EXTENDED ABSTRACT

Analysis of Interpolation Techniques

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Brief Outline:

This paper critically examines common interpolation techniques and determines which technique is suitable for a specific set of data points. It also presents C++ program codes incorporating numerical techniques for fitting a curve through given data points by the following methods and analyzes the efficiency of each of the following methods by comparing the graphs obtained for different functions:

1. Lagrange Polynomial

2. Newton Interpolation Polynomial

3. Normal Cubic Spline Interpolation.

4. Clamped Cubic Spline Interpolation.

My contribution to the paper:

1. C++ source code for each of the above mentioned techniques which includes plotting of graphs.
2. Extensive analyzing of the graphs obtained in each of the techniques for simple and complex functions to compare their efficiency (this has been elaborated in the next section).
3. Data Correlation: To determine which technique works best for a specific set of inputs.

What's new in the paper:

1. The consistency and efficiency of the spline as a data correlation tool has been demonstrated.

2. Ability of spline technique to correlate data which doesn't follow any specific pattern without a single polynomial's extreme behavior has been illustrated with different sets of data points.
3. Pros and cons of the 4 techniques mentioned above have been extensively researched upon using variety of inputs and a broad conclusion has been reached as to which method to adopt for the specific problem under scrutiny.
4. Discusses the cubic spline interpolation technique as a possible tool for curve fitting in programs for which more commonly used techniques may be unsuitable or of limited value.
5. Demonstration of the fact that spline interpolation is advantageous over polynomial interpolation because the interpolation error can be made small even when using low degree polynomials and that it avoids the problem of Runge's phenomenon which occurs when using high degree polynomials.

Scope of the paper:

The programs have been developed using Turbo C++ and the executable files of all the programs have been generated. These .exe files can be used for correlating experimental data points using different techniques. In the future, program codes for implementing advanced techniques like Genetic Algorithms, Simulated Annealing could be written and then integrated with these programs to provide a complete Numerical analysis package.

The spline interpolation technique is widely used in curve fitting because of its ability to work for both low and high degree polynomials. It has applications in Image Mosaics (combining two very different images smoothly by editing histogram data), Aerospace engineering (model airplane drag as a function), Computational chemistry (to find the minimum in the energy level of a molecule), Statistics(data correlation), Experimental science(interpretation of results of a particular experiment), computer aided design (especially in surface design of vehicles),space technology (maximize the payload delivered by rocket by minimizing the integral of square of applied acceleration) and many other areas too.