User's Manual for Programming Assignment No.3
For course CS6670, fall 2007

Submitted
By
Leena Kora.
(**Uid: 0527667**)

Abstract

The main aim of the assignment was to produce a graphics program, which helps the user to view 3D polynomial B-spline surfaces using isolines. The user should be allowed to open any 3D polynomial Bspline surface dataset file and display isoparametric curves at nodal values and Knot values in each direction.

The second part of the assignment was to create surface that interpolates to a grid of data with nodal interpolation. The user should be allowed to read grid data from file and allowed to select degrees of interpolation in each direction. Using the selected degrees of the interpolation, appropriate knot vectors should be created and should be used in the interpolation of surface.

Implementation

About the logic (Algorithms used)

1) To create 3D polynomial B-spline surface, I created a class called bsplineSurface. I set the attributes like degreeKu, degreeKv, uKnotVector, vKnotVector, Nu(number of elements of U knot vector), Nv(number of elements of V knot vector) and control mesh points by reading the respective values from the file. I then computed basis functions using u knot vector and using v knot vector separately and multiplied with the mesh points to get the point on the surface.

   To display isocurves I fixed u value first and rendered the points varying the v values. In the same manner I rendered some more isocurves fixing v values and varying the u values.

   To display isoparametric curves at nodal values, I evaluated the isocurves using U and V knot vectors but setting u and v values from the respective nodes vector.

   To display isoparametric curves at knot values, I evaluated the isocurves using U and V knot vectors but setting u and v values from the respective knot vector.

2) To do nodal interpolation, I have created a class called bsplineInterpolation. After reading the data points from the file, I took the degrees of the interpolation, which were selected by the user using slides, and the number of rows and column values, which were read from the data file to create appropriate U and V knot vectors. I then created the nodes vector for each direction and solved the system of equation using the solver provided

to us. I have used equations like F(CG')=H, where H is the matrix of data points read from the file, C the matrix of control mesh points to be computed, F is the matrix of basis functions calcuated using U knot vector, and G is the matrix of basis functions computed using V knot vector. I set Z=CG' and computed Z by calling solver(F, H, Z). Then I got C' by calling solver(G, Z', C') and then I computed C by transposing C'. And then I used the control mesh points and rendered the B-spline surface as isocurves.

3)To implement file reading and storing, I have used fstream of c++ language and have written the code to read the files with the specified format.

About the GUI (Graphical User Interface)

1) I have used my previous assignment code, and added classes like bsplineSurface and bsplineInterpolation to implement the creation and display of 3D polynomial B-spline surfaces and interpolated surfaces. I have also changed the GUI as well for this assignment.

2) As per the condition, I have used C++ for the programming and FLTK for GUI development.

3) I have added one toggle button(checkbox) to toggle the display of control mesh of the currently displayed B-spline surface.

4) The display of the surface as isocurves can also be toggled on and off by toggling the check box labeled as B-spline surface.

5) Users can also open any B-spline surface dataset file(with the mentioned format) by clicking the "File" menu and selecting "Open" option.

6)Users can also save the curves by selecting the "save" option from the "File" menu. When the 'save' operation is triggered, a dialog box is opened and the user has to enter the name of the file.

7)Users can clear the curve (also the display screen) by selecting "Clear Curve" option from the "file" menu.

8)The "Exit" option from the "file" menu can close the application.

9)I have put sliders for the users to select degrees of the interpolation in each direction. The user has to select the degrees before they open the data files.

10.I) I have put check boxes to toggle the display of isoparametric curves at nodal values and at Knot values.

10.II) I have added one more check box to allow the user to toggle the display of interpolation data, which is read from the file.

11)The user can rotate the 3D polynomial B-spline surface by dragging the mouse.

12)Scrolling the mouse gives zoom editing.

13) To allow the user to do translation of the camera, I used arrow keys to accomplish the task. The Up and Down arrow keys takes the focus of the camera in the Y direction. The Left and Right arrow keys moves the focus of the camera in the X direction.

14)Pressing the key 'l' or 'L' gives panning effect that is the camera is moved or rotated to the left and pressing the key 'r' or 'R' makes the camera rotated to the right direction.