Homework #6 Due: Friday March 29

Math 471

Choose one of the following projects.

1. **Aortic Flow Data Interpolation**

   (a) Go to the web site and download the MATLAB data file *few.m*. This gives you 23 data points (time,flow) measured in the ascending aorta of a sheep. In this data, the first and last flow measurement are equal and we want to use cubic spline interpolation for periodic data. Generate the piecewise cubic spline that interpolates this data.

   (b) Plot the piece-wise cubic at the time values in the data file *flow min one.m* (from the web site). Superimpose this graph on the graph of the actual data found in *flow min one.m*. For this part of the problem you may wish to download the program *findint.m* which, given a vector of x-nodes and an x-value, returns the number of the interval in which x lies. This way you will know which cubic applies to a particular value of x.

   (c) Hand in this plot of the piecewise cubic superimposed on the graph of the actual data. Describe any discrepancies between the two graphs and why they might occur.

2. **Mitral Valve Annulus Interpolation** (2 and 3 dimensions)

   (a) Go to the website and download the MATLAB file *anndata.m*. This gives you the (x,y,z) coordinates of 6 crystals placed on the mitral valve annulus of a sheep. Consider the parameterization of the curve describing the mitral valve annulus

   $$u(t) = (x(t), y(t), z(t))$$

   where

   $$\begin{array}{ccccc} u(0) & = & (x(0), y(0), z(0)) & = & (x_1, y_1, z_1) \\ u(1) & = & (x(1), y(1), z(1)) & = & (x_2, y_2, z_2) \\ \vdots & = & \vdots & = & \vdots \\ u(5) & = & (x(5), y(5), z(5)) & = & (x_6, y_6, z_6) \\ u(6) & = & (x(6), y(6), z(6)) & = & (x_0, y_0, z_0) \end{array}$$

   (b) Perform cubic spline interpolation for periodic data on $x(t)$, $y(t)$ and $z(t)$ individually. With this parameterization, the $h_i = t_{i+1} - t_i = 1$ for all i. You now have the cubic spline for $u(t)$. Choose uniform time steps of 0.1 and interpolate $(x(t), y(t), z(t))$ at these times.

   (c) Now superimpose the plot of the spline on the original data. You do this using the **plot3** command demonstrated in *anndata.m*. Please plot the point (0,0,0) as I have done in *anndata.m*. Give this plot to me.

   (d) **Undergraduates** may choose this option using only the (x,y) coordinates. In this case, the command **plot3** is not necessary, neither is the requirement to plot the origin.