Micro Simulations in ORA

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Agenda

- Micro Simulations Background
- Generate Stylized Networks for Micro Simulation Experiments
- Run Micro Simulations from ORA Visualizer
- Run Micro Simulations from ORA Menu
  - Visualization of networks over time
  - Visualization of agent trails
  - Utilized Network
- Questions
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What are Micro Simulations?

- Simulations of something moving through a network over time

- Four Types of Diffusion Models in ORA:
  - “Disease” diffusion
  - “Monetary” diffusion
  - “Idea” diffusion
  - “Technology adoption”
Input to and Output of Micro Sims. In ORA

• Input to Micro Simulations
  – A square network comprised of one node class (e.g. agent by agent, location by location)
  – A subset of nodes with resources to initialize the diffusion
  – A parameter, transmission resistance
  – Model specific parameters

• Output of Micro Simulations
  – Diffusion networks
  – Dynamic visualizations of the diffusion process over time (only if run via ORA Visualizer)

General Micro Simulation Process in ORA

• The Diffusion Process
  – On each time step, agents who have resources will try to propagate them to their neighbors.
  – Resources will be diffused if the BOTH of the link activation checks are passed.

• The Link Activation Check
  – A probabilistic process
  – Link weight check:
    • On each link, there is a Link Weight / Maximum Link Successful Rate to pass the check.
  – Transmission resistance check:
    • There is a 1 - Transmission resistance probability to pass the second test.
Types of Micro Simulation Models

1. Idea Diffusion
   - An agent can give away information it has access to
   - An agent retains information even after giving it away
   - An agent never loses information it gains
   - An agent never stops giving away information

2. Money Diffusion
   - An agent can give away money it possesses (all or nothing) to only one of its neighbors (pick randomly)
   - Once given, the agent loses the money immediately
   - An agent can re-acquire money previously given away

3. Disease Diffusion (cont.)
   - An agent can give the disease to other entities while it is infectious.
   - A agent will be “cured” after a user-specified number of time periods.
   - Once the agent is cured, it becomes immune against it and cannot become infected again.
   - Additional model parameter: a user-specified parameter indicating the proportion of agents who are immune
Types of Micro Simulation Models (cont.)

4. Technology Adoption

- An agent may adopt a technology if enough of its neighbors use the technology.
- An agent can stop using a technology, especially if its neighbors are not using the technology.
- For an agent with no incoming links, it will flip a coin to adopt/drop a technology.
- An agent can re-start using a technology.

Overview of Micro Sim. Types

<table>
<thead>
<tr>
<th></th>
<th>I can give it to others</th>
<th>I lose it after sharing</th>
<th>I lose it after some time</th>
<th>I can get it back</th>
</tr>
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<tbody>
<tr>
<td>Ideas</td>
<td>YES</td>
<td>No</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td>Disease</td>
<td>YES</td>
<td>No</td>
<td>YES</td>
<td>No</td>
</tr>
<tr>
<td>Money</td>
<td>YES</td>
<td>YES</td>
<td>No</td>
<td>YES</td>
</tr>
<tr>
<td>Tech</td>
<td>YES</td>
<td>No</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>
Micro Simulations Background (9 of 9)

- Things you should know
  - Micros Simulation is a random model
    - The results could be different each time you run the simulation
  - Link weight is important
    - The larger the link weights are, the more likely diffusion is
    - In a network that has equal weights on links (e.g. binary networks), the probability to pass link weight check will always be 1 on each link.
  - Transmission resistance
    - The larger transmission resistant is, the less likely diffusion will happen in the network.
    - If transmission resistance is 0, the diffusion is solely depends on the weights of every link in the network.

ORA Startup Screen

Open ORA from where you installed it
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ORA Startup Screen

open ORA from where you installed it
Generate Network

Pick 'Core-Periphery'

Generate a Core-Periphery Network

Leave all parameters as default and hit OK.
Visualize Network

Click the “visualize” button
Generate Network

Pick 'small world'

ORA Small World Generation

Change Defaults settings
- Press 'Create' then
- Press 'Close'
Visualize Network

Click the “visualize” button

Small World Visualization
Micro-Simulation in Visualizer

Under “Tools” menu, select “Micro Simulations”

Select Nodeclass and Network for Diffusion

select node class and appropriate network id, then hit “next” button
Select Initial Agents

We'll pick two on opposite sides of network and click Next.

Choose Simulation Parameters

Set Choices in GUI (Diffusion of Ideas, 0.1 resistance) & Run/Pause.
Run Simulation

- observe diffusion in action (green shows diffusion)

Run Simulation

- Step through time periods
- Save simulation if desired
Run Simulation

Use additional tools to vary number of simulations to run and number of periods per simulation

Increase Sims to Run (2) & Periods per Simulation (10)
Results of Multiple Runs

Run 1 and 2 results

Diffusion of Money

Set Parameters, Run, and View
Diffusion of Disease

1. Set Sim Parameters, Run, and View

Adoption of Technology

1. Set Sim Parameters, Run, and View
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Start the Microsimulation

Select “Micro Simulations” from “Simulations” menu
Select Network for Diffusion

- Select node class and appropriate network id, then hit "next" button.

Select Initial Agents

- We’ll pick two on opposite sides of network.
Choose Simulation Parameters

1. Set Choices in GUI (Diffusion of Ideas, 0.1 resistance, 50 runs)

Meta-Network Manager

2. Good idea to add details to “ID” field
   Consider saving files
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Visualize Simulation Networks over Time

Observe diffusion in action (links between agents and knowledge)
Observe diffusion in action (links between agents and knowledge)

As Idea/Knowledge links to more agents, the idea moves to the center of the visualizer.
Another way to view the ties between Ideas/Knowledge and agents

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Another way to view the ties between Ideas/Knowledge and agents

Change from ‘Graph’ to ‘Simulation Links’
Trails of Information over time

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What is the Utilization Network?

- A end-of-sim view of network links used for transmission
- Link Weight\(_{AB}\) = count of times transmission occurred from node A to node B (More useful for money and technology)
- If transmission occurs between Node A and B
  - Link Weight\(_{AB}\) := Link Weight\(_{AB}\) + 1

Utilized Network

Link Weight === Number of times transmission occurred between agent 5 and agent 6
Micro-Sims vs Near Term Analysis & Construct

- Micro-sims use fixed probabilities of transmission, Construct’s probabilities of interaction vary
- Micro-sims only require one node set and network type to run the simulation, Construct requires many
- Micro-sims used via two ways in ORA GUI, Construct is primarily non-GUI
- Micro-sims treat the examined network as static; none of the other networks (e.g. the knowledge network) will change during the simulation
- Micro-sims do not calculate diffusion metrics

Questions?
Backup Slides

Exclusivity of Disease/Resource Diffusion Overtime

Select the dynamic network generated by Micro-Simulation. Select View Measures over time from Visualizations.
1. Choose click to select
2. In the pop up window, enter exclusivity
3. Choose Exclusivity
4. Click OK and Compute

1. Click 1 and 2 in Idea Level Tab
2. View Exclusivity of idea over time