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APPROXIMATION ACCURACY ANALYSIS OF HIGH ORDER ELECTROMECHANICAL SYSTEMS OBJECTS WITH FRACTIONAL TRANSFER FUNCTIONS OF DIFFERENT TYPES

When optimizing circuits of automatic control system (ACS) of electromechanical systems in which objects are described by transfer functions (TF) of high order, there is tendency to resort to lowering the order of the numerator and denominator, ignoring the elements of operators in a high degree, resulting in significant adequacy deterioration of this model in relation to a real object. An effective way which ensures order lowering is to present control object with fractional parts of low order. This article is the continuation of the research conducted in this area in order to form a more complete theory of the creation of fractional order models for high-order TF approximation developed on the identification of real electromechanical objects with typical fractional models of first and second order and a comparative analysis of this approximation accuracy both in frequency and time domain. The results of this analysis enable to make recommendations on the usage of certain fractional order parts characterized by certain frequency and transition parameters.

This analysis is carried out in MATLAB Simulink environment and provides the following:

– creation of low order fractional models of individual parts chosen as the basis of modeling that are not presented in the environment;

– high order part approximation, which is the transfer function of an induction generator with self excitation, with low order fractional models and estimation of approximation accuracy of the object with a fractional model by applying square error of mismatch of both frequency and transition functions of full and simplified models;

– evaluation of approximation accuracy of all part types is done in time and frequency domain with the same step, thus ensuring validity of the results.

Due to the comparative analysis to approximate the control object which is an induction generator with self excitation, it is necessary to use fractional order part with the transfer function $W(s) = \frac{k}{a_1 s^{\alpha_1} + 1}$ which provides high approximation accuracy and is simpler to be implemented in comparison with others.