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Active Resistance Capacitance Filter Design

The problem:

To develop simple, active resistance-capacitance (RC) networks that will perform integration and filtering functions that normally require inductors or transformers, and to develop a practical synthesis method using these networks. The heavy magnetic core materials characteristic of passive inductance-capacitance (LC) networks are thereby eliminated.

The solution:

An active RC network formed by combinations of distributed RC elements with positive-feedback voltage amplifiers. Filters of this type may be made to provide transfer functions similar to those the heavier LC filters ordinarily employ; they may also provide signal amplification, instead of the attenuation ordinarily experienced with passive filters.

How it's done:

The simplest active RC networks comprise distributed RC elements and low-gain voltage amplifiers. A method of calculating the response of these distributed, lumped, active (DLA) networks was developed together with an approximation technique to relate the response to that of an infinite set of poles and zeros (Reference 1). The actual amplitude response can thus be represented by a simple equivalent pole-zero set. In this way, a set of design charts may be calculated and the network parameters determined for any given transfer function and any specific DLA network. The transfer function is broken down into a number of quadratic and linear factors; each factor is realized separately. The complete filter function is then obtained by cascade connection of the individual sections. Placement of the voltage amplifier at the output of each section allows cascading without interaction.

A complete set of design charts for each of these networks is given in Reference 2. In order to synthesize a network for a given pole-zero position, the quadratic factor to be synthesized is normalized, and the required network parameters are obtained by interpolation from the design charts. The network capacitors are then scaled by the amount of the normalization ratio, to place the zeros and poles at the original design locations. The resulting network can then be scaled in the standard manner to any frequency or impedance level desired.

References:

1. "Digital Computer Analysis of Distributed, Lumped, Active Networks", by L. P. Huelsman and W. J. Kerwin, published in IEEE Journal of Solid State Circuits, Vol. SC-3, Number 1, March 1968.
2. "Synthesis of Active RC Networks Containing Distributed and Lumped Elements", by William J. Kerwin, proceedings of the Asilomar Conference on Circuits and Systems, Pacific Grove, California, October 31 and November 1, 1967.
3. "Active Integrated Circuit Synthesis", by Dr. R. W. Newcomb, Prentice-Hall 1968.

Note:

Requests for further information may be directed to:

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Patent status:
Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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