Hybrid Billboard Clouds for Model Simplification

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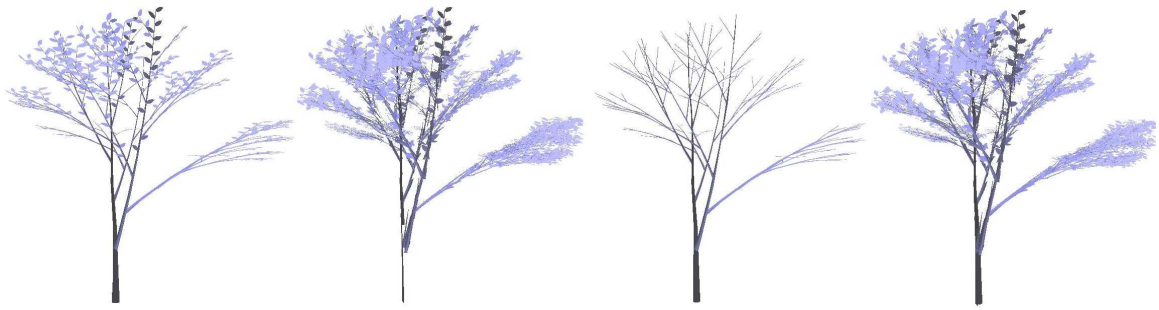

Figure 1: From left to right: original tree model, 17400 polygons; billboard cloud, 140 billboards; simplified mesh, 1700 polygons; hybrid billboard cloud, 1840 polygons. Note that the hybrid preserves both the trunk and leaves of the tree.

Abstract

We introduce *hybrid billboard clouds*, a part-mesh, part-billboard representation used to simplify 3D models in the context of real-time rendering. Our hybrid generation method produces simplified models with improved appearance when compared to models generated by either image-based or mesh simplification alone.

1 Motivation

Billboard clouds [Décoret et al. 2003] are collections of intersecting, textured, normal-mapped quadrilaterals that look from a distance like a real object. Billboard clouds are great for rendering fine detail in real-time (e.g. leaves on a tree), but increase fillrate requirements and require many billboards to prevent cracks when rendering simple, smooth geometry (e.g. a tree trunk). On the other hand, mesh simplification algorithms lose fine detail in the simplification process, but preserve geometry appearance and have little effect on fillrate requirements.

The hybrid models we propose combine the strengths of the two approaches in a unified framework. We also propose *fractional coverage*, a method for efficiently patching cracks in billboard clouds.

2 Method

A hybrid billboard cloud is created from a polygonal model by greedy optimization of a user-specified cost function f_{cost}, which includes terms for surface error, polycount, and fillrate. The hybrid begins as a normal billboard cloud representation of the original model [Décoret et al. 2003]. Then, for each billboard b in the hybrid, we propose a new hybrid h_b in which b is replaced by the polygons it represents. h_b is subjected to mesh simplification using a quadric error metric [Garland and Heckbert 1997], modified to only accept simplifications which decrease $f_{cost}(h_b)$. If none of the proposed hybrids have a lower cost than the current one, we stop. Otherwise, we accept the best proposed hybrid and repeat. We must create a new set of proposed hybrids after each step, because adding polygons to the hybrid affects subsequent mesh simplification.

To further address the issue of cracks in billboard clouds, we introduce the concept of fractional coverage of each polygon: the fraction of all viewing angles from which it is visible. A polygon that is not displayed to all viewers continues to attract billboards to cover it from other angles, thus patching the crack.

3 Results

Hybrid results for a cherry tree model are shown in Figure 1. A low level-of-detail billboard cloud preserves the look of the leaves, but leaves jarring cracks in the trunk. A simplified mesh preserves the shape of the trunk, but not the leaves. Our hybrid combination of the two preserves both the trunk and leaves of the tree. Other hybrid results are shown in submitted images and animations.

4 Conclusion

Hybrid billboard clouds can be optimized for user-specified tradeoffs between error and rendering budget, and appear to be of higher-quality than comparable billboard clouds and mesh simplifications. For example, our method can produce hybrid trees with mesh trunks and billboard leaves, which currently must be created manually or with specialized algorithms.

References

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