Numerical Analysis

Homework 10. Spline Interpolations

Due: May 12, 2015

In this home work, you will find the functions that approximate the simulated waveform shown below using spline interpolations.

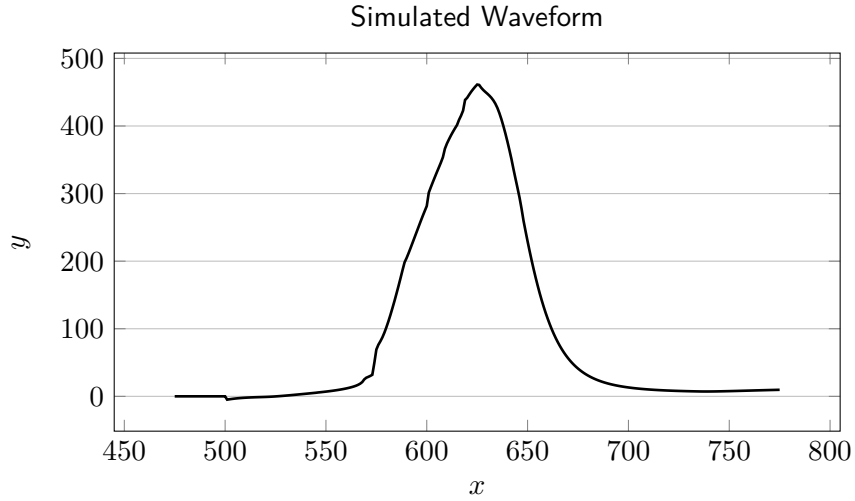

Figure 1. A simulated waveform

The data for this waveform are also given in the file `f301.dat`. Please implement the following functions for spline Interpolation.

```
void splineM(int N,VEC &X,VEC &Y,VEC &M);   // generate spline momentum M
double spline(double x,int N,VEC &X,VEC &Y,VEC &M); // spline interp at x
```

For both functions, `X` and `Y` are two `N` vectors which represent the support points. The function `splineM` calculates the momentum vectors `M` such that `M[i]` is the second derivative at `X[i]`. Once this momentum vector is calculated, function `spline` perform interpolation to find the value at point `x`, `X[0]` <= `x` <= `X[N-1]`.

1. Suppose the support points are given by the file `f3.dat`, please find the interpolated values for `x=475, 476, ..., 775`. Plot the interpolated values against the data given by `f301.dat`. What is the maximum absolute error of the interpolated values?

2. Suppose the support points are given by the file `f5.dat`, please find the interpolated values for `x=475, 476, ..., 775`. Plot the interpolated values against the data given by `f301.dat`. What is the maximum absolute error of the interpolated values?

3. Suppose the support points are given by the file `f7.dat`, please find the interpolated values for `x=475, 476, ..., 775`. Plot the interpolated values against the data given by `f301.dat`. What is the maximum absolute error of the interpolated values?

4. Suppose the support points are given by the file `f13.dat`, please find the interpolated values for `x=475, 476, ..., 775`. Plot the interpolated values against the data given by `f301.dat`. What is the maximum absolute error of the interpolated values?

5. Suppose the support points are given by the file `f21.dat`, please find the interpolated values for `x=475, 476, ..., 775`. Plot the interpolated values against the data given by `f301.dat`. What is the maximum absolute error of the interpolated values?

6. Please state your observations.

Notes.

1. For this homework you need to turn in a set of C++ source codes. That includes `hw10.cpp`, which solves question 5 above, `MAT.h`, the new header file, `MAT.cpp`, which includes the two functions above, `VEC.h` and `VEC.cpp` files.

2. A `pdf` file is also needed. Please name this file `hw10a.pdf`.

3. Submit your files on EE workstations. Please use the following command to submit your homework 10.

   ```
   $ ~ee407002/bin/submit hw10 hw10a.pdf hw10.cpp MAT.h MAT.cpp VEC.h VEC.cpp
   ```

   where `hw10` indicates homework 10.

4. Your report should be clearly written such that I can understand it. The writing, including English grammar, is part of the grading criteria.