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SIMULATION-BASED DECISION MAKING FOR URBAN POLICIES

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ABSTRACT

As recent cities are getting diverse and complex, a method for developing urban policies for a city needs to become systematic and sophisticated. In this sense, data-oriented policy making can be one feasible approach. This paper proposes a simulation-based decision making tool for urban policies. Using the proposed framework, it is expected that users evaluates their political ideas and discovers an optimized policy for their objectives before implementing real polices.

1 INTRODUCTION

Various policies have been developed in many cities, but it is hard to find successful one. This may come from the uncertainty from rapidly changing dynamics of socio-economics in the cities. In this case, one feasible method is adopting simulation methods. Simulation techniques have already adapted to analyze and predict changes of various systems. For example, Land-Use Transportation Interaction (LUTI) models have been studied over sixty years using various modeling techniques, including micro-simulation (Acheampong and Silva 2015). Moreover, the policy making case would be one of the most appropriate one that simulation is applied to: one reason is that the data needed for the analysis are insufficient, because their volume and range are considerably large. Another reason is that before making a policy, it is better to evaluate the future changes after implementing various policies (i.e., what-if analysis) (Gilbert 2004). Due to these reasons, simulation techniques were applied to obtain political insights (Holmer, Janney, and Cohen 2009).

This paper proposes a simulation-based decision making framework for urban policies. The previous works mainly focused on evaluating policy effects using simulation techniques. For example, UrbanSim is a urban simulation model describing urban development based on the relationship between land-use and transportation (Borning, Waddell, and Förster 2008). The proposed work is also an application of LUTI models, but we take one step forward for policy making: the proposed framework was designed to carry out some tasks for suggesting a policy, such as selecting the best policy among multiple candidates and searching an optimized policy fitted to user's objective, within making various domain policies. Moreover, such functions are realized via the interplay of simulation and AI techniques. We expected that the proposed framework would help to analyze city-level policies before implementing them in real world.

2 SIMULATION-BASED DECISION MAKING FOR URBAN POLICIES

The proposed framework consists of three main components: *Data Repository*, *Urban Simulator*, and *Policy Optimizer* (see Figure 1). *Data Repository* is a storage of data that are generated in a target city and relevant with designing and evaluating urban policies (e.g., city-level population size and market revenue). These data are used 1) to provide policy knowledge to policy manager for efficiently searching optimal policies, 2) for users to develop urban simulation models, and 3) to test the model validation of

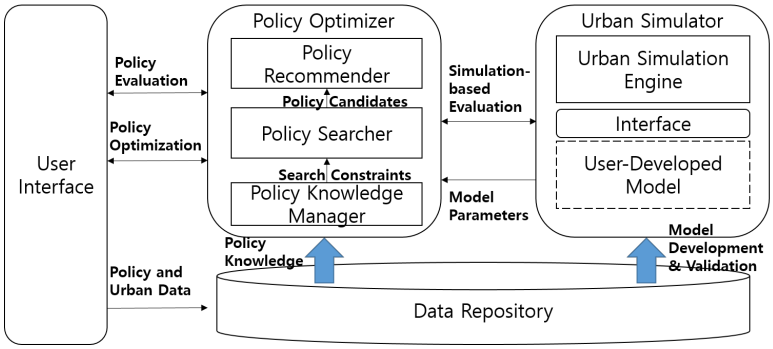

Figure 1: Structure of Simulation-Based Policy Evaluation and Optimization Framework

the developed models. *Urban Simulator* is a simulation environment where users can develop and execute their urban simulators. To this end, the urban simulator consists of simulation engine and model interface. The model interface is closely related with the simulation engine so that the simulation models based on the model interface could be simulated with the provided simulation engine without additional efforts. Currently, macro-level, micro-level, and the integration of both modelings are considered to explicitly represent various facets of urban dynamics. *Policy Optimizer* is the most important block of the propose framework. Receiving user's request, the policy optimizer evaluates and identifies the best policy through the urban simulation results. From the received user requirements (i.e., policy conditions and objectives), it discovers an answer efficiently; the best policy is explicitly a setting of model parameters, so this is a specific case of simulation-based optimization. To efficiently do that, the policy optimizer uses policy knowledge (from the data repository) related with the simulation models to reduce the searching space of the model parameters. Within the constrained searching space, the policy optimizer varies the model parameters setting and evaluate its performance through the urban simulator. Finally, the searching results are reviewed and recommended considering user specific conditions.

3 Conclusion and Further Works

This paper introduces the outline and the functions of the proposed framework, so the further works would be fulfill the details of the framework. For example, we consider that the urban simulator be related with the concept of digital twin which is a digital city synchronizing with the data of the associated real city. Also, we plan to apply the proposed method to analyze and develop policies for real-city commerce.

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