

## A B S T R A C T

ECONOMIC DESIGN OF CLOSED LOOP PHYSICAL SYSTEMS  
SUBJECT TO FLUCTUATING ENVIRONMENTAL CONDITIONS

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The purpose of this investigation is to develop a generalized method of numerical solution of the economic analysis of closed loop systems wherein:

- (a) Equilibrium operating conditions cannot be readily established by conventional methods of solving the simultaneous equations based on mass and energy flows through multiple circuits;
- (b) The problem of changing environment changes the efficiency of operation of the system, so that the most economical design is that which gives the best time weighted combination of operating cost and investment charges; and
- (c) The functions describing the operating characteristics of the various components of the system are largely empirical and available commercial standards must be used.

A computer program has been developed which takes the operating characteristics of a direct expansion air conditioning system with

an air cooled condenser and from these characteristics determines the equilibrium operating condition of such a system. For any given set of external parameters the economic consequences of changing the design specifications of the several elements have been explored until the most economic combination is attained under known or assumed costs of investment and maintenance of component elements, and of energy cost.

The solution is accomplished by a repeated application of sequential univariate search and "buy-back" strategies until the constrained minimum of the system is obtained. This search process is simple and is suitable for the use of modern digital computers where elegant methods such as linear and/or nonlinear programming, Lagrange multipliers and steepest descent techniques either cannot be formulated or a solution cannot be obtained.