A Study on Fractal Interpolation in Shape Preserving and in Numerical Methods for Ordinary Differential Equations

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Interpolation is an essential tool to approximate the unknown function from its samples. Many situations, when data arises from various complex phenomena, the data exhibits irregularity. Giving smooth approximation for these data may not be suitable. Fractal interpolation provides a non-smooth approximation for the interpolation data. Iterated function system is a basic tool to construct the fractal interpolation function and the graph of the fractal interpolation function is the attractor of the iterated function system. Data visualization is an essential subject because when data comes from scientific experiments or natural phenomena, the data may contains certain shape properties and preserving the shapes of these data are needed. Though traditional interpolation methods (polynomial, spline etc.) are good for shape preserving, these methods may not be good for irregular representation of the unknown functions. Fractal interpolation functions can be used both in shape preserving and irregular representation of the unknown functions. Also, fractal interpolation can be used to develop the numerical methods for the boundary-value problems of the ordinary differential equations. In this thesis, we have developed rational cubic fractal interpolation functions for preserving the shapes of the univariate data. We have constructed fractal interpolation surface for preserving the shapes of the bivariate data. With the help of fractal cubic spline, we have developed the numerical schemes for singularly perturbed boundary-value problems and singular boundary-value problems. Using non-polynomial fractal cubic spline, we have developed numerical schemes for singularly perturbed boundary-value problems. With the help of fractal quintic spline, we proposed the numerical schemes for singularly perturbed boundary-value problems, nonlinear boundary-value problems and fourth-order boundary-value problems.