Project CASSIA — Framework for Exhaustive and Large-scale Social Simulation —

Itsuki Noda, Yohsuke Murase, Nobuyasu Ito, Kiyoshi Izumi, Hiromitsu Hattori, Tomio Kamada, and Hideyuki Mizuta

1 Overview

Project CASSIA (Comprehensive Architecture of Social Simulation for Inclusive Analysis) aims to develop a framework to administer to execute large-scale multi-agent simulations exhaustively to analyze socially interactive systems. The framework will realize engineering environment to design and synthesize social systems like traffics, economy and politics.

The framework consists of:

- MASS Planning Module: a manager module conducts effective execution plans of simulations among massive possible conditions according to available computer resources.
- MASS Parallel Middleware: an execution middleware provides functionality to realize distributed multi-agent simulation on many-core computers.

Itsuki Noda
AIST, 1-1-1 Umezono, Tsukuba, Japan, e-mail: i.noda@aist.go.jp

Yohsuke Murase
Riken

Nobuyasu Ito
Univ. Tokyo & Riken

Kiyoshi Izumi
Univ. Tokyo

Hiromitsu Hattori
Ritsumei Univ.

Tomio Kamada
Kobe Univ.

Hideyuki Mizuta
IBM

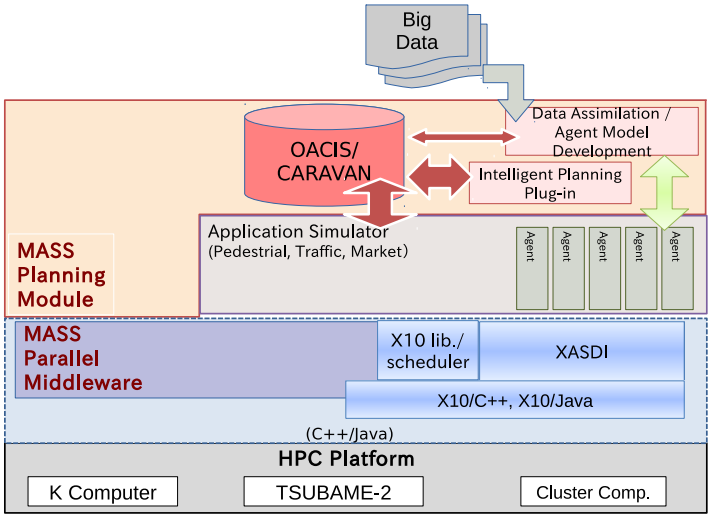

Fig. 1 Cassia Framework

2 MASS Planning Module

(Murase, Ito)

OACIS (Organizing Assistant for Comprehensive and Interactive Simulations) is a job management software for large-scale simulations. It controls a large number of simulation jobs executed in various remote servers, keeps these results in an organized way, and manages the analyses on these results.

CARAVAN provides more powerful scalability for exhaustive simulation. These functionalities are especially beneficial for the complex simulation models having many parameters for which a lot of parameter searches are required.

3 MASS Parallel Middleware

3.1 X10 Extentions and Plham

(Kamada)

Plham is a platform for large-scale and high-frequency artificial market simulation. It consists of models of markets for each stocks and three types of agents (high-freq. traders, short-term and long-term traders).

In order to enhance parallelism of computation, we introduce asynchronous computation in agents and communication between agents/markets, and provide high-level library to program them.

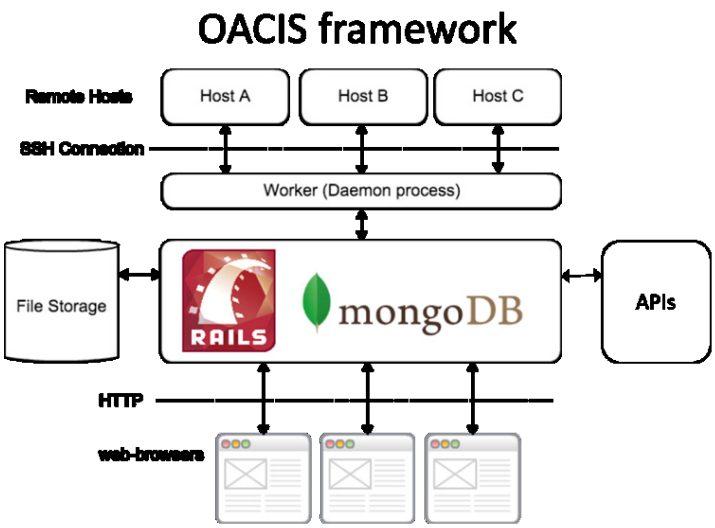

Fig. 2 OACIS

Fig. 3 CARAVAN

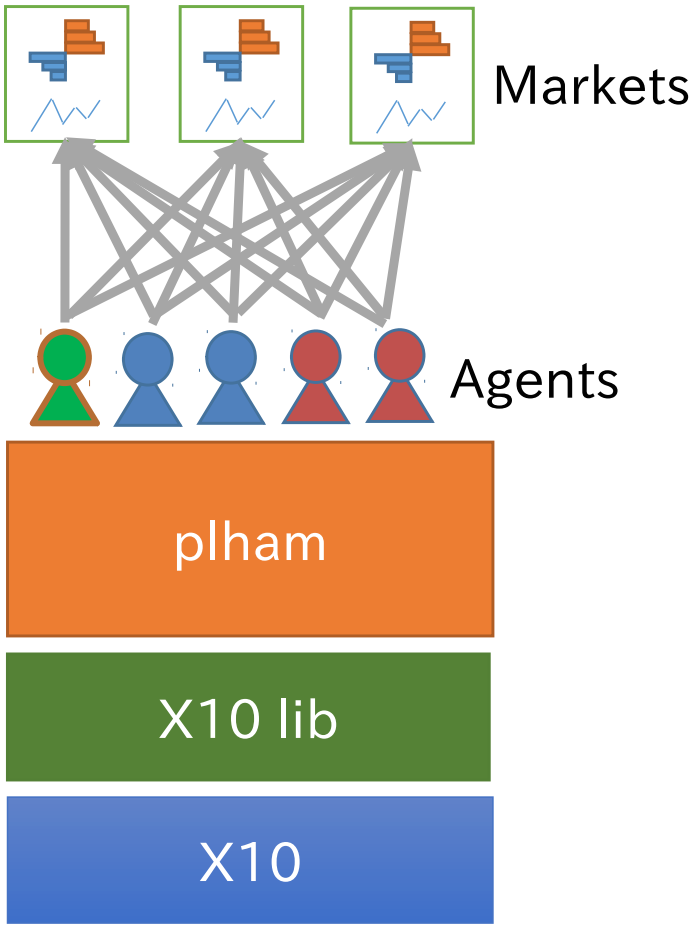

Fig. 4 Plham

3.2 XASDI

(Mizuta)

XASDI is the Large-scale agent-based social simulation framework with billions of distributed agents that provides easy-to-use API bridge with Java and X10-based runtime for high scalability. XASDI environment executes various social simulations written in Java with distributed agents and managers written in X10.

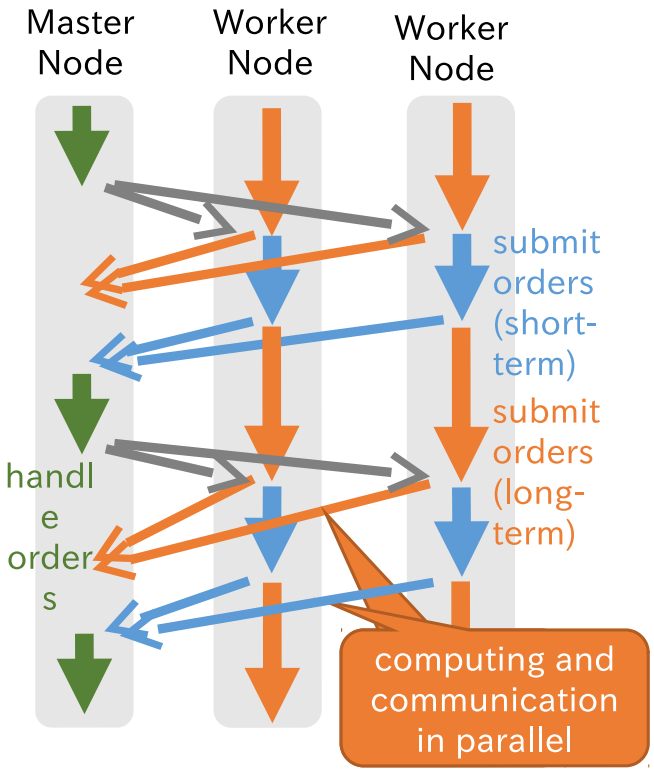

Fig. 5 Parallel Execution of Market Simulation

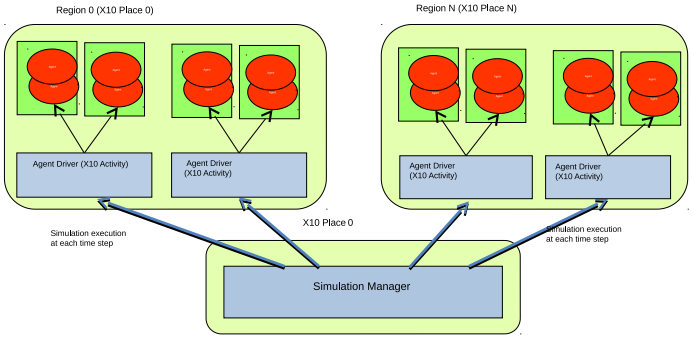

Fig. 6 XASDI

4 Applications

4.1 Market Simulation

(Izumi)

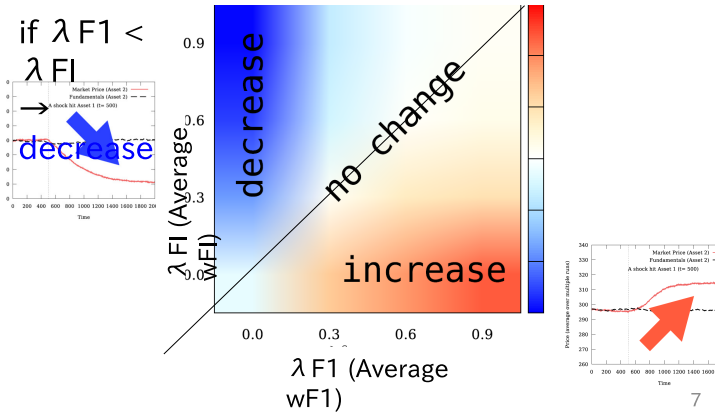

Fig. 7 Phase Diagram of Market Simulation

4.2 Pedestrian Simulation

(Noda)

CASSIA Framework can illustrate a trade-off structure in planning of evacuations from disasters. Optimization in disaster responses is serious requirements for local governments. But, such optimization includes multiple objective functions. So, the important issue is how to understand trade-off structures of such multi-objective functions over large number of policy options.

We apply our framework to evaluate evacuation plans, which have over 300 control parameters, to find out such trade-off. We implement NSGA-II algorithm to search optimal structures over large parameter spaces, and utilize the performance of K-computers to speed-up the process.

4.3 Traffic Simulation

(Hattori, Ito?)

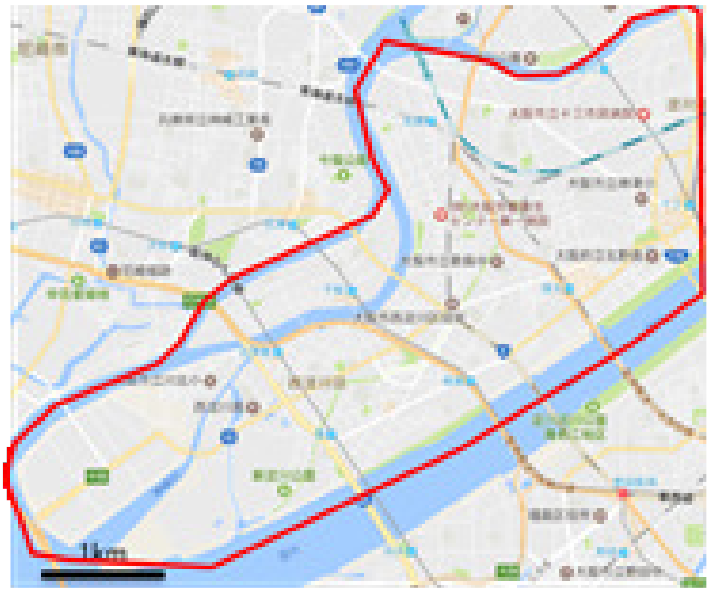

Fig. 8 Nishiyodogawa Area used in Pedestrian Simulation

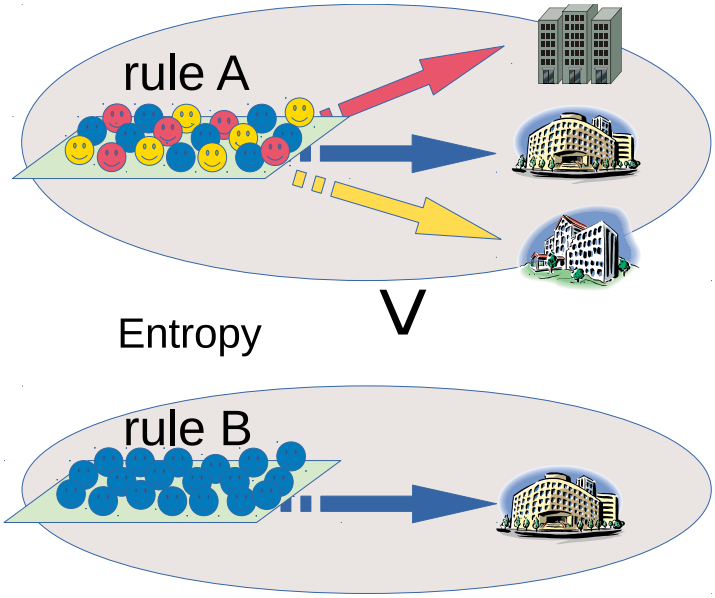

Fig. 9 Rule Entropy

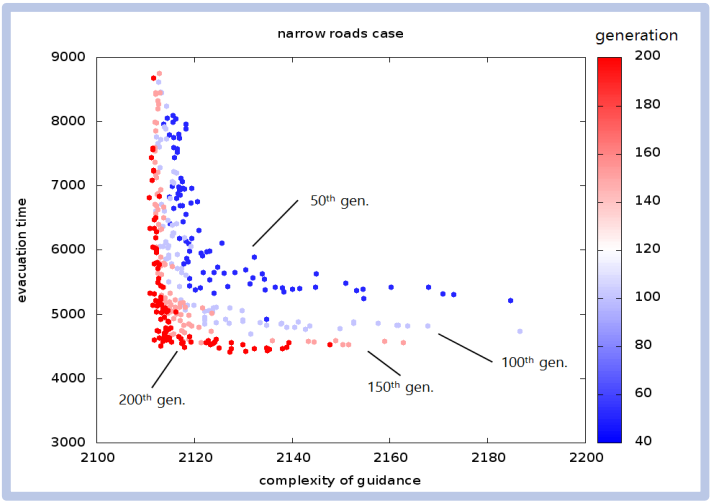

Fig. 10 Result of Evacuation Simulation (narrow road)

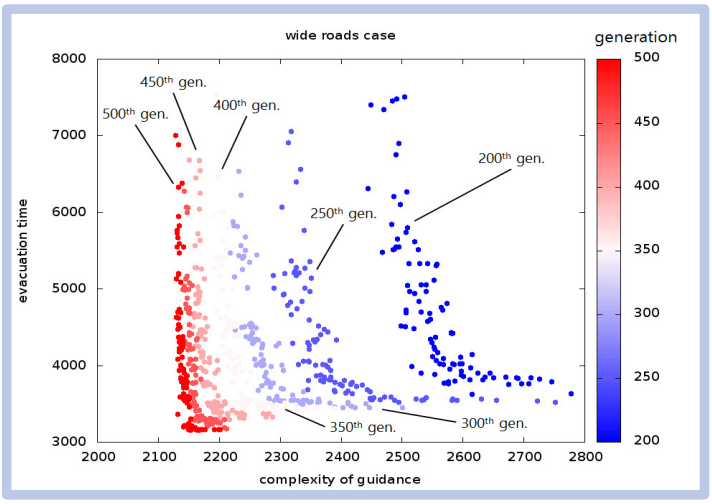

Fig. 11 Result of Evacuation Simulation (wide road)