

## XX. NETWORK SYNTHESIS

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### RESEARCH OBJECTIVES

The general comments in the first four paragraphs of the corresponding report made a year ago (see the Quarterly Progress Report, Jan. 15, 1954) still apply to the field of interest in which the activities of this group are centered. Considerable progress has been made in clarifying the time-domain synthesis procedures; reports on these results should be forthcoming within the present year.

Work on the production of theoretically and computationally improved methods of synthesis to replace the Brune, Darlington, and Bott-Duffin procedures, mentioned in last year's report, is now completed and in the write-up stage. Also being written up is a more direct and computationally simplified method of carrying out the Dasher synthesis of RC networks (Technical Report 215). Work is in progress to exploit this new method from a practical point of view in order to reduce the design of RC filters to a more useable form for the engineer in industry.

As a by-product of these investigations a quasi-Darlington-Dasher method of synthesis has been developed for a positive real driving-point impedance. If the given impedance has holes at the points  $s = 0$  and  $s = \infty$  and if the zeros of its even part are not more than  $45^\circ$  from the  $j$ -axis (conditions that are often met in practice), the method permits realization without mutual inductive coupling and without resorting to the Bott-Duffin method, which leads to an excessively large number of elements. These results will also be forthcoming in report form.

Regarding the synthesis of transfer functions, an investigation with the following two major objectives is under way:

1. To discover some general properties of voltage transfer functions and to develop synthesis procedures that yield networks with the highest possible gain;
2. To study the voltage transfer properties of some common network configurations (the lattice, the ladder, and so on) and to develop for these networks synthesis procedures that yield the highest possible gain.

Two new projects having to do primarily with the analysis aspects of network theory are getting under way. One of these will produce an alternate approach to the derivation of equilibrium equations for systems involving various constraint relations that are sometimes awkward to handle in the classical method. The other is aimed primarily at augmenting the analysis methods in order to accommodate network elements having three or more terminals (rather than the conventional pair) and to extend these methods to the consideration of active and/or unilateral circuit elements (vacuum tubes and transistors are examples of such multiterminal and/or active or unilateral elements).

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