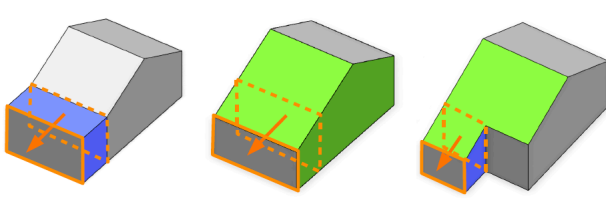
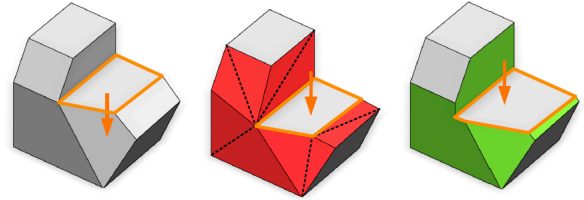


PushPull++

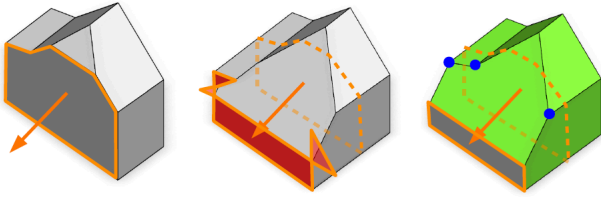
Markus Lipp Peter Wonka Pascal Müller



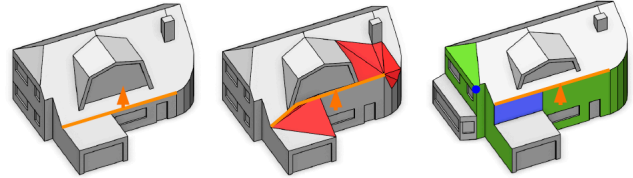
(a) Where should new faces be inserted?



(b) How should adjacent faces be updated, keeping them planar?



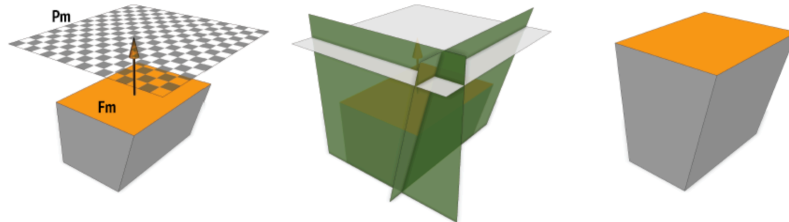
(c) How should edge collapses be handled?

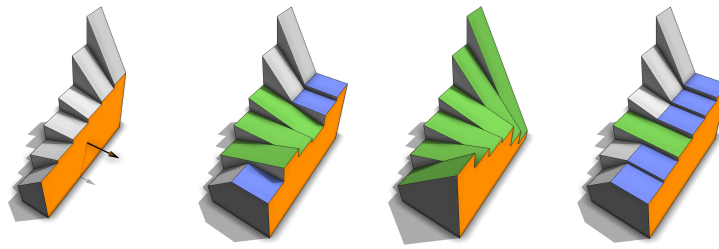


(d) Example showing all features

In this paper, the authors presented PushPull++ tool for 3D modeling of plane-dominant objects. PushPull++ tool provides the ability for face, edge and vertex transformation and adapts the polygonal mesh accordingly. PushPull techniques have been previously investigated and implemented in several commercial suites. However, previous tools have limitations in which this paper aims to overcome. This paper provides novel methods for adaptive face insertion, mesh updating and edge collapse handling, the tree main challenges in mesh adaption in most PushPull tools.

The first presented method is the adaptive face insertion method that answers the question: when new faces should be inserted? The method depends on angular threshold value between planes to decide where to insert new faces. As shown in the figure below, when the user selects a face F_m and defines a target plane P_m , new vertex positions are computed by intersecting the adjacent face planes with P_m . However, when face plane is parallel to P_m , the planes cannot be intersected. The presented adaptive method uses an angle threshold value to determine if the planes of the adjacent faces can be used or new faces have to be inserted.





In the figure above, an initial mesh with face modification is left. Middle left is the resulting mesh with 30 degree as the angle threshold value, which determines if existing planes can be used (green) or if new faces have to be inserted (blue). Middle right object is the resulting mesh with Threshold = 70 degree. Right is a traditional extrude operation that results when threshold is 0 degree.

Next, the mesh is updated by computing the new geometry resulting from the face modification phase. In the simple case, positions of new vertices are computed by intersecting Pm with its adjacent faces. In more complex cases when one vertex has to be replaced with multiple vertices, set of faces that around the vertex v has to be determined first. Then, new vertices can be computed by intersecting Pm with each face around vertex v .

I think with PushPull++ tool, the construction process of 3D models is significantly less complicated compared with other PushPull techniques. Some adjustment operations can be done in one step while it takes more complex steps in other techniques.

Reference

Lipp, Markus, Peter Wonka, and Pascal Müller. "PushPull++." *ACM Transactions on Graphics (TOG)* 33.4 (2014): 130.