Catmull–Clark Algorithm

A quadrilateral mesh can be subdivided by splitting each quadrilateral into four parts, according to the following rules.

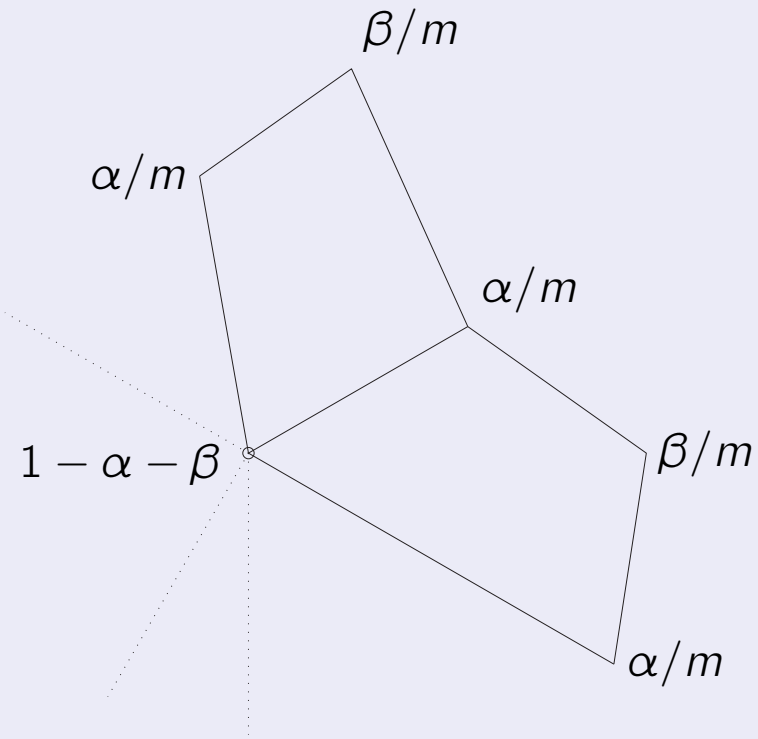
(i) A new face point is the average of the four vertices of the enclosing quadrilateral.

(ii) A new edge point is the average of the two vertices of the edge and the two neighboring face points.

(iii) A vertex v of the coarse mesh is replaced by a convex combination of the vertices of the surrounding quadrilaterals with weights indicated in the figure:

$$v \leftarrow (1-\alpha-\beta)v + \frac{\alpha}{m}\sum_{\nu=1}^{m} v_{e,\nu} + \frac{\beta}{m}\sum_{\nu=1}^{m} v_{f,\nu}\,,$$

where m denotes the number of edges incident at the vertex v.



m	α	β
3	1/2	1/12
4	3/8	1/16
5	3/10	1/20
6	1/4	1/24

The algorithm can be applied to quadrilateral meshes, which model closed surfaces or surfaces with boundary. In the latter case, the coarse boundary, i.e., one layer of quadrilaterals, is discarded after a subdivision step.
For a regular quadrilateral mesh ($m = 4$), the algorithm is identical with uniform subdivision for bicubic spline surfaces.