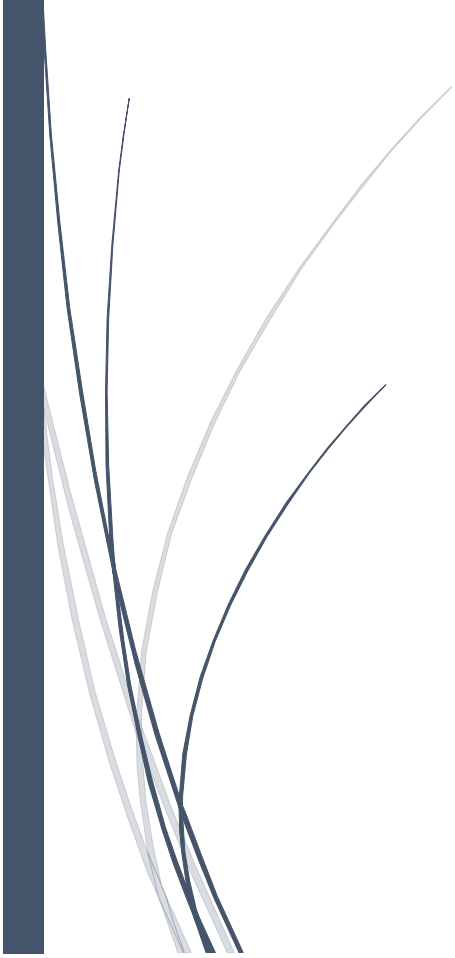
Ritesh Sharma

Homework #3

CS 554



OREGON STATE UNIVERSITY

It is always important to provide a better and easily accessible GUI for the user to use the software. I have tried to build the GUI as simpler as it can be. Right after the launch of the project, the below screen appears:

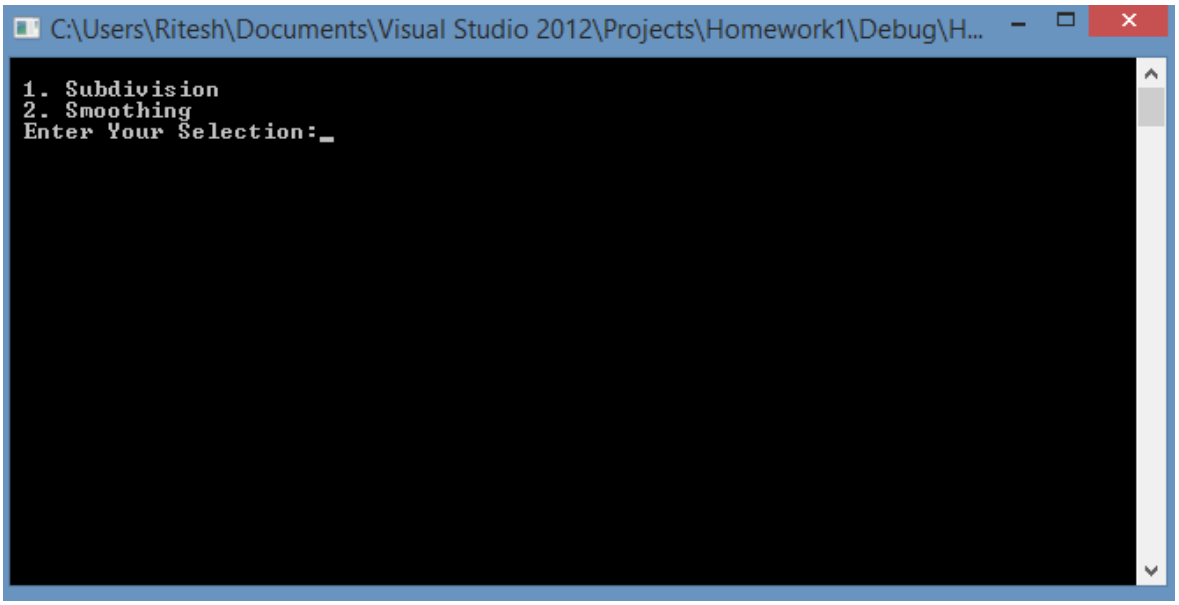


Figure 1. Screen 1

The user can select either Subdivision or Smoothing by entering the number shown against the option. For this homework, let the user enters 2 and the below screen appears.

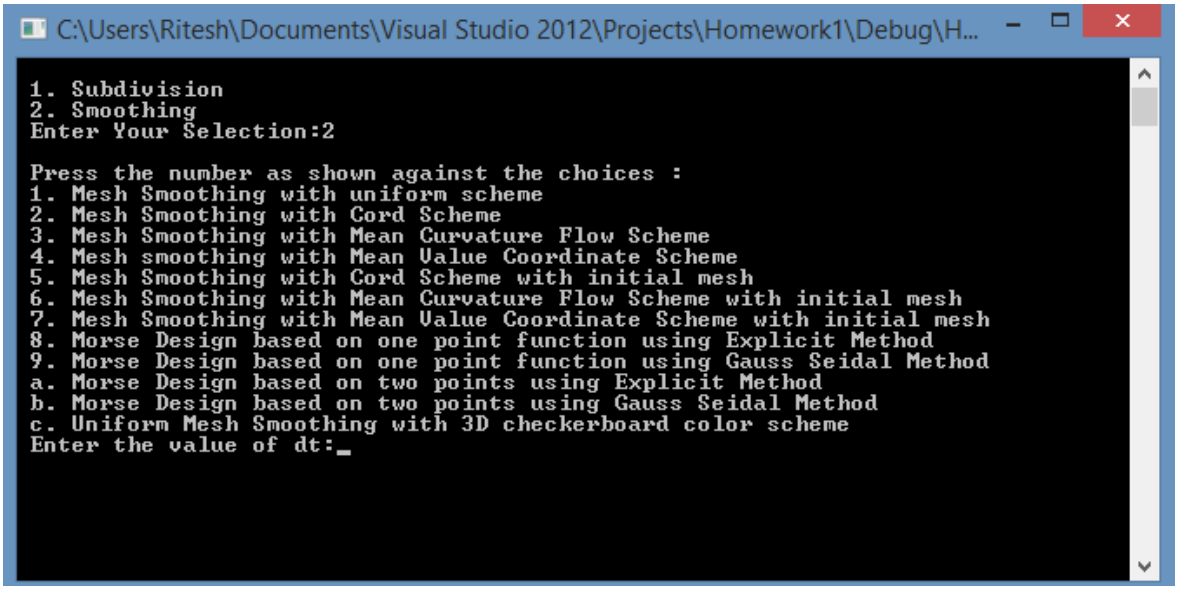


Figure 2. Screen 2

The above screen shows the different choices a user can have. To move further, user needs to provide the value of the time step, **dt**. After this user is ready to select the model. The screen below shows the model to be selected.

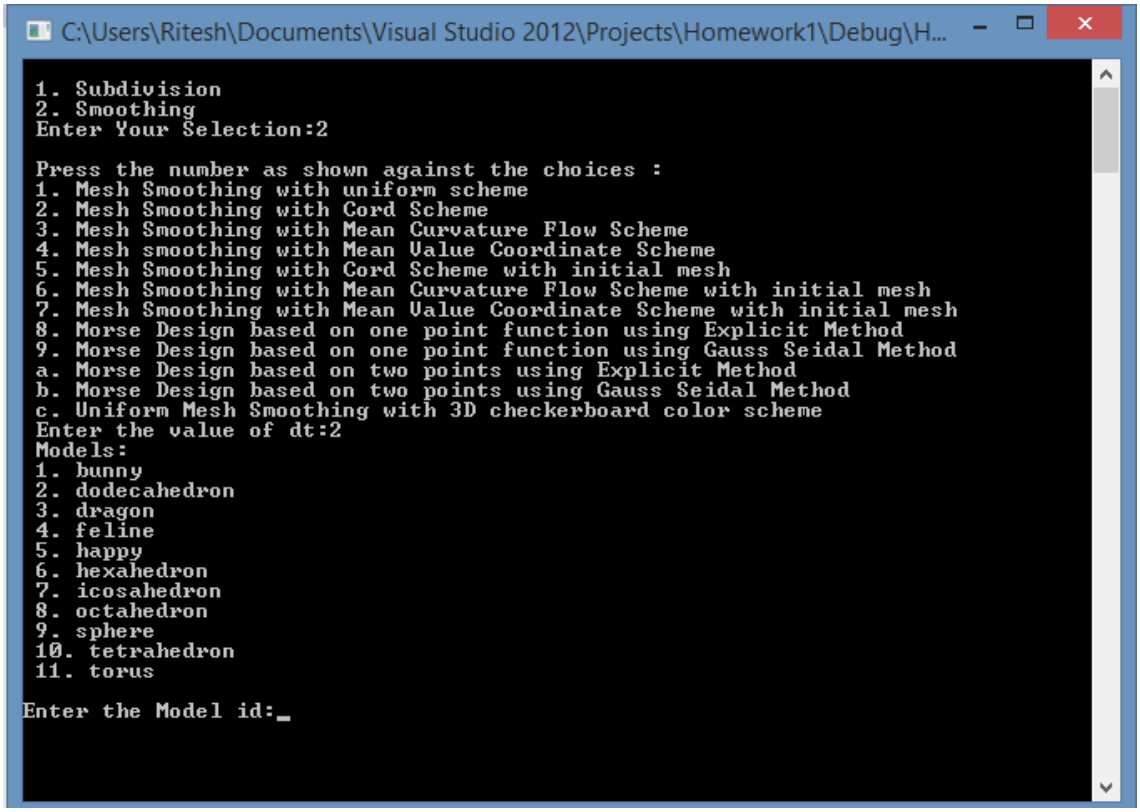


Figure 3. Screen 3

In the next step, Model id needs to be entered to display the model on the screen. The screen shows wait on the screen and then displays the selected model.

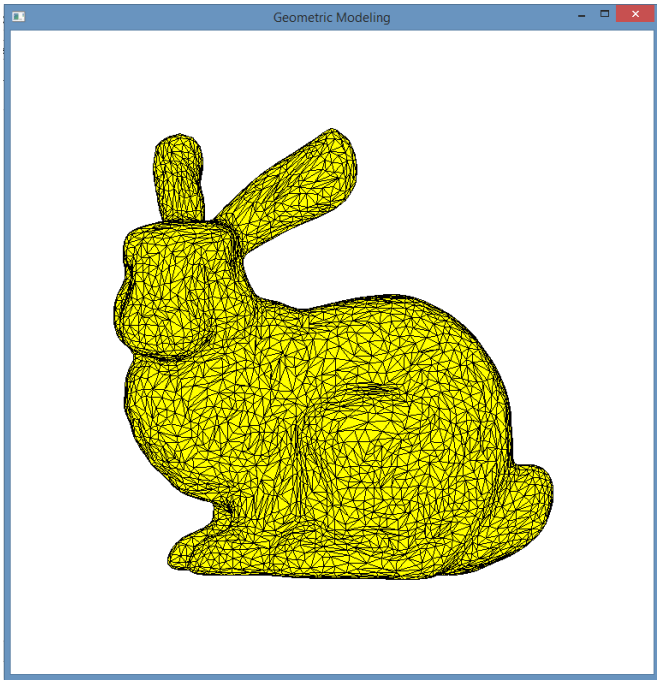


Figure 4. Displaying Model without any mesh operation

1. Smoothing

For smoothing, I have followed four scheme. These schemes are as follows:

a. Uniform
b. Cord
c. Mean Curvature Flow
d. Mean Value Coordinate

Further for the updation, I have used two approach. First approach is to take the updated weight and the other approach is to take the weights of the initial mesh.

The below figure displays the initial mesh of the selected model.

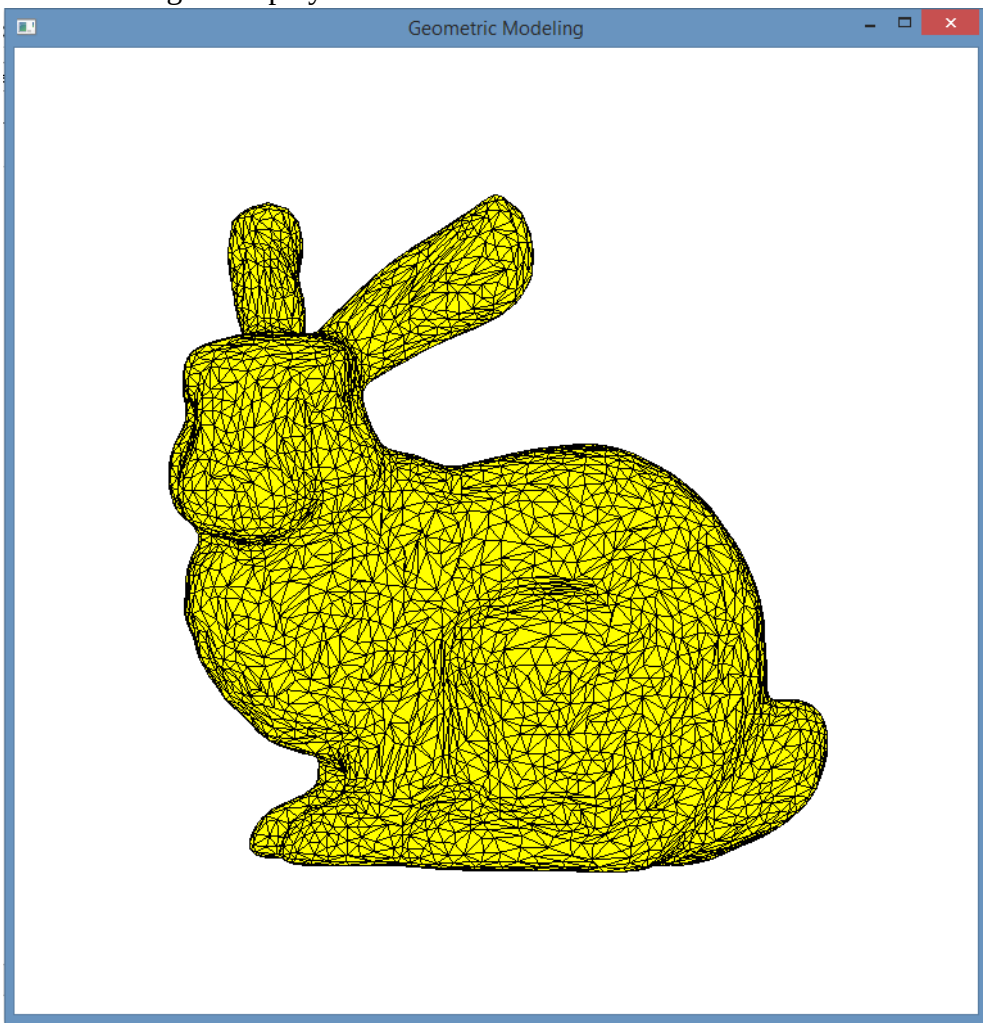
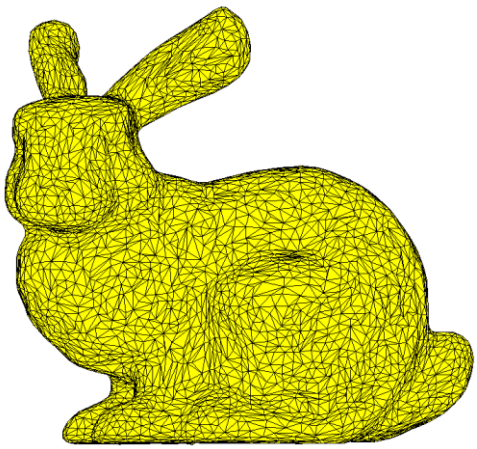
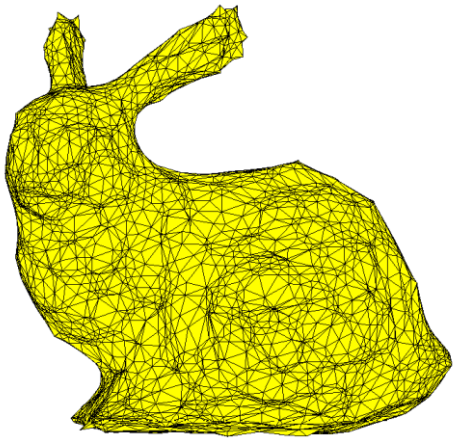
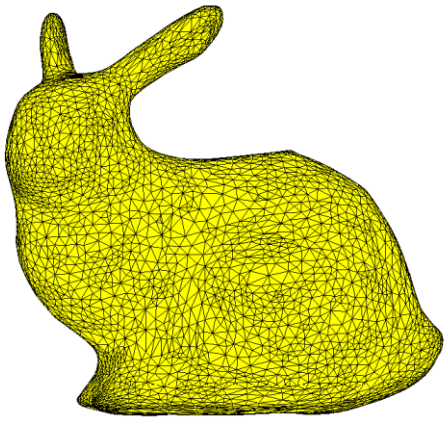
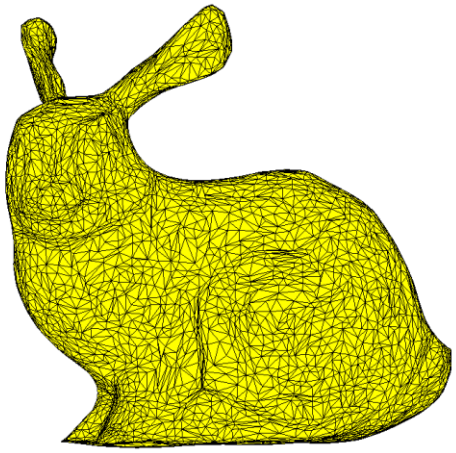
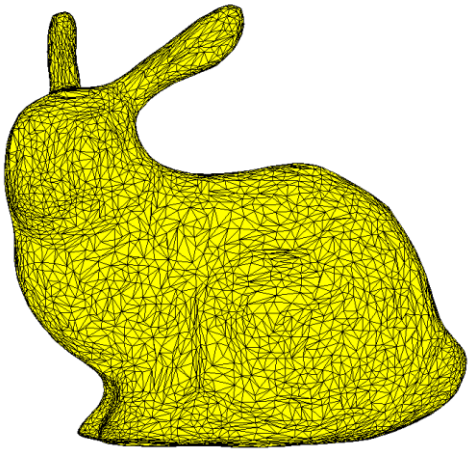


Figure 5. Model with Initial Mesh

Let us apply the different scheme and see how the result appears.

Bunny model with dt=0.5

Scheme	Mesh Smoothing with Update weights After 50 Iterations	Mesh Smoothing with Initial Weights After 50 Iterations
Uniform		Since there will be no effect in uniform scheme, the result has not been added here.
Cord		
Mean Curvature Flow		

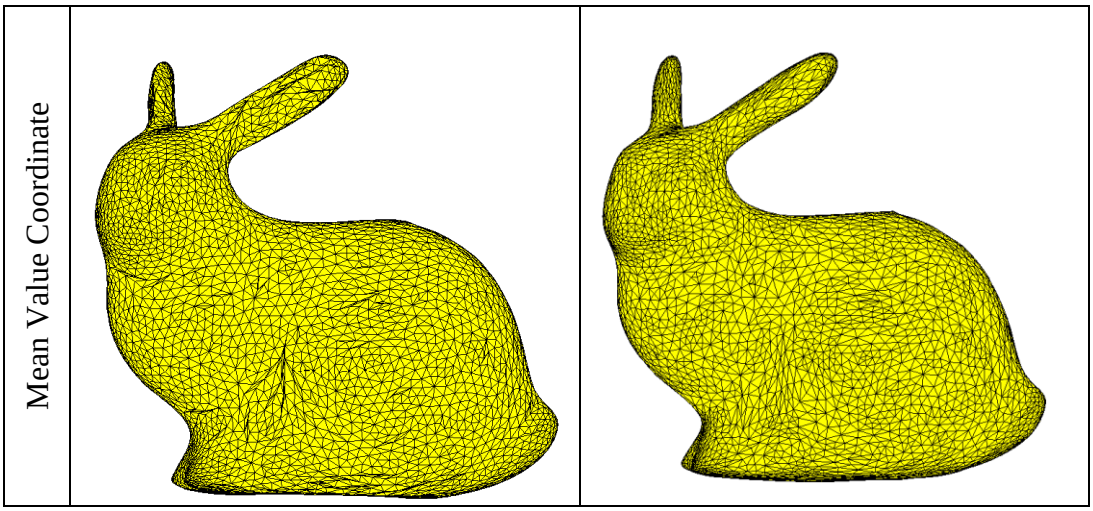


Figure 6. Different Mesh Smoothing Scheme

From above results, it can be seen that the method which uses initial weight smoothens faster than the method which uses updated weight. I feel that the method which used initial weight gives better quality of smoothing than the other method which takes the updated weight.

When the time step (**dt**) is very large, the process blow up and gives us the result which rather is not smooth.

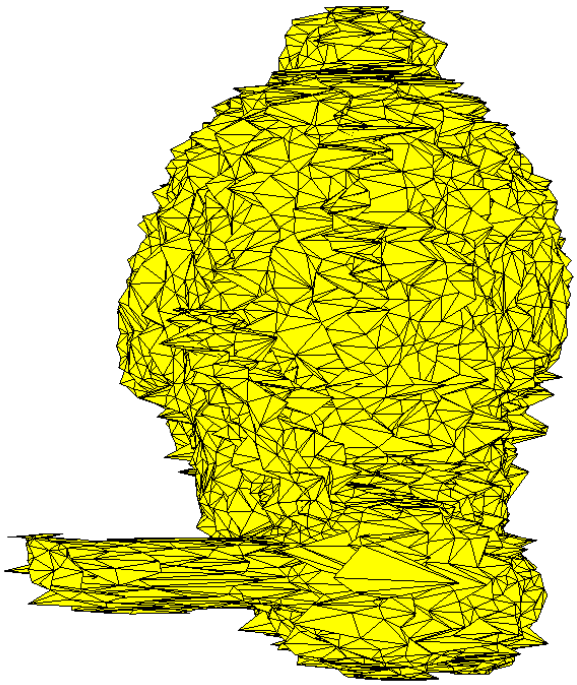


Figure 7. Display the model after dt is set to 5 and uniform smoothing is used

a. Comparison is provided in the figure 6 given above.

Uniform Scheme:

Strength: Computational time is less.

Weakness: Does not smoothen fast enough with less iteration.

Cord Scheme:

Strength: Computational time is less and makes the sides of triangles in a mesh equal.

Weakness: Does not smoothens fast enough with less iteration.

Mean Curvature Flow Scheme:

Strength: Smoothens both the convex and concave portion of the model faster.

Weakness: Computational time is more.

Mean Value Coordinate Scheme:

Strength: Smoothens the convex portion of model faster than other method.

Weakness: Computational time is more.

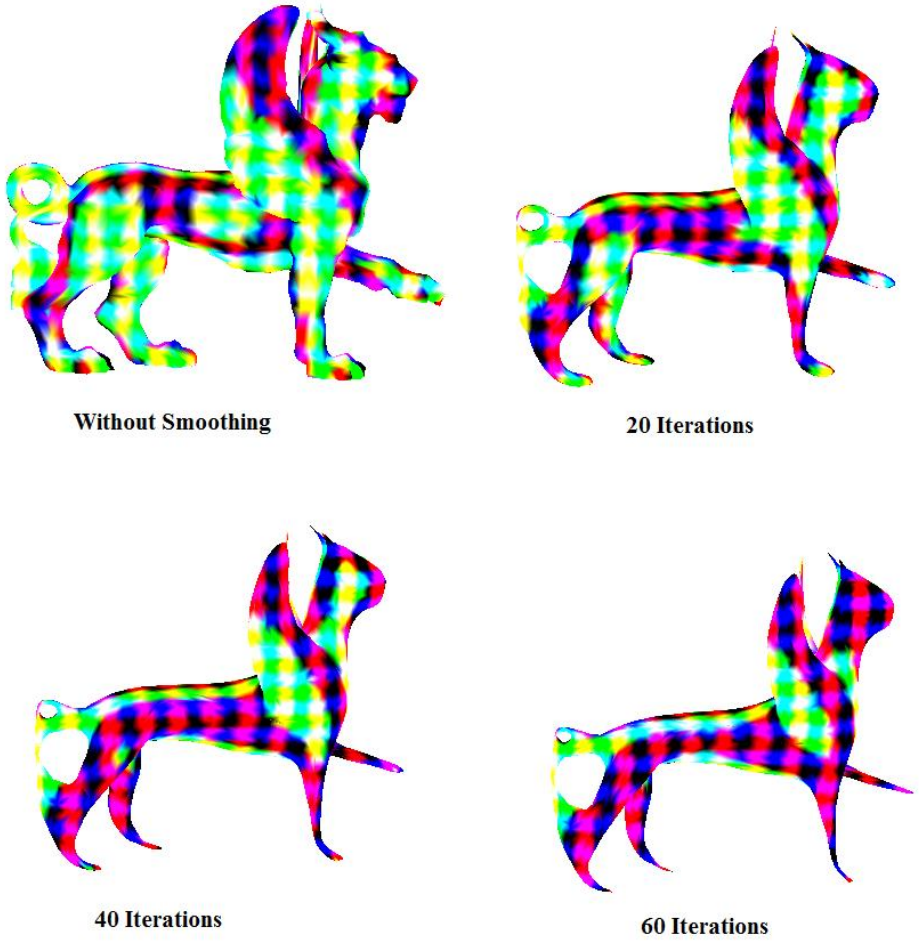


Figure 7. Mesh Smoothing effect on the 3D checkerboard Color Scheme

It can be observed from the above example that the grids on the mesh becomes more significant with the smoothing. If you focus on the face of the above model, it can be

seen that the grids becomes more and more significant with increasing number of iterations.

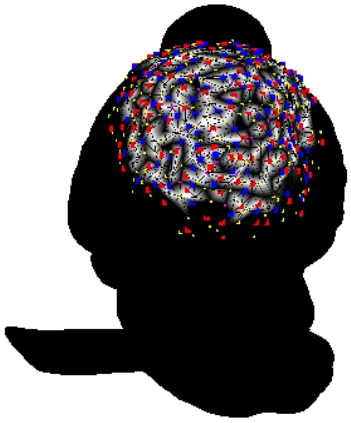
2. Morse Design

a Single point Morse Design

i. Explicit Method

Iterations:2

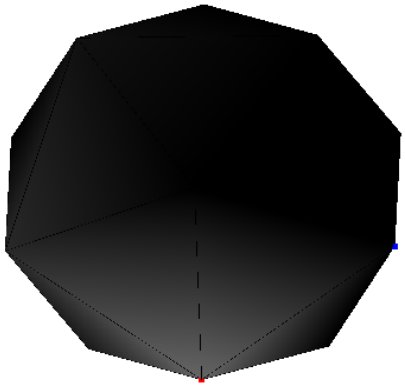
Number of Maxima=2
Number of Minima=4
Number of Saddle=4
M=2+4-4=2



Iteration:12

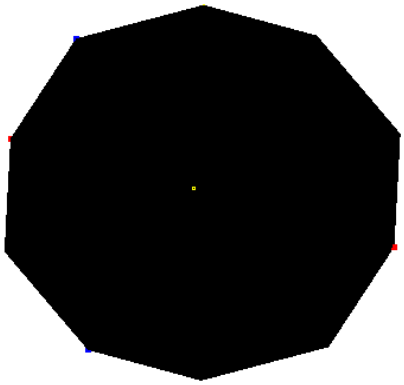
Number of Maxima=111
Number of Minima=94
Number of Saddle=203
M=111+94-203=2

ii. Gauss Seidel Method



Iteration:1

Number of Maxima=1
Number of Minima=1
Number of Saddle=0
M=1+1-0=2



Iteration:2

Number of Maxima=2
Number of Minima=2
Number of Saddle=2
M=2+2-2=2

Figure 8

b.

Maxima is found to be present at the convex point where as Minima is found to be at the concave point on the mesh. To balance each maxima with corresponding minima, a saddle is found to be present on the mesh where both the convex and the concave surface of the mesh meet each other. The saddle count depends on how many such neighborhood surfaces meet at that point.

c.

From the homework 1, we know that the euler's characteristics for Bunny and the Icosahedron is 2 and if we see the figure 8, the value of M is found to be also equal to 2.

From the above observation, we can guess that the value of M is equal to the euler's characteristics of a mesh in the model,

3. Morse Design based two point function

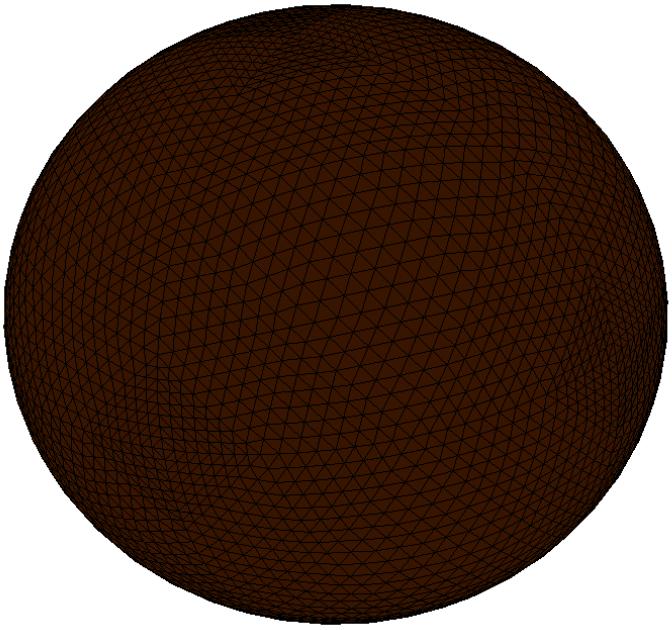


Figure 9. Initial Texture

Explicit Method:

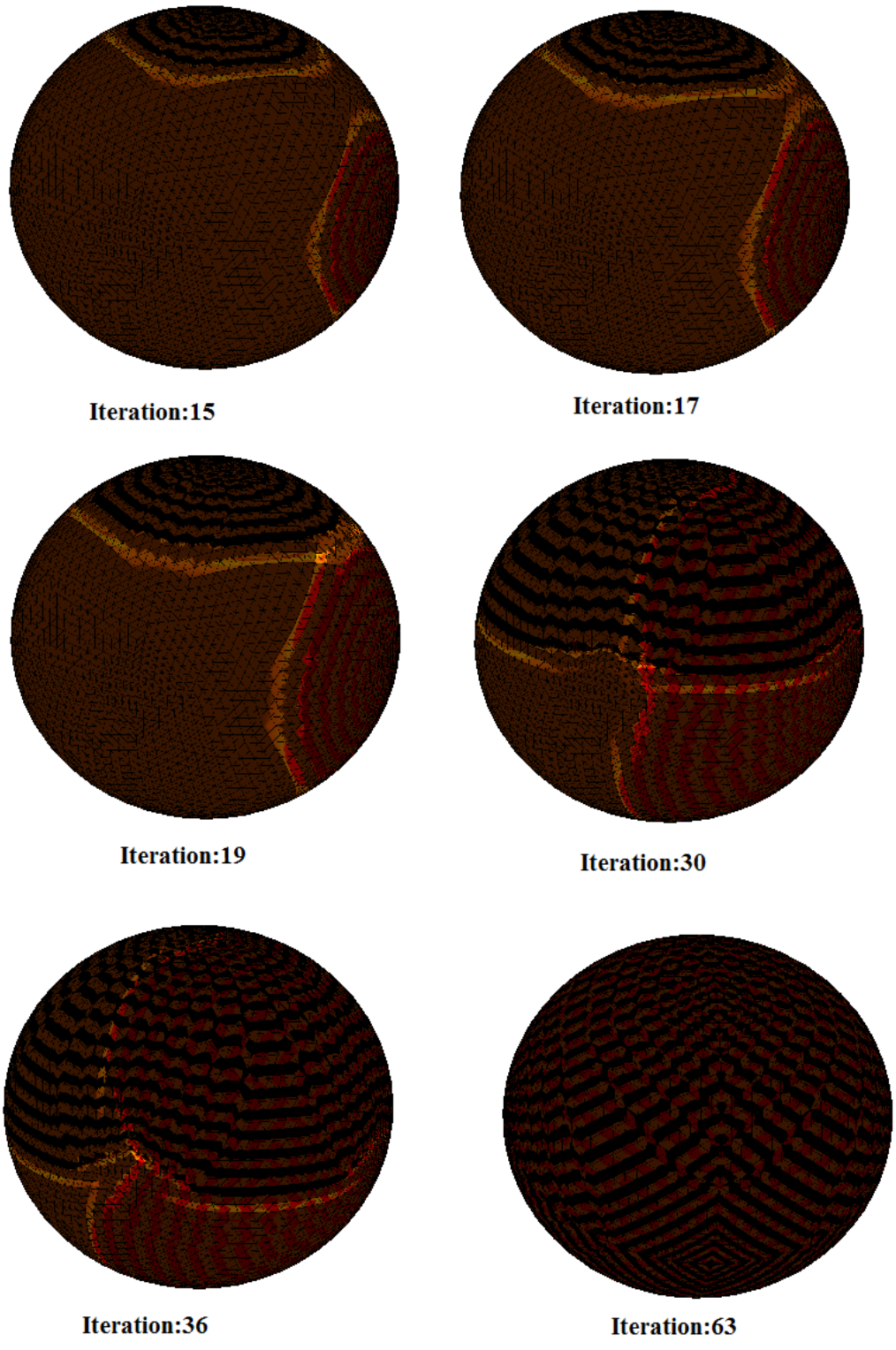


Figure 10. Results shown for few intermediate iterations where dt=3.0

In the Explicit method, I observed that two functions grow over the model and after certain number of iteration it is found that the level set for both the functions becomes perpendicular to each other. In the above example shown in figure 10, the texture starts to flip back and forth after iteration number 63.

Gauss Seidel Method:

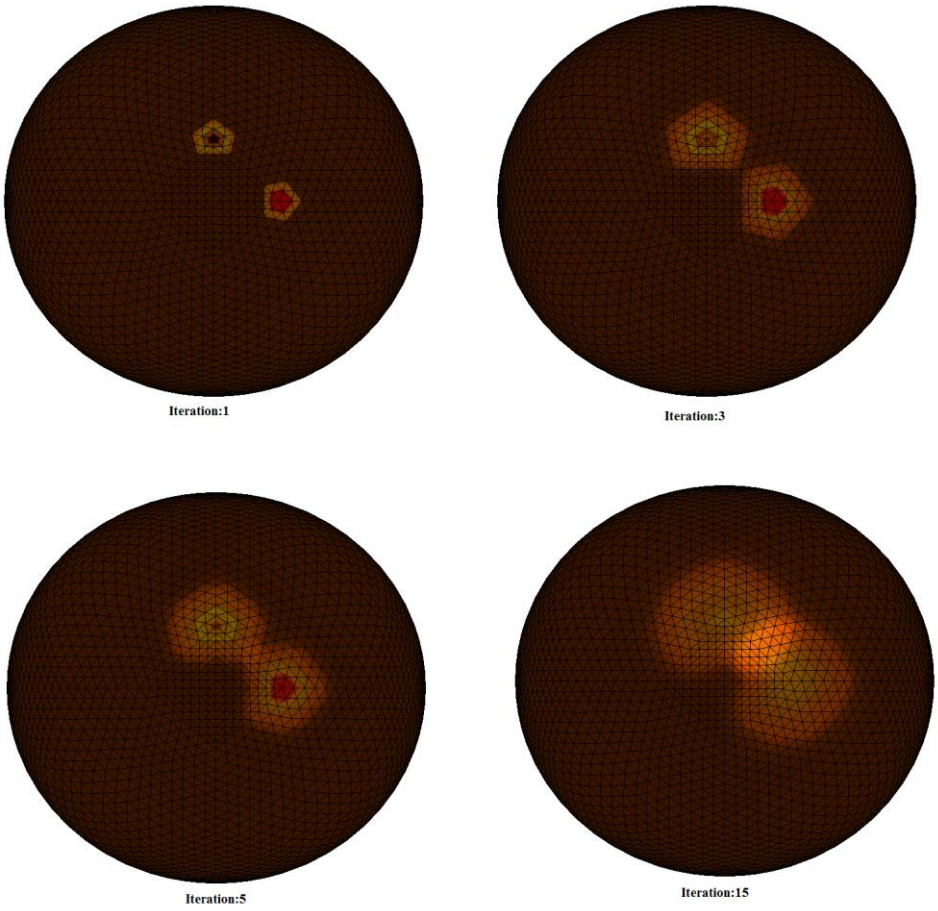


Figure 11. Results shown for few intermediate iterations

In the Gauss Seidel method, the two functions work in the same way as they do in explicit method. Here I observe that for a large time step, nothing happens at all on the mesh and no level set is drawn. But if the time step less than 1, the method works. Since we have lower time step, we have to ignore the speed of the method.

Yes, the results are somewhat satisfying. In order to have higher quality synthesis, the selection of texture and stability of the method used should be considered.