* 1. Topics/Purpose
* Implementing a multiresolution curve editor
* Recreation of images by tracing and approximating mulitresolution curves
  1. Statement

I will create an application allowing for the flexible representation and editing of curves. These curves will be approximated using a multiresolution curve representation.

This representation will allow for the ability to change the overall sweep of a curve while maintaining its fine details, as well as the ability to change a curve’s fine details without affecting the overall sweep. The curve will maintain the ability to be edited at any continuous level of detail via direct manipulation, and continuous levels of smoothing will also be supported. Finally, curve approximation within a guaranteed maximum error tolerance will be supported.

A basic UI will be created, allowing for users to free-form draw curves, edit control points, directly manipulate a curve, control the resolution level of the curve, display a colour chooser (applying to selected points), and adjusting the width of the curve (applying to selected points). Menu options will also allow for clearing, loading, and saving a curve, checkboxes to determine whether the control polygon or curve are shown, adjust the curve parameters, and select the manipulation mode (control point or direct).

Finally, the end goal for this multiresolution curve representation is to allow for the basic approximation of images by tracing out these curves over an image. Multiple curves will be supported, and an advanced example will be included to demonstrate this ability.

* 1. Technical Outline

The bulk of this multiresolution curve modelling lies in implementing the filter bank that takes a cubic B-spline and breaks it into successively smaller sets of control points (and successively larger sets of detail functions).

Basically, we take in an arbitrary number of input control points and break it down into smaller sets of points (depending on the level of detail). The fewer control points, and more sweeping the editing of the curve. If we have the full amount of control points, we control every detail.

Since this is the second draft of the proposal, I will leave the details of the implementation to the Filkelstein and Salesin paper. Their explanation is quite thorough and I will fill in the gaps on my own.

However, from a report by Joanne KcKinley (2001):

“First specify a bunch of matrices that represent the scaling functions (B-spline basis functions - from Cox-de Boor-Mansfield recursion formula) and the orthogonal wavelets. For decomposition, the problem distills down into successively solving Ax = b linear equations. For this, use LU decomposition since there are multiple right-hand-sides (6, for x, y, r, g, b, and width). Reconstruction can be done with simpler matrix additions and multiplications.”

* 1. Bibliography

1. Multiresolution Curves. Finkelstein and Salesin, University of Washington 1994. – *This PhD thesis describes a multiresolution curve representation, based on wavelets, that supports a variety of operations (smoothing, editing preserving details, approximation within any given error tolerance).*
2. Wavelets for Computer Graphics. DeRose, Salesin, Stollnitz, Morgan Kaufmann Publishers, Inc., San Francisco, 1996. – *This book outlines the usage of wavelet analysis. I will be using wavelet analysis to provide different resolution levels for my cubic b-spline curves.*
   1. Objectives

* Create a user interface for the multiresolution curve editor
* Implement the drawing of endpoint-interpolation cubic B-spline curves from input data points
* Allow for dragging the mouse to define a line, and implement functionality to edit the curve by moving control points
* Implement adaptive curve sampling, ensuring a smooth curve
* Extend this smoothing to continuous levels (multiresolution) using wavelet analysis
* Extend the editing of the curves to continuous levels (multiresolution, allowing editing of both the sweep and the details of the curve)
* Extend the editing of the curves to allow direct manipulation of a curve
* Allow for the editing of colour and size dimensions
* Allow for multiple curves to be drawn, allowing for the tracing of an image
* Demonstrate the drawing functionality by approximating a complicated drawing using at least 20 curves and multiple thicknesses/colours