CIRCUIT DESIGN FOR SINGLE-ORDER SYSTEM WITH FRACTIONAL POWER USING SINGULARITY FUNCTION APPROACH

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ABSTRACT

This project presents the analysis and synthesis of single-order system with fractional power m. The singularity function method and the partial-fraction expansion for a rational function to approximate the function by a series of negative real pole-zero pairs was used.

First, the analysis is done for $0<m<1$ and then extended to $m>1$. Singularity function method is used to approximate the fractional-order function by pole-zero pairs. The function is then synthesized to circuit form. A circuit design method for the synthesis is proposed and the resulted circuit is simulated using PSPICE. The simulation results are presented for both the frequency and unit-step responses and compared with the responses from the original transfer function plotted using MATHCAD.

In the synthesis, the magnitude of the presented transfer function is approximated. The passive filter design and active filter design method are proposed in this thesis.

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CONTENTS

CHAPTER 1

1. INTRODUCTION

A fractional slope of log-log bode plot has been observed to characterize of a certain types of physical phenomena [1]. Many physical phenomena, including certain types of electric noise, relaxation behavior of polarized impedances in dielectric and interfaces, transmission lines, cardiac rhythm and spectral densities of music are known to exhibits a fractional power function dependence on frequency or equivalently a fractional slope on the log-log plot.

The concept of fractal is an extension of the classical geometry develope by Mandelbrot [2]. Numerous studies made about the 1/f phenomena ever since it was pointed out by Van der ziel [3]. The studies on fractal system are mostly carried out on single-order fractal system. Little has been done on multiple fractal system, second-order fractal system or dominant pole fractal system, and higher order fractal system.