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# A STUDY OF THE FUNCTION-BASED POLICY OPTIMIZATION IN SYSTEM DYNAMICS MODEL

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Abstract. *Policy optimization has been a focus in research of system control in recent years. By using the principles of systems dynamics and polynomial control theory, this paper demonstrates how to convert a function-based policy problem into a parameter-based policy problem which can then be solved with a programming model based on genetic algorithm. A case of multi-vendor inventory system is studied to validate the proposed programming model and solution methods. This paper is of theoretical and practical significance in developing and perfecting the fundamental principles of Systems Dynamics as well as in exploring the theories of socio-economic system control and policy optimization.*
**Keywords:** System dynamics, Policy optimization, Genetic algorithm

1. **Introduction.** Management Science (MS) is a cross-functional, multi-disciplinary filed which examines the advances and solutions supporting enhanced strategic planning, executing, controlling, feedbacking and managing in the modern business world [1]. However, while the methodologies in MS for dealing with static systems have been widely explored with significant advancements, the theories and methods for dealing with dynamic systems are not well developed [2]. Systems Dynamics (SD) is an effective approach to analyze complex dynamic systems which absorbs the essence of cybernetics and informatics to carry on systems modeling and policy analysis via numerical simulation with qualitative and quantitative methods as well as applications of computer technologies [3].

According to the principles of SD, a loop is the basic structural unit of a system. A socio-economic system can be abstracted into loops, accumulation, information, delay, and decision-making, and the interaction among these elements is similar to the law of physics describing how fluid flows in a loop [4]. When fluid flows in a loop, accumulation is bound to occur, and thus pressure which is caused by the accumulated substances will influence the decision-maker through information transfer. The decision-maker will in turn make necessary decisions to influence the rate of flow in accordance with the received information, thus to change the level of accumulated substance [5]. This modeling idea closely integrates the state of a system and the decision-making process, and thus brings the policy factors into a model to study the system behaviors [6]. Additionally, SD can cope with the phenomena of material and information delays commonly observed in the real world, which makes the model a good representation of the real system to be studied.