Subdivision surfaces

Loop subdivision

Your goal is to implement the Loop subdivision in Blender. The Loop scheme is shown in Figure 1. The split and replace scheme is quite simple : a new vertex per edge is added and old vertices are smoothed using a weighted average over the one-ring neighborhood. The main difficulty lies in the fact that the split scheme will change the topology of the mesh and prevent access to the one-ring neighborhood needed for the replace step.

$$Replace_k = (1 - n\,\beta)S_{k-1} + \beta\,S^0_{k-1} + \beta\,S^1_{k-1} + ... + \beta\,S^{n-1}_{k-1}$$

$$Split_k = \frac{3S_{k-1} + 3\,S^0_{k-1} + S^1_{k-1} + S^5_{k-1}}{8}$$

$$\beta = \frac{1}{n}\left(\frac{5}{8} - \frac{(3 + 2\cos(2\,\Pi/n))^2}{64}\right)$$

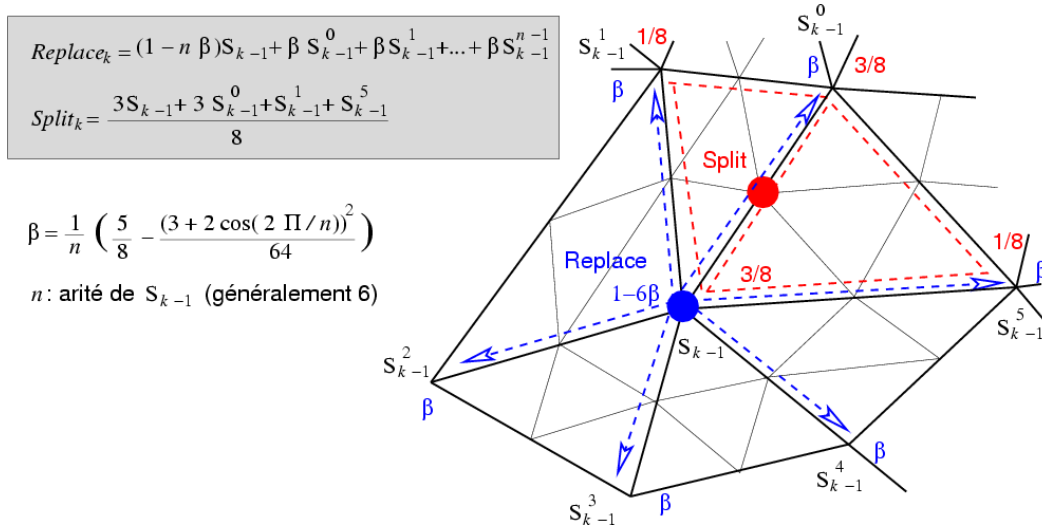n : arité de S_{k-1} (généralement 6)

FIGURE 1 – Loop subdivision scheme.

One solution is to first precompute all vertex positions in separate arrays, and to rebuild the full topology of the subdivided mesh. Note that, if an edge is a boundary (connected to a single face), the split scheme simply consists in taking the average of its two neighbor vertices.

1. precompute new vertex positions and store them in an array (replace scheme)
2. precompute positions of newly inserted vertices, store them in another array (split scheme)
3. create a new mesh and insert all these positions in it
4. for each face of the old mesh, insert 4 new faces in the new mesh. Each face needs 3 vertices of the new mesh, be carefull with the indices !

Launch Blender and split the 3D view in 2 subwindows. In the menu of the right window, select "text editor" and load the file "loop.py" (Text menu). Familiarize yourself with python and mesh manipulations in Blender. The example simply rescales the selected mesh in the x-dimension and shows how to access data types such as vertices, edges and faces. It also shows how to create a new mesh from scratch. The full python API for Blender is given here : `http://www.blender.org/api/blender_python_api_2_62_2/bmesh.utils.html#module-bmesh.utils`

Your source code will have to be sent to romain.vergne@inria.fr.
The python file should be named "name1-name2-loop.py"