From Conceptual Models to Simulation Models
Model Driven Development of Agent-Based Simulations

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From Conceptual Models to Simulation Models:
Model Driven Development of Agent-Based Simulations

1. Motivation and Background
2. Proposed Process and Tools
3. Demonstration
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Position of Social Simulation Studies

- society as interaction
- social sciences
- decision making and Learning
- a new approach of modeling and analysis
- a practical application
- multi-agent system
- computer science
- computer simulation

What should we make?
How should we make it?
What we should improve is the Process!

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**Traditional Development Process of Software**

The traditional development process of software is driven by implementation (program coding).

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Development Process

Analysis → Design → Implementation → Execution

Iteration (if necessary)
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A New Development Process of Software: Model Driven Development

A new development process is driven by modeling.

Raising the level of Abstraction

Cf. “MDA” (Model Driven Architecture) and “Executable UML”
The point is “using modeling languages as programming languages rather than merely as design languages.” (Frankel 2003)
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Overview of Proposed Process

The proposed process, which is based on Model Driven Development, consists of three major phases.

- In the conceptual modeling phase, the modeler analyzes the target world and describes the conceptual model.
- In the simulation design phase, the modeler designs and implements the simulation model.
- In the verification phase, the modeler runs the simulation and inspects whether the simulation program is coded rightly.
Describing Agents’ Activities

Extracting Types from Target World

Describing Agents’ Interaction

Simulation Design Phase

Designing Types and Classes

Designing Statechart of Behavior

Making the Initial Settings

Verification Phase

Run and Verify the Simulation

Boxed Economy Foundation Model (BEFM)

Model Frameworks for Model Driven Development of Simulations

[Iba et al., 2002]
Component Builder (CB)
Tools for Model Driven Development of Simulations

- Component Builder is developed as the plug-in for the currently standard development environment “Eclipse.”
- Component Builder consists of four designers and one composer.

Plugins for

Activity Designer  Communication Designer
Model Designer  Behavior Designer  World Composer

Boxed Economy Simulation Platform (BESP)
Tools for Model Driven Development of Simulations

- An integrated environment to execute and analyze the agent-based social simulations.
- Implemented in Java language.
- The source code and detail specification are opened to the public.

[Iba et al., 2002]
From Conceptual Models to Simulation Models

Languages for software Development
- Modeling language
- Programming language (3rd generation)
- Assembler Language
- Machine Language

Conceptual Model

Simulation Model

Now we still need to write source code a little bit.

Source Code of Simulation

Executable Program of Simulation

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We have already applied to …

- Format Competition (VHS vs. Beta)
- Evolving Network (Scale-Free Network)
- Evolutionary Market Competition
- Emergence and Collapse of Money
- Artificial Financial Market
- Strategic Evolution in Iterated Prisoners Dilemma
- Airport Queuing Model
- Influence Analysis of Social Interaction to Voting
- Electric Power Market
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Contact us by sending E-mail to iba@sfc.keio.ac.jp
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if you are interested in our tools.

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