LAB REPORT: LAB 3

TNM079, MODELING AND ANIMATION

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Abstract

This lab report describes the basics of two different, albeit similar, concepts: curve subdivision and mesh subdivision. The process of curve subdivision is described briefly with an emphasis on how newly added vertices lead to having to calculate new weights for all vertices. The process of mesh subdivision is similarly focused on the way new weights are calculated after adding new vertices as well as the function of adding new vertices. The results show how well the curve subdivision and mesh subdivision implemented during the lab performed, which for the most part is rather well, although some issues still remain. Out of the two different types of subdivision the mesh subdivision is the one which could be developed further for a better result, this could be done through implementing more adaptive mesh subdivision and localizing the the evaluation of the splines.

1 Background

This lab consisted of two different parts with close relation, curve subdivision and mesh subdivision. As seen in the first part of Figure 1 a line can be represented by several coefficients, in this case shown as dots. When performing curve subdivision new coefficients are added in between the already existing coefficients and the weights of each coefficient is changed to more accurately represent the knew representation. The only coefficients which remain untouched in their weight are the beginning and end coefficients.

Figure 1: A representation of how spline curve subdivision changes the look of the line.*Image taken from lab instructions.*

The second part of the lab, as mentioned above, consisted of mesh subdivision. Similarly to curve subdivision the point of mesh subdivision is to add new vertices and adjusting their weight to create more and smaller faces to an object for the sake of making it appear smoother. As seen in Figure 2, there are certain ways of calculating the new weights of vertices after having adding new ones.

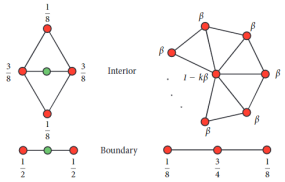
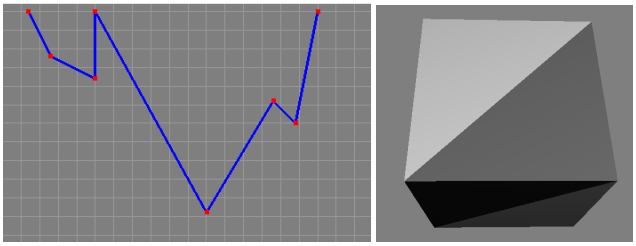


Figure 2: A representation of the weights for the new vertex positions, k representing the valence.*Image taken from lab instructions.*

The left side of Figure 2 describes how to think when calculating the new weight when adding a new vertex halfway across to an already existing edge. By looking at the four surrounding vertices, on the left, right, above and below the new one, their weights can be combined to calculate the weight of the new vertex (the green dot). The right side of the figure describes how to think when calculating the new weight when adding or moving a vertex in comparison to it's surrounding one-ring of vertices. In this case the k value is the valence, which is the same as the number of incident edges, while β is a variable which depends on the k value.

2 Results

Figure 3 shows two images, 3(a) is the original line geometry that was pre-implemented while 3(b) is the original cube object before applying any subdivisions.

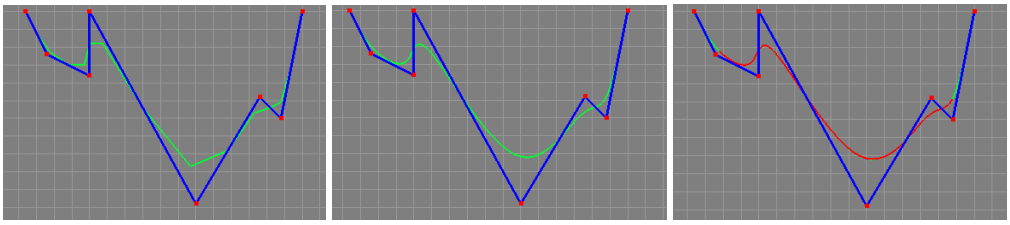


(a) (b)

Figure 3: (a)The original line without subdivision applied. (b) The original cube object without any subdivision applied.

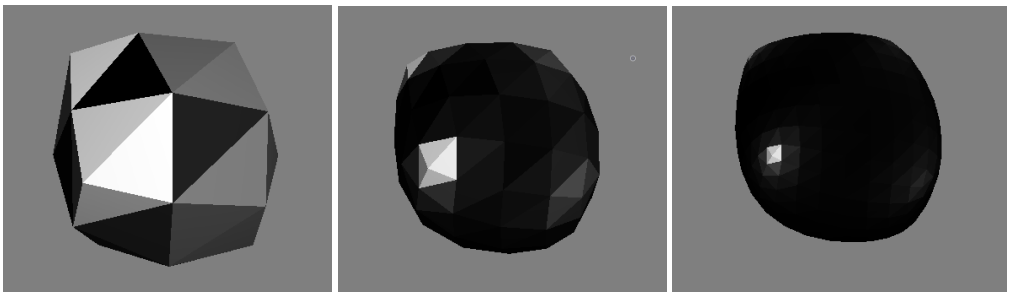
Figure 4 shows the results of implementing the uniform cubic spline subdivision curve. Figure 4(a) shows the resulting line (in green) when the blue line (previously shown in Figure 3(a))is subdivided ones. The result is still rather blocky and can be improved, to get a smoother curve three more subdivision were performed, resulting in 4(b). To show just how well the uniform cubic spline subdivision worked, an analytical cubic spline curve was overlaid (in red), resulting in Figure 4(c). The result clearly shows that the function has worked well, even going so far as to reach the beginning and end vectors of the line, which the analytical cubic spline curve does not.

Figure 5 shows the cube object in 3(b) after different levels of subdivision, mainly after one, two and three subdivisions. As seen the object becomes more and more rounded, yet there is still a clear boxy structure and corners persist.



(a) (b) (c)

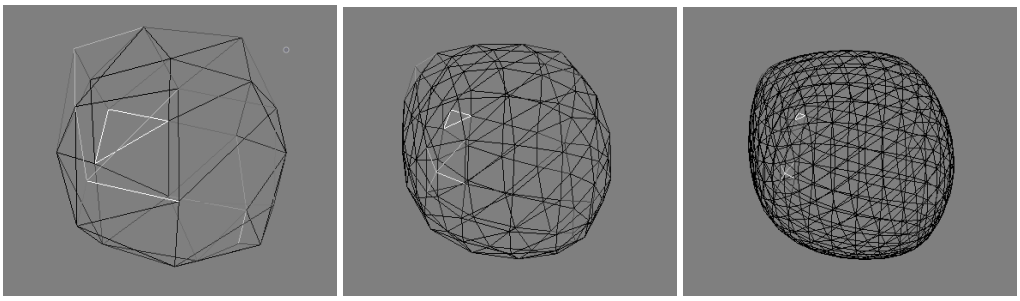
Figure 4: (a) Line is subdivided ones. (b) Line subdivided four times. (c) Green line is the subdivided line, red is the uniform spline.



(a) (b) (c)

Figure 5: (a) Cube object subdivided ones. (b) Cube object subdivided twice. (c) Cube object subdivided thrice.

As Figure 5(a) through 5(c) becomes progressively darker (because of some issues with colour mapping) it is somewhat hard to properly see what is going on. For this reason the same images were also saved but with their wireframe representation instead. Figure 6(a) through 6(c) shows more clearly the progressive subdivision of the surface as more and more triangles/faces are created to smooth out the surface further.



(a) (b) (c)

Figure 6: Wireframe of: (a) Cube object subdivided ones, (b) Cube object subdivided twice, (c) Cube object subdivided thrice.

3 Conclusion

The curve subdivision works well and, compared with a uniform spline representation it is very correct, even going so far as to be a more accurate result in the endpoints. It takes a few subdivisions to get a really good result, but even one subdivision is enough to get closer to the wanted curve.

As for the mesh subdivison the results are mostly good. The good thing is obviously that the object indeed got rounded, but the final shape is less of a ball and looks more like a somewhat bumpy round object without clear rhyme or reason. What I mean by this is that the final object still has clear points, so to speak, but they don't appear uniformly, which might be more desirable.

As the implementation stopped after the tasks needed for grade three, it is clearly possible to obtain a better result. This could be done by for example implementing an analytical spline which localizes the evaluation of the spline as well as a version of mesh subdivision which is more adaptive.

4 Lab partner and grade

For the records: My lab partner was Felix Lindgren. All assignments for grade 3 were completed, hence, I should get grade 3.