The 7th International Symposium on Frontiers in Ambient and Mobile Systems (FAMS 2017)

Towards Agent Based Modeling for Mobility Behavior Shift

Samar El-Amine[a]*, Stéphane Galland[a], Ansar-Ul-Haque Yasar[b], Abderraffiaa Koukam[a]

LE2I, Univ. Bourgogne Franche-Comté, UTBM, 90010 Belfort Cedex, France
Hasselt University, Transportation Research Institute (IMOB), Agoralaan, 3590 Diepenbeek, Belgium

Abstract

This research paper is a literature review on the behavioral shift using agent-based modeling. We will go through different topics based on agent-based modeling. This research paper points out on different sayings on behavioral shifts. Moreover, it explains the modern research on this topic and many pros and cons on a behavioral shift by using agent-based modeling.

Keywords: Agent Based Modeling; behavioral shift; Modeling and Simulation

1. Introduction

A behavioral shift is fundamental as it represents reality and explains and eliminates the differences between fusion and reality in Mobility. A behavioral shift is needed for several reasons which differ from one person to another depending on what someone is looking for from this shift. For example, a behavior shift is fundamental to fill the gap between the reality of government improvements for pensioners in Europe and the rhetorical statements by different peoples in Europe. Despite the changes they are self-significant and taken by government in business model of European pensioners after the financial crisis, there are gaps to fill between the government policies and the reality of the ground.

In the traffic domain, a behavior shift in terms of the person's goal-oriented destination(s) will lead to a shift in the person's mobility. For example, a new office location or favorite restaurant will shift individuals' routes, perhaps

* Corresponding author. E-mail address: samar@sanda.be

cause increased traffic in certain region, and result in mobility shifts for other agents. If a person endeavor in a mobility behavior shift while a non-agent based simulation was running, there would be no ripple effect measured in surrounding persons. For example, in the simulation, drivers would continue driving a predestined route with a traffic jam, without making an effort to change their behavior. Other types of models do not necessarily contain an expandable network of persons, whose numbers, routes and goals are able to changed and measured by agents. Traffic is dynamic and ever changing, thus a successful Agent Based Modeling for Mobility Behavior Shift must be adaptable and flexible.

For solving the previous issues, we advocate an agent-based model (ABM) will capture the individuals' behaviors, and enable the simulation of the shifting behaviors in order to obtain system level indicators. In this paper, a literature review on ABM for behavior shifting is discussed.

This paper is structured as follows. Section 2 presents more in-depth elaboration upon Agent Based Modeling, specifically, behavioral shifts, four standard ABM objectives and configuration based modeling. Section 3 is a discussion part about the existing models limits and how to create a novel ABM model for mobility behavior shift. Section 4 is a conclusion and perspectives.

2. Agent Based Modeling

ABM is one class of computational models for recreating activities and communications of independent agents (both individual and aggregate substances such as associations and gatherings) with a view to surveying their consequences for the framework all in all. It consolidates components of diverse hypothesis, complex frameworks, rise, computational humanism, multi-operator frameworks, and developmental programming. ABMs are likewise called individual-based models (IBMs) especially inside environment.

2.1. Agent Based Modeling for Behavior Shifting

A specialist-based simulation is being utilized for understanding and/or predicting the behavior of the studied system. For instance, the sociologies look to comprehend how people carry on as well as how the communication of numerous people prompts to substantial scale results. Understanding a political or monetary framework requires more than a comprehension of the people that contain the framework. It likewise requires seeing how the people collaborate with each others, and how the outcomes can be more than the total of the parts. ABM is appropriate for this sociology objective. It is a strategy for contemplating simulation frameworks showing the accompanying two properties:

- The framework is made out of collaborating entities named agents;

- The framework displays eminent properties, that is, properties emerging from the associations of the specialists that can't be reasoned essentially by amassing the properties of the agents. At the point when the cooperation of the specialists is dependent upon past experience, and particularly when the agents persistently adjust to that involvement, numerical investigation is regularly extremely restricted in its capacity to infer the dynamic outcomes. For this situation, ABM may be the main pragmatic techniques for examination.

ABM starts with suppositions about agents and their communications and after that utilizations reproduction to create "histories" that can uncover the dynamic results of these presumptions. Hence, ABM analysts can examine how substantial scale impacts emerge from the smaller scale procedures of associations among numerous specialists. These specialists can speak to individuals (say, shoppers, dealers, or voters), yet they can likewise speak to social groupings, for example, families, firms, groups, government offices and countries. Recreation as a rule and ABM, specifically, is a third method for doing science notwithstanding derivation and acceptance. Researchers utilize reasoning to get hypotheses from suspicions, and enlistment to discover designs in exact information. Reproduction, similar to finding, begins with a thoroughly indicated set of suspicions in regards to a genuine or proposed

arrangement of intrigue; be that as it may, not at all like a reasoning, the recreation does not demonstrate hypotheses with all-inclusive statement. Or maybe, reenactment produces information reasonable for examination by acceptance. As opposed to common acceptance, be that as it may, the reenacted information originates from controlled examinations instead of from direct estimations of this present reality.

2.2. ABM Objectives

Thus, reproduction varies from standard finding and enlistment in both its usage and its objectives. Reenactment grants expanded comprehension of frameworks through controlled computational trials. The particular objectives sought after by ABM scientists take four structures: *experimental, standardizing, heuristic, and methodological*.

The objective of observational comprehension asks: **Why have specific huge scale regularities developed and held on, notwithstanding when there is minimal top-down control?** Cases of such regularities incorporate overwhelming applauses, exchange systems, socially acknowledged monies, common collaboration in view of correspondence, and social standards. ABM specialists look for conceivable clarifications grounded in the rehashed communications of agents working in determined situations. Specifically, they solicit whether specific sorts from observed worldwide regularities can be dependably produced from specific sorts of operator based models.

A second objective is regulating seeing: **How can operator based models be utilized as research facilities for the revelation of good plans?** ABM scientists seeking after this goal are keen on assessing whether outlines proposed for social arrangements, organizations, or procedures will bring about socially alluring framework execution after some time. Cases incorporate the outline of closeout frameworks, voting tenets, and law implementation. The general approach is much the same as filling a can with water to figure out whether it spills. A specialist based world is built that catches the remarkable parts of a social framework working under the outline. The world is then populated with secretly roused agents with learning capacities and permitted to create after some time. The key issue is the degree to which the subsequent world results are effective, reasonable, and deliberate, in spite of endeavors by these secretly propelled agents to increase singular favorable position through key conduct.

A third objective is heuristic: **How can more noteworthy understanding be achieved about the key causal components in social frameworks?** Regardless of the possibility that the presumptions used to demonstrate a social framework are straightforward, the outcomes can be a long way from evident if the framework is made out of many interfacing agents. The substantial scale impacts of interfacing specialists are regularly astonishing on the grounds that it can be difficult to suspect the full outcomes of even basic types of communication. For instance, one of the soonest and most rich operator based models - the city isolation (or "tipping") show created by Thomas Schelling exhibits how private isolation can rise up out of individual decisions notwithstanding when everybody is genuinely tolerant.

A fourth objective is a methodological progression: **How best to furnish ABM specialists with the strategies and instruments they have to attempt the thorough investigation of social frameworks through controlled computational tests and to look at the similarity of tentatively created speculations with genuine information?** ABM specialists are investigating an assortment of approaches to address this objective going from cautious thought of methodological standards to the reasonable advancement of programming, perception, and observational approval devices.

In synopsis, ABM connected to social procedures utilizes ideas and devices from sociology and software engineering. It speaks to a methodological approach that could at last allow two essential advancements:

- The thorough testing, refinement, and augmentation of existing hypotheses that have ended up being hard to define and assess utilizing standard measurable and numerical apparatuses.

Table 1. Summary of the objectives that are considered in the reviewed papers[1,2,3,4,5,6,7,8,9,10].

	Experimental Objective	Standardizing Objective	Heuristic Objective	Methodological Objective
Governance Practices: Bridging The Gap Between Rhetoric And Reality[1]			✓	✓
Evolving Market Structure: A Model of Price Dispersion and Loyalty[3]	✓	✓		✓
From Factors to Actors: Computational Sociology and Agent-Based Modeling[4]	✓	✓	✓	✓
Elements of Dynamic Economic Modeling: Presentation and Analysis[5]	✓	✓		✓

- A more profound comprehension of essential causal instruments in multi-specialist frameworks whose review is at present isolated by counterfeit disciplinary limits.

We chose at the start to offer a short rundown of readings instead of make any endeavor at extensiveness. We construct our determinations in light of two criteria:

- The instructive estimation of the perusing for newcomers to ABM in the sociologies.

- The openness of the perusing. The particular selection of themes and readings is our own. We perceive that our choices are close to home and essentially to some degree self-assertive.

Table 1 summarizes the considered objectives in the significant papers that we have reviewed.

2.3. Institutional Design of Agent-Based Modeling

Simon[6] casually characterizes a "mind boggling framework" to be a framework made up of an expansive number of parts that collaborate in a no simple way. He considers various complex frameworks experienced in the behavioral sciences, from families to formal associations, and portrays highlights that are regular in a wide assortment of such frameworks. His focal topic (p. 196) is that "unpredictability as often as possible appears as chain of importance and that hierarchic frameworks have some regular properties free of their particular substance." He talks about the outline preferences of almost decomposable subsystems with a progressive association of their parts. He additionally guesses that unpredictable frameworks advance from straightforward frameworks a great deal more quickly. If there are steady middle structures a route, subsequently development favors hierarchic over non-hierarchic frameworks.

Wilhite[10] builds up a specialist based computational model of a reciprocal trade economy. He utilizes this model to investigate the outcomes of confining exchange to various sorts of systems, including a "little world system" with both neighborhood network and worldwide reach. His key finding is that little world systems give the majority of the market-proficiency points of interest of totally associated systems while holding the greater part of the exchange cost economies of privately associated systems.

2.4. Configuration Based Modeling Networks

Social researchers ordinarily concentrate the ramifications of given association systems, e.g., fellowship or exchange systems. An essential part of numerous social frameworks, be that as it may, is the manner by which agents come to shape collaboration systems. Kirman and Vriend[3] address this issue with regards to a specialist based computational model catching notable auxiliary parts of the real discount angle showcase in Marseille, France. Two elements describing this real market are

- Loyalty connections (determined exchange organizations) between specific purchasers and venders.

- Persistent value scattering unexplainable by noticeable qualities of the fish. The reproduction comes about demonstrate that reliability connections can in reality rise actually between specific purchaser dealer matches as the purchasers and merchants co-advance their exchanging rules after some time. Purchasers figure out how to wind up distinctly faithful to specific dealers while, in the meantime, venders figure out how to offer higher adjustments (bring down costs and more solid supplies) to their more steadfast purchasers. Also, this advancing exchange arranges bolsters industrious value scattering after some time[4].

The essential objective of these basic notes is to advance the unmistakable presentation and thorough examination of element monetary models, whether communicated in the condition or operator based shape.

3. Discussion

In this section, the contributions from the reviewed papers are discussed according to the four objectives that are described in Section 2.

3.1. Limits of the existing models

One key limitation of current models is the need to fully establish and complete the model prior to running certain simulations. Two scientific questions arise. First, what the key variables to consider in the model in order to reproduce the mobility behaviors and the behavior shifting, including the mobility, social, and personal attributes of each individual? The second problem concerns the need of high quality data for setting up the variables of the simulation model. What is the best level of detail, the needed level of data quality for ensuring valid simulation results?

The purpose of a computational model is to shed light upon certain conditions in the real world. Ideally, the models would be programmed, simulated and then verified against real world data. The final stage of verification is limited by the difficulty of statistically comparing real world data with simulation data. The resulting scientific question is then related to the validation of a simulation model against the real system: what is the methodology? What are the methods and tools for validating?

3.2. Towards a novel ABM model for mobility behavior shift

The ideal model will embrace and achieve each of the four objectives stated earlier. The model will focus on the actions and behavioral shifts of local agents and agents to depict large scale events and regularities investigate social structures and individual agents to uncover mobility behavior shifts, incorporate communication and heuristic understanding between agents, and lastly, use real world observations to formulate the model's tests.

The model's flexibility and incorporation of real world data (the fourth objective) are especially important in terms of mobility behavior shifts; behavior shifts are social events which, when modeled, require consideration of many variables that exist in actuality.

4. Conclusion and Perspectives

Agent based simulation is being used for many purposes. Its uses and benefits vary. Behavioral shift is a basic thing and is need to avoid many consequences. Behavioral shift can be done through many ways in terms of computational modelling. Agent based modelling is an effective solution to various issues because it provides communication that is independent of agents. Unlike other models, ABM is able to include real time shifts in behaviour and mobility as well as adapt to changing conditions and parameters. It combines mechanisms of diversion hypothesis, multifaceted outlines, rise, computational humanism, multi-operator frameworks and developing programming.

By using agents to model the flow of traffic, one can model an accurate and successful flow of traffic by achieving each of the four objectives highlighted previously. Such a model will include human sociology, behavioral shifts and their consequences in mobility, as well as considerations for parameter adaptability. Future ABM traffic models, which encompass mobility behavior shifts, will allow for maneuvers such as an agent changing their predetermined route, or avoiding a pedestrian at a crosswalk.

Future efforts should center on overcoming current ABM limitations by allowing flexibility and a greater insight into real world variables that determine the nature of mobility behavior shifts. Such limitations are overcome through programming models, which allow inter-temporal planning (making decisions during the simulation); and achieving each of the four objectives, which combine to form an accurate, heuristic model of social awareness and local focus to uncover global trends and shifts.

Acknowledgement

References

1. Bridgeland, Sally and Amin Rajan. "Governance Practices: Bridging The Gap Between Rhetoric And Reality". The 300 Club 2016. Web. 13 Jan. 2017.
2. Kendrick, D. A., Mercado, P. R., & Amman, H. M. (2006). *Computational economics* (Vol. 18). Princeton, NJ: Princeton University Press.
3. Kirman, A.P.; Vriend, N.J. 1998. Evolving Market Structure: A Model of Price Dispersion and Loyalty. Working Paper. University of London, London, UK.
4. Macy, Michael W., and Robert Willer (2002), "From Factors to Actors: Computational Sociology and Agent-Based Modeling" (htt10), Annual Review of Sociology, Vol. 28, pp. 143-166. Distributed article   accessible at (jstor.org, n.d.)
5. Leigh Tesfatsion (2016), "Elements of Dynamic Economic Modeling: Presentation and Analysis," Eastern Economic Journal, to appear. doi:10.1057/eej.2016.2. http://www2.econ.iastate.edu/tesfatsi/DynamicEconomicModelingBasics.WPVersion.pdf
6. Simon, H. (1982). The Sciences of the Artificial, Second Edition. Cambridge, MA: The MIT Press.
7. Tesfatsion, L. (2017, January 10). *Notes on Wilhite (CE, 2001)*. Reading presented in Iowa State University, Ames.
8. Tesfatsion, Leigh (2006). Agent-Based Computational Economics: A Constructive Approach to Economic Theory. In Leigh Tesfatsion & Kenneth L. Judd (eds.), *Handbook of Computational Economics, Volume 2: Agent-Based Computational Economics*. Elsevier.
9. Tesfatsion, L. (n.d.). ACE Research Area: Agent-Based Computational Laboratories. Retrieved January 10, 2017, from http://www2.econ.iastate.edu/tesfatsi/acomplab.htm
10. Wilhite A. (2006). "Economic Activity on Fixed Networks", In: L. Tesfatsion and K.L. Judd, Editor(s), Handbook of Computational Economics, Elsevier, Volume 2, Pages 1013-1045, ISSN 1574-0021, ISBN 9780444512536, http://dx.doi.org/10.1016/S1574-0021(05)02020-4.