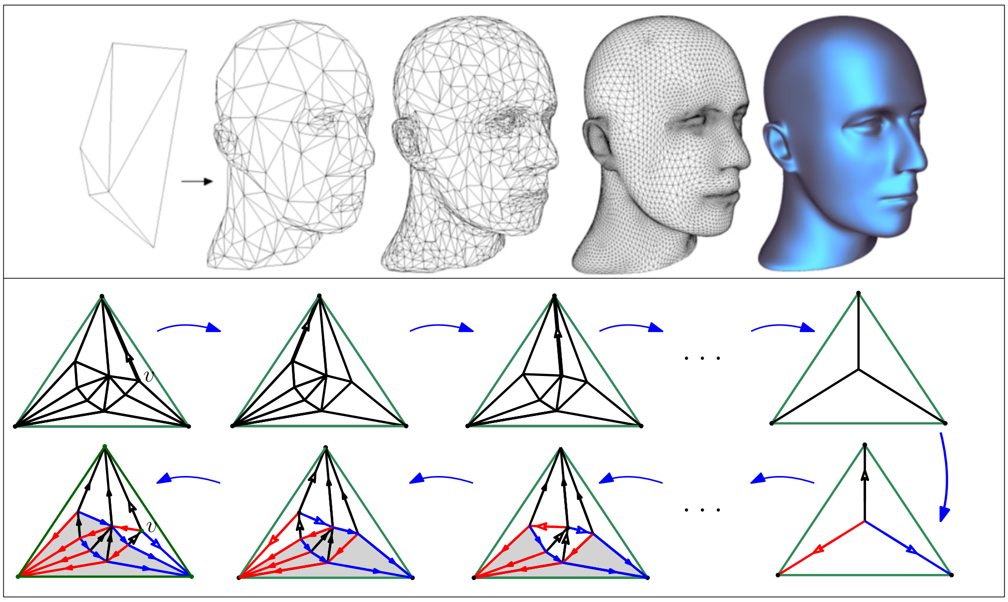

Figure 1: Top figures: progressive transmission of a 3D mesh (image by Alliez and Desbrun [1]). Bottom figures illustrate the computation of a Schnyder wood [2]: the initial triangulation is decimated first via a sequence of *edge collapses* (top row). Then the edges are colored (red, blue and black) and oriented in reverse order to obtain a partition into three vertex spanning trees.

Thesis Description: we consider the problem of the *progressive compression* of a 3D triangle mesh: this consists in the lossless transmission of a very coarse mesh first, followed by subsequent bits (representing both the geometry and the connectivity information) that allow the progressive addition of more and more details of the input mesh (see the Figure for an illustration). This problem has been addressed by a large number of works in the last three decades: on the practical side, there exist several efficient heuristics [1] which make use of *edge collapses* or *vertex decimation* and achieve very good compression rates, but which are not provided with worst case bounds.

The goal of this internship is twofold: try to use combinatorial properties of planar graphs (such as Schnyder woods [2]) to design a new mesh progressive scheme provided with rigorous theoretical guarantees; evaluate experimentally the performance of the existence heuristics [1] on synthetic and non regular datasets (previous existing evaluations only considered regular 3D meshes).

References

[1] P. Alliez and M. Desbrun. Progressive compression for lossless transmission of triangle meshes. In *Siggraph*, pages 195–202, 2001.

[2] Walter Schnyder. Embedding planar graphs on the grid. In *SoDA*, pages 138–148, 1990.