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Synthesis and Design of Constant Phase Elements Based on the Multiplication of Electronically Controllable Bilinear Immittances in Practice

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Abstract:

The main aim is the investigation of practical aspects of synthesis of so-called active constant phase elements (CPE). The proposed synthesis is based on the multiplication of partial bilinear immittance segments with electronically adjustable locations of zero and pole. An overview of already known methods for the synthesis of active types of CPE is given and explained as the initial motivation of this work. This work introduces a solution of new simplified two-active-elements-based bilinear immittance and investigates its implementation in loop of operational-transconductance-amplifiers-based impedance converter operating as a general immittance multiplier of a theoretically infinite number of partial immittance segments. The presented results show practical consequences of applying these bilinear immittance segments in CPE synthesis. The most important advantages of the presented proposal are: simplified circuitry of a partial bilinear segment and mutually independent electronic and linear control of zero and pole frequencies allowing electronic reconfiguration of the order of CPE. The design is accompanied by a detailed analysis of real behavior and practical recommendations for design. Real non-ideal features of active elements have significant impact on CPE operation. Therefore, a detailed study of practical aspects has been prepared and supported by Matlab calculations. Conclusions resulting from analyses are supported by PSpice simulations and real experiments.

Keywords:

Bilinear immittance; constant phase element; electronic reconfiguration; fractional-order synthesis; immittance multiplication.

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