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Urban logistics as a Complex Adaptive System:

Understanding the emergence of dynamics

Introduction

In this study, we view urban logistics as a Complex Adaptive System (CAS), characterized by dynamic interactions between various components. Our approach involves three critical stages. Firstly, we simplify the intricate simulation into a focused 'meta game,' providing a clearer perspective. Next, we scrutinize this simplified model to reveal strategic patterns within logistics operations. Finally, through continuous adjustments to simulation parameters, we gain insights into their impact on the dynamic nature of urban logistics.

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Stakeholders

References

Holland, John H (2002). “Complex adaptive systems and spontaneous emergence”. In: Complexity and Industrial Clusters: Dynamics and Models in Theory and Practice. Springer, pp. 25–34.

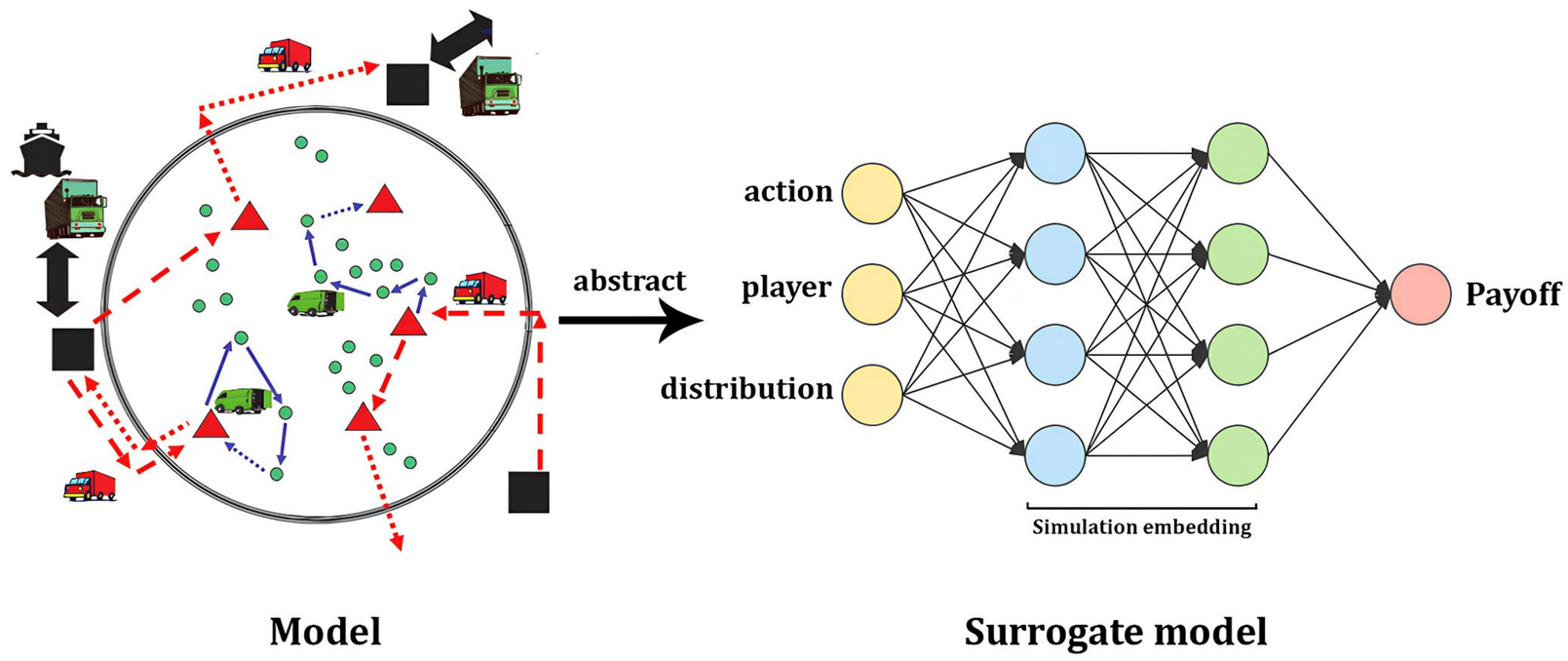
Dessalles, Jean Louis and Denis Phan (2004). Emergence in multi-agent systems: cognitive hierarchy, detection, and complexity reductions. Tech. rep. Working Paper ELICCIR.

Tuyls, Karl et al. (2018). “A generalised method for empirical game theoretic analysis”. In: arXiv preprint arXiv:1803.06376.

Smith, J. Maynard and G. Randall Price (1973). “The Logic of Animal Conflict”. In: Nature 246, pp. 15–18. url: https://api.semanticscholar.org/CorpusID:4224989.

Abstracting the simulation into a “Meta Game”

- **Turning Complexity into a Game**: We simplify the complex urban logistics simulation by representing it as a game. This helps us focus on the strategic aspects. It is an appropriate representation for comprehending the emergence of strategies and behaviors.



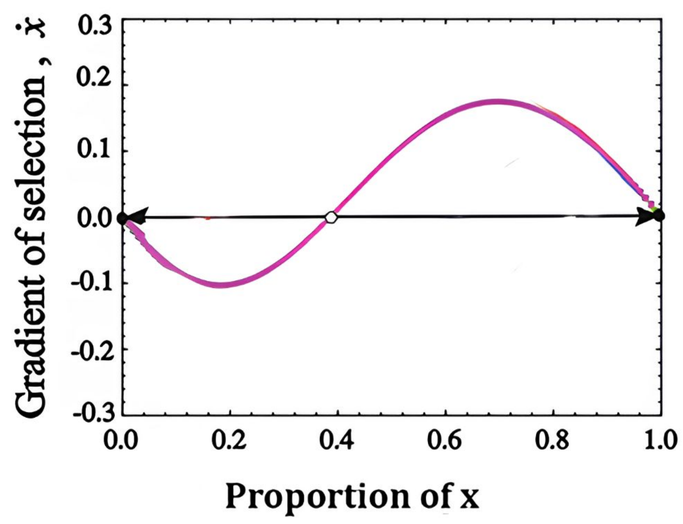
Analysing the game by computing a dynamical field

- **Analyzing the Meta Game with a Dynamical Field**: We use a dynamic field to scrutinize the interactions and strategies within the simplified representation (meta game). It enhances our comprehension of interaction patterns among the players.

Player 1

Player 2	Use UCC	Not use UCC
Use UCC	X	Y
Not use UCC	Z	T

MetaGame



Dynamical field

Assessing the impact of the simulation parameters

- **Assessing Simulation Parameters' Impact through Open-Ended Evolution:** We continuously modify simulation parameters to understand their effects on urban logistics dynamics, providing insights into system behavior under various conditions.

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