

Numerical Analysis

Homework 9. Spline Interpolations

Due: May 2, 2017

In this home work, you will implement the functions that approximate the simulated waveform shown below using spline interpolation method.

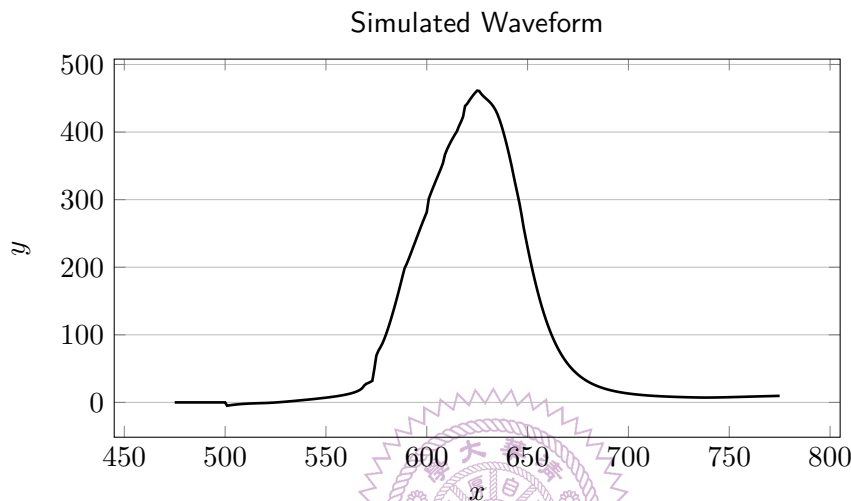


Figure 1. A simulated waveform

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 $x=475, 476, \dots, 775$. 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 $x=475, 476, \dots, 775$. 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 $x=475, 476, \dots, 775$. 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. It is a good idea to compare to the polynomial interpolation method that you have implemented in the last homework.

Notes.

1. For this homework you need to turn in a set of **C++** source codes. That includes **hw09.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 **hw09a.pdf**.
3. Submit your files on EE workstations. Please use the following command to submit your homework 9.

```
$ ~ee407002/bin/submit hw09 hw09a.pdf hw09.cpp MAT.h MAT.cpp VEC.h VEC.cpp
```

where **hw09** indicates homework 9.

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