Abstract

This dissertation is situated at the intersection between computational social sciences, migration studies, and knowledge representation and reasoning within the symbolic approaches to AI. More specifically, it leverages the capacity of agent-based models to display the nature of emerging phenomena that arise out of the complex interaction between actors and institutions operating in the sector of interational migration, and uses this capacity to test hypotheses about the causes for migration trajectories and migration-related decisions. It also enables the merging of independent disciplines that study the same phenomena of physical human migration. The ontology-based representation system that is used in the dissertation enables the creation of world representations that pertain to international migration, while simultaneously interlinking various heterogeneous data sources that belong to the same unified system.

The first paper, "A Literature Review on the Usage of Agent-Based Modelling to Study Policies for Managing International Migration", establishes the theoretical foundation by surveying the literature in computational migration studies. It identifies a critical gap in existing ABMs: the difficulty of systematically integrating highly interconnected, heterogeneous socio-political contexts (such as policies, institutional metrics, and economic data) with spatial movement constraints to evaluate complex migration dynamics.

The second paper (pending publication) addresses this conceptual gap by deploying a hybrid, agent-based simulation framework with an ontology layer which instantiates a representation of international migration as a movement across a discrete graph of countries connected by land borders. The simulation integrates physical movement constraints with socio-political attributes (such as GDP and Polity scores) and is initialized using endpoints inferred from a large corpus of migration-related news articles. By analyzing over one million simulated trajectories, the study tests whether the well-established negative correlation between economic development and political instability observed at the country level persists when encountered sequentially along a path. The findings demonstrate that macro-level regularities do not automatically scale down to migrant-level experiences once sequencing and path dependence are taken into account, which challenges theoretical approaches to international migration, such as the push-pull factor models, that are based primarily upon endpoints and do not consider the sequence of migration.

The third paper (pending) further develops the world representation approaches utilised in the previous paper by instantiating a world simulation that attempts to replicate the empirical distribution of migrant stocks measured by relevant international organisations. To achieve this empirical validation, the orchestration layer utilizes automated Python scripts to query a curated repository of global demographic data within an RDF triple store, mapping international migrant stock matrices directly onto the initialization parameters of the world. The agent-based system discussed here constitutes a reproducible, data-driven pipeline capable of validating emergent macro-level agent distributions against real-world observations, and is used for hypothesis testing about the processes that generate aggregate migration statistics.