Analysis of the Transient State in a Parallel Circuit of the Class RL_βC_α

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Abstract

In recent years, the fractional-order integral-differential calculus has been gaining wide applications in the description of phenomena occurring in various fields of science and technology, among others, in technical sciences [1], medical and bioengineering [2]. It has been noted that electrical circuits containing supercapacitors and inductors with ferromagnetic cores, are described with good accuracy by fractional-order differential equations. Analysis of such systems include, among others, resonance phenomena [3-5], their stability [6] and transient states [7-8] occurring in these circuits. The paper presents the results of the analysis of the transient states in a parallel circuit of the class $RL_\beta C_\alpha$. For solving equations describing the considered circuit, a method of decomposition of fractional-order rational function into partial fractions and Laplace transform method have been used. Universal, analytical formulae have been obtained, which allow to determine the currents and voltages for different kinds of excitations: constant, monoharmonic, periodical, almost-periodical and arbitrary being an element of a Hilbert space. Obtained results have been illustrated by simulation and experimental examples.

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