

**SOME APPROXIMATIONS
OF FRACTIONAL ORDER OPERATORS
USED IN CONTROL THEORY AND APPLICATIONS**

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Abstract

In this paper, starting from the formulation of some possible models of fractional-order systems, several approximations are discussed. For continuous models, some methods for obtaining an approximated rational function using evaluation, interpolation and curve fitting techniques are studied. For discrete models, approximations using Lubich's formula, the trapezoidal rule, and the application of continued fractions expansion technique to integro-differential operators formulated in the Z domain are studied. The methods are compared, in both the time and the frequency domains, using an illustrative example.

Mathematics Subject Classification: 26A33 (main), 93C15, 93C55, 93C80

Key Words and Phrases: fractional calculus, fractional-order systems, fractional-order controllers, integer-order approximations

1. Introduction

At least since the sixties some researchers have been interested in obtaining approximated integer order models for fractional order systems, or finite dimensional models for infinite dimensional systems. Most of these researchers worked in electrochemistry where the problem is (roughly speaking) to build an equivalent electrical circuit for processes in which diffusion is present. Even earlier, other

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