



Micro Simulations in ORA

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Summer Institute 2013



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Center for Computational Analysis of
Social and Organizational Systems
<http://www.casos.cs.cmu.edu/>



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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Agenda

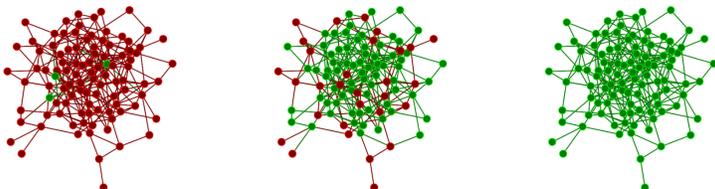
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What are Micro Simulations?

- Simulations of something moving through a network over time



- Four Types of Diffusion Models in ORA:
 - "Disease" diffusion
 - "Monetary" diffusion
 - "Idea" diffusion
 - "Technology adoption"

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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)

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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.

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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 lost the money immediately
 - An agent can re-acquire money previously given away

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Types of Micro Simulation Models (cont.)

- 3. Disease Diffusion
 - 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 can not become infected again.
 - Additional model parameter: a user-specified parameter indicating the proportion of agents who are immune

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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

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Overview of Micro Sim. Types

	I can give it to others	I lose it after sharing	I lose it after some time	I can get it back
Ideas	YES	No	No	N/A
Disease	YES	No	YES	No
Money	YES	YES	No	YES
Tech	YES	No	YES	YES

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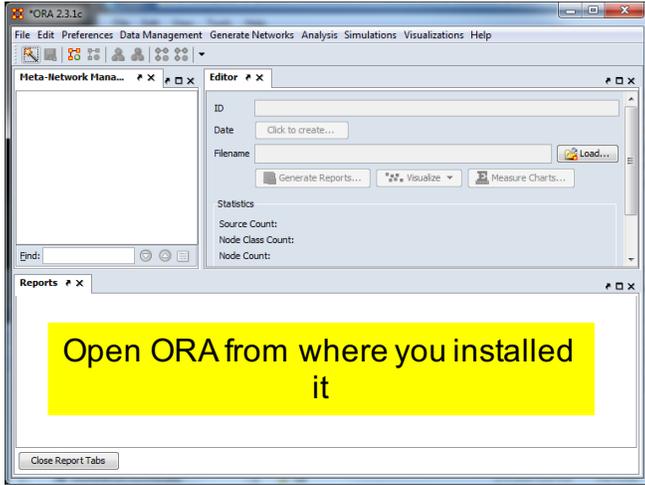
Micro Simulations Background (9 of 9)

- 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.

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ORA Startup Screen



Open ORA from where you installed it

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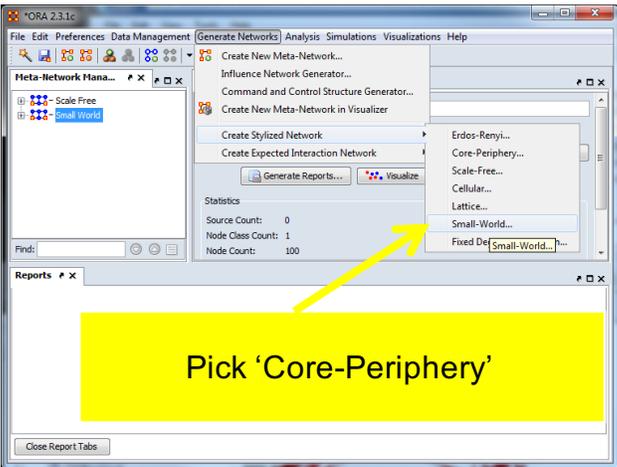
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Generate Network



Pick 'Core-Periphery'

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Generate a Core-Periphery Network

Select where to create the random network:

Create a new meta-network with name: Core Periphery

Add to the existing meta-network: Erdos-Renyi

Select the nodeset for the new network:

Existing: []

Create the new class:

type: Agent

id: Agent

size: 100

Select the algorithm parameters:

Proportion of core nodes: 0.15

Density of core nodes: 0.3

Enter an output network name:

Core Periphery network

Create Close

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Visualize Network

Meta-Network: Small World

ID: Small World

Date: Click to create...

Filename: [] Load...

Generate Reports... Visualize Measure Charts...

Statistics

Source Count: 0

Node Class Count: 1

Node Count: 100

Reports

Close Report Tabs

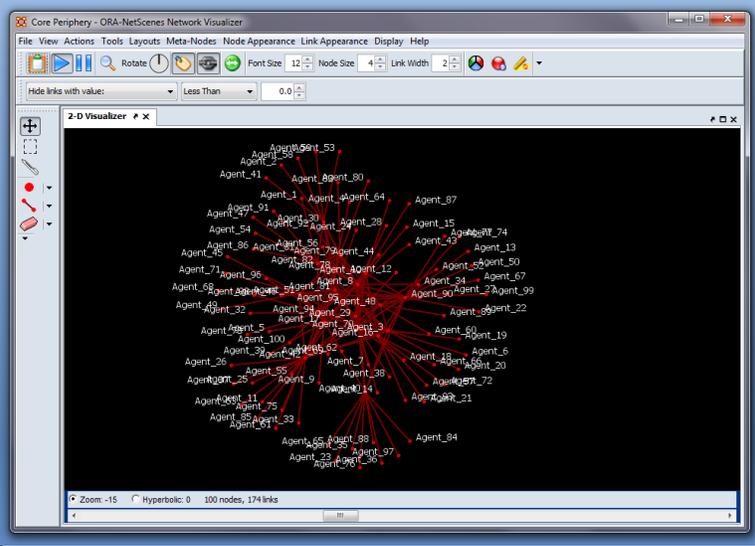
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Visualize Network



Core Periphery - ORA-NetScape Network Visualizer

File View Actions Tools Layouts Meta-Nodes Node Appearance Link Appearance Display Help

Hide links with value: Less Than 0.0

2-D Visualizer

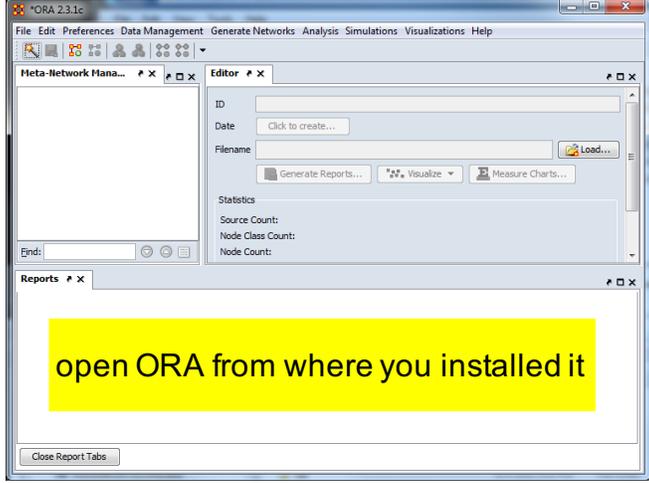
Zoom: -15 Hyperbolic: 0 100 nodes, 174 links

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ORA Startup Screen



ORA 2.31c

File Edit Preferences Data Management Generate Networks Analysis Simulations Visualizations Help

Meta-Network Manager

Editor

ID:

Date:

Filename:

Statistics

Source Count:

Node Class Count:

Node Count:

Reports

open ORA from where you installed it

Close Report Tabs

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Generate Network

ORA 2.3.1c

File Edit Preferences Data Management Generate Networks Analysis Simulations Visualizations Help

Meta-Network Manager

Scale Free
Small World

Generate Networks

- Create New Meta-Network...
- Influence Network Generator...
- Command and Control Structure Generator...
- Create New Meta-Network in Visualizer
- Create Stylized Network
- Create Expected Interaction Network
- Generate Reports...
- Visualize

Statistics

Source Count: 0
Node Class Count: 1
Node Count: 100

Find:

Reports

Close Report Tabs

Demo: Pick 'small world'
(feel free to use any network style
or network generation parameters)

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ORA Small World Generation

Small World

Select where to create the random network:

- Create a new meta-network with ID: Small World
- Add to the existing meta-network:

Select the node class for the new network:

- Existing:
- Create the new class:

type: Agent
id: Agent
size: 100

Select the algorithm parameters:

Number of neighbors: 10
Probability of removing neighbor: 0.10
Probability of adding far neighbor: 0.05
Power law exponent: 0.01

Enter an output network ID:
Small World network

Create Close

Change Defaults settings

- Press 'Create' then
- Press 'Close'

1
2
3
4

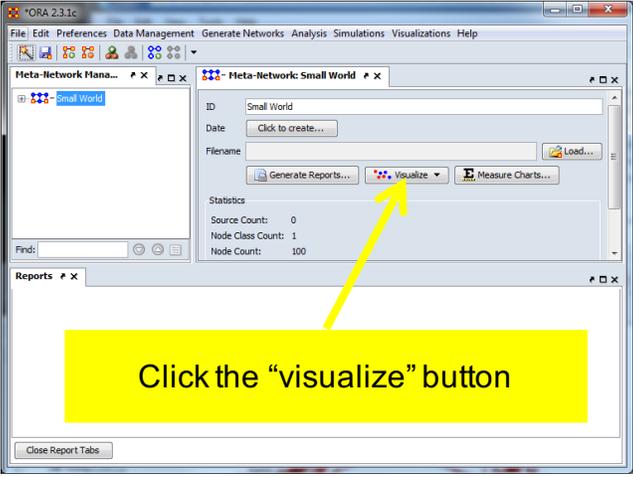
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Visualize Network

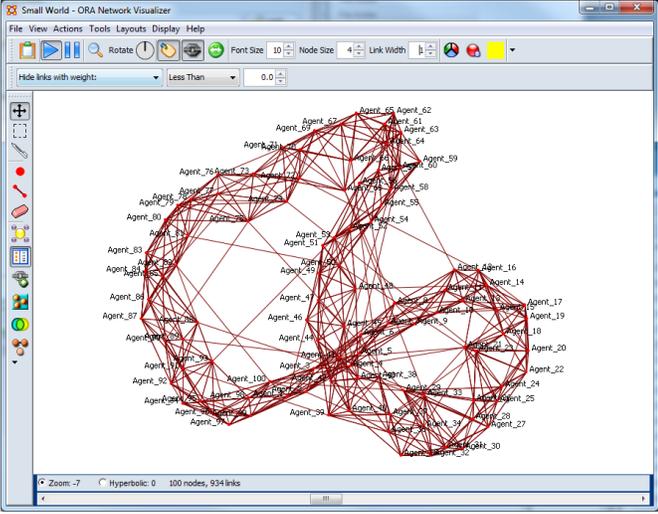


Click the "visualize" button

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Small World Visualization



Zoom: -7 Hyperbolic: 0 100 nodes, 934 links

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ORA Startup Screen

File Edit Preferences Data Management Generate Networks Analysis Simulations Visualizations Help

Meta-Network Manager

Meta-Network: Small World

ID: Small World
Date: Click to create...
Filename: C:\Users\mlanham\Documents\CASOS\IST 2011\Small_World_Micro_Sim_Demo.xml
Generate Reports... Visualize Measure Charts...
Load...

Statistics
Source Count: 0
Node Class Count: 1
Node Count: 100
Link Count: 934

Reports

Close Report Tabs

Select "Visualizations" (or select "Visualizations -> View Networks -> 2 D Visualizer" from the menu)

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Micro-Simulation in Visualizer

Small World - ORA Network Visualizer

File View Actions Tools Layouts Display Help

Node Status
Group Viewer
Node Selector
Link Selector
Legend
Meta-Nodes
Path Finder
Sphere of Influence
Backwards Influence
Block Maps
Node Locator
Micro Simulation
Meta-Network Design
Networks Over Time
Vector Maps

Front Size: 10 Node Size: 9 Link Width: 2 Hide links with weights: Less Than 0.0

Legend
Agent: size 100
Small World network

Under "Tools" menu, select "Micro Simulations"

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Select Nodeclass and Network for Diffusion

The Micro Simulations dialog allows you to run some fairly basic simulations on the visualization. Link weights are important, as once they're normalized, they correspond to the probability of a transmission (note:negative weight links are ignored).

First, select a node class. Then select the square networks that use that class that you want to use in your simulation

Agent : size 100

Small World Network

select node class and appropriate network id, then hit "next" button

Cancel < Back Next >

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Select Initial Agents

Select the nodes that will act as the sources for your simulation.

agent_48 | agent_16

<input type="checkbox"/>	Node ID	Node
<input checked="" type="checkbox"/>	Agent_16	Agent_16
<input checked="" type="checkbox"/>	Agent_48	Agent_48

We'll pick two on opposite sides of network

Select Un-Select 2 item(s) selected, 2 visible

Cancel < Back Next >

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Choose Simulation Parameters

Micro Simulation

Select a Simulation
Diffusion of Ideas

Set Transmission Resistance. A value of 1.0 denotes perfect transmissions, meaning nodes will always take what is given to them. A high resistance (max of 1.0) decreases the probability of a node accepting transmissions.
0.1

Increase nodes size as it is hit

Export
Additional Tools
Cancel
< Back Next >

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

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Run Simulation

Small World - ORA Network Visualizer

Micro Simulation

Diffusion of Ideas

Set Transmission Resistance. A value of 0.0 denotes perfect transmissions, meaning nodes will always take what is given to them. A high resistance (max of 1.0) decreases the probability of a node accepting transmissions.
0.1

Increase nodes size as it is hit

Export
Additional Tools
Cancel
< Back Next >

observe diffusion in action
(green shows diffusion)

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Run Simulation

Small World - CRA Network Visualizer

Micro Simulation

Diffusion of Ideas

Set Transmission Resistance. A value of 0.0 denotes perfect transmission; meaning nodes will always take what is given to them. A high resistance (max of 1.0) decreases the probability of a node accepting transmissions.

0.1:5

Increase nodes size as it is hit

Export

Additional Tools

Cancel Back Next

Step through time periods

Zoom: 0 Hyperbolic: 0 100 nodes, 934 links

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Run Simulation

Small World - CRA Network Visualizer

Micro Simulation

Diffusion of Ideas

Set Transmission Resistance. A value of 0.0 denotes perfect transmission; meaning nodes will always take what is given to them. A high resistance (max of 1.0) decreases the probability of a node accepting transmissions.

0.1:5

Increase nodes size as it is hit

Export

Additional Tools

Cancel Back Next

Save simulation if desired

Zoom: 0 Hyperbolic: 0 100 nodes, 934 links

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Run Simulation

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

Small World - ORA Network Visualizer

Micro Simulation

Diffusion of Ideas

Set Transmission Resistance. A value of 0.0 denotes perfect transmissions, meaning nodes will always take what is given to them. A high resistance (max of 1.0) decreases the probability of a node accepting transmissions.

0.1

Export

Additional Tools

Back

Next

Zoom: 0 Hyperbolic: 0 100 nodes, 934 links

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Run Simulation

Increase Sims to Run (2) & Periods per Simulation (10)

Small World - ORA Network Visualizer

Rapid Simulation

Number of Simulations to Run: 2

Number of Periods per Simulation: 10

Run Simulations

0.1

Export

Additional Tools

Back

Next

Zoom: 0

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Results of Multiple Runs

The screenshot shows the ORA 2.3.1c application window. The 'Meta-Network Manager' pane on the left lists 'Small World', 'MicroSim', and 'MicroSim'. The main window displays the 'Dynamic-Meta-Network: MicroSim' configuration. The 'ID' is 'MicroSim' and the 'Filename' is empty. The 'Timeline' is set to '2011/05/20 15:01:04'. A yellow callout box with the text 'Run 1 and 2 results' has arrows pointing to the 'MicroSim' entries in the Meta-Network Manager and the 'Timeline' field.

Run 1 and 2 results

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Diffusion of Money

The screenshot shows the 'Micro Simulation' dialog box. The 'Select a Simulation' dropdown is set to 'Dispersion of Money'. The 'Set Transmission Resistance' section has a value of '0.1'. The 'Number of periods to run for' is set to '11'. The 'Condition Number' is set to '1'. A yellow callout box with the text 'Set Parameters, Run, and View' has arrows pointing to the '0.1' spinner, the '11' spinner, and the 'Generate MicroSimulation Matrix' button.

Set Parameters, Run, and View

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Diffusion of Disease

The screenshot shows the 'Micro Simulation' dialog box with the following parameters and callouts:

- 1: Select a Simulation (Diffusion of Disease)
- 2: Transmission Resistance (0.1)
- 3: Number of periods to run for (11)
- 4: Number of periods nodes remain contagious (1)
- 5: Percent nodes immune at start (0)
- 6: Condition Number (1)

Set Sim Parameters, Run, and View

Generate MicroSimulation Matrix

Cancel < Back Next >

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Adoption of Technology

The screenshot shows the 'Micro Simulation' dialog box with the following parameters and callouts:

- 1: Select a Simulation (Adoption of Technology)
- 2: Transmission Resistance (0.1)
- 3: Number of periods to run for (11)
- 4: Condition Number (1)

Set Sim Parameters, Run, and View

Generate MicroSimulation Matrix

Cancel < Back Next >

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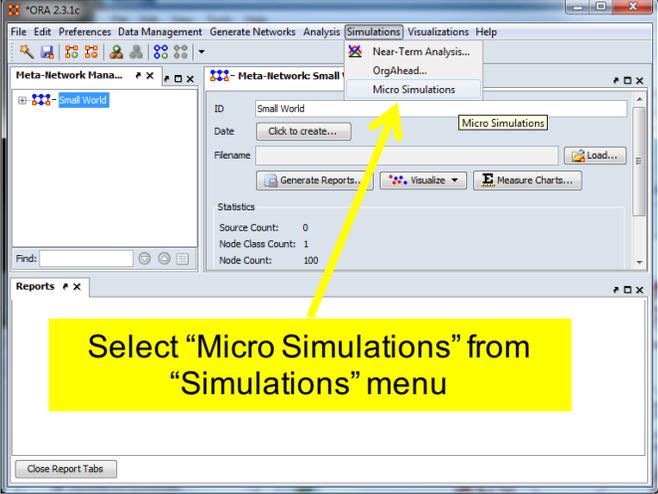
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Start the Microsimulation



Select "Micro Simulations" from "Simulations" menu

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Select Network for Diffusion

The Micro Simulations dialog allows you to run some fairly basic simulations on the visualization. Link weights are important, as once they're normalized, they correspond to the probability of a transmission (note:negative weight links are ignored).

First, select a node class. Then select the square networks that use that class that you want to use in your simulation

Agent : size 100

Small World

select node class and appropriate network id, then hit "next" button

Cancel < Back Next >

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Select Initial Agents

Select the nodes that will act as the sources for your simulation.

agent_48 | agent_16

<input type="checkbox"/>	Node ID	Node
<input checked="" type="checkbox"/>	Agent_16	Agent_16
<input checked="" type="checkbox"/>	Agent_48	Agent_48

We'll pick two on opposite sides of network

Select Un-Select 2 item(s) selected, 2 visible

Cancel < Back Next >

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Choose Simulation Parameters

Select a Simulation
Diffusion of Ideas

Set Transmission Resistance. A value of 0.0 denotes perfect transmissions, meaning nodes will always take what is given to them. A high resistance (max of 1.0) decreases the probability of a node accepting transmissions.
0.1

Number of periodic runs
50

Condition Number
1

Generate MicroSimulation Matrix

Cancel < Back Next >

Deprecated.

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Meta-Network Manager

Meta-Net Manager

Dynamic-Meta-Network: Small World Diffusion of Ideas, 0.1 resistance 50 runs 2 con...

ID
Small World Diffusion of Ideas, 0.1 resistance 50 runs 2 conditions

Filename

Select the dates to analyze:
11/05/20 11:43:42

Aggregate... Select All Clear All

Generate Reports... Visualize Mean Charts... View Trails...

Statistics
Keyframe Count: 1
Delta Count: 49

Find:

Reports

Close Report Tabs

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)

Small World - CRA Network Visualizer

File View Actions Tools Layouts Display Help

Font Size 10 Node Size 5 Link Width 0.5

Hide links with weight: Less Than 0.0

Legend

- Agent: size 100
- Idea: size 2
- Graph
- Simulation Links
- Utilized Network

Animation [Timeslices] Clustering

Phase Duration

Transition Phase duration: 0.5 sec

Display Phase duration: 0.5 sec

Node Positioning

Constant

Auto-Layout

Autozoom

Play Stop

Zoom: 4 Hyperbolic: 0 102 nodes, 1870 links

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Visualize Simulation Networks over Time

As Idea/Knowledge links to more agents, the idea moves to the center of the visualizer

Small World - CRA Network Visualizer

File View Actions Tools Layouts Display Help

Font Size 10 Node Size 5 Link Width 0.5

Hide links with weight: Less Than 0.0

Legend

- Agent: size 100
- Idea: size 2
- Graph
- Simulation Links
- Utilized Network

Animation [Timeslices] Clustering

Phase Duration

Transition Phase duration: 0.5 sec

Display Phase duration: 0.5 sec

Node Positioning

Constant

Auto-Layout

Autozoom

Play Stop

Zoom: 4 Hyperbolic: 0 102 nodes, 1563 links

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Visualize Simulation Networks over Time

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

Legend

- Agent: size 100
- Ideas: size 2
- Orgraph
- Simulation Links
- Utilized Network

Networks Over Time

Animation | Timeslices | Clustering

Phase Duration

Transition Phase duration: 0.5 sec

Display Phase duration: 0.5 sec

Node Positioning

Constant

Auto-Layout

Autostream

Play Stop

Zoom: -16 Hypercubic: 0 102 nodes, 95 links

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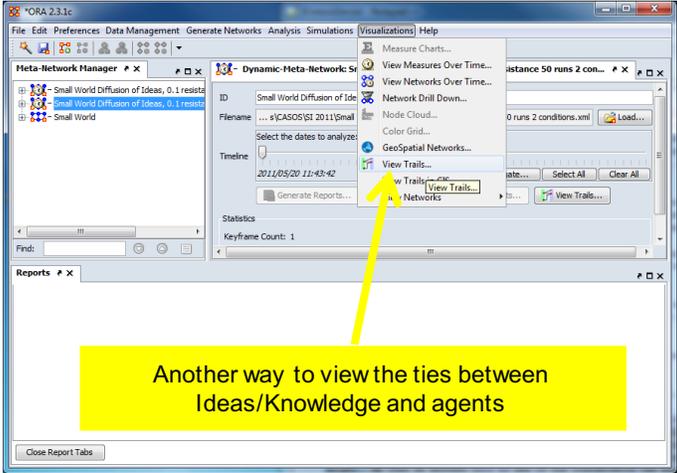
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Visualization of Trails

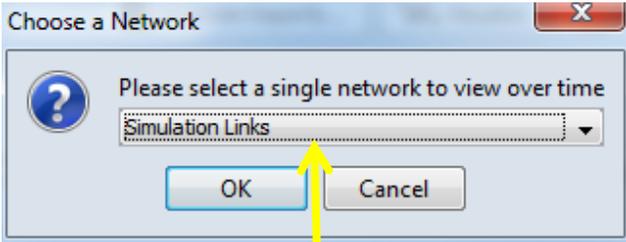


Another way to view the ties between Ideas/Knowledge and agents

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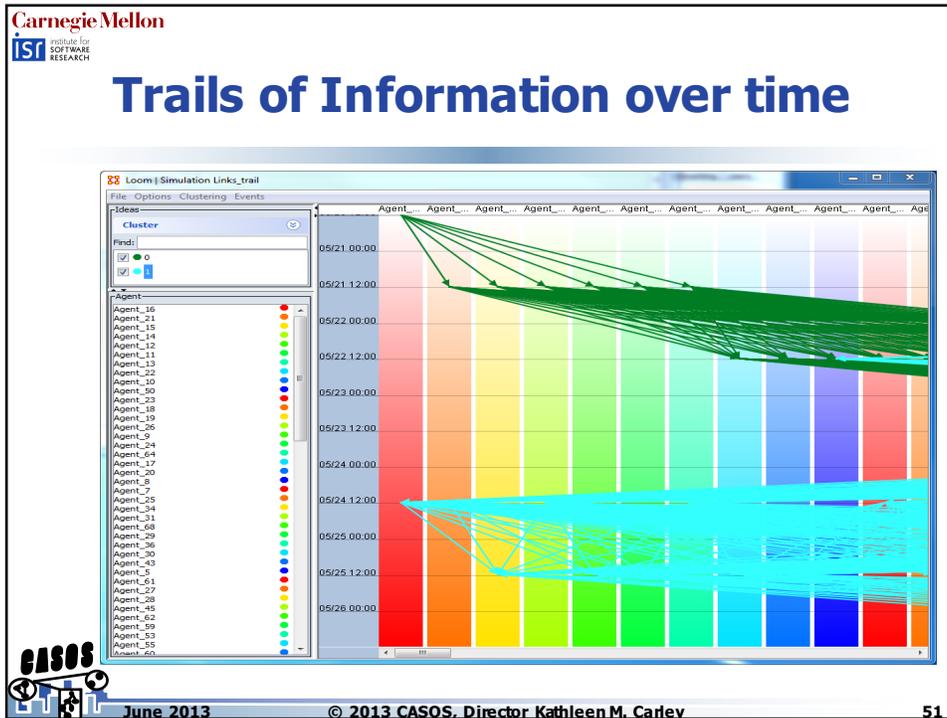
Visualization of Trails



Change from 'Graph' to 'Simulation Links'

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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

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Utilized Network

Link Weight == Number of times transmission occurred between agent 5 and agent 10

	gent_8	Agent_9	Agent_10	Agent_11	Agent_12	Agent_13	Agent_14
Agent_4	165.0	167.0	160.0	0.0	0.0	0.0	0.0
Agent_5	163.0	165.0	160.0	0.0	0.0	0.0	0.0
Agent_6	0.0	0.0	159.0	170.0	0.0	0.0	0.0
Agent_7	160.0	167.0	162.0	162.0	165.0	0.0	0.0
Agent_8	0.0	165.0	160.0	164.0	160.0	168.0	0.0

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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

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Questions?

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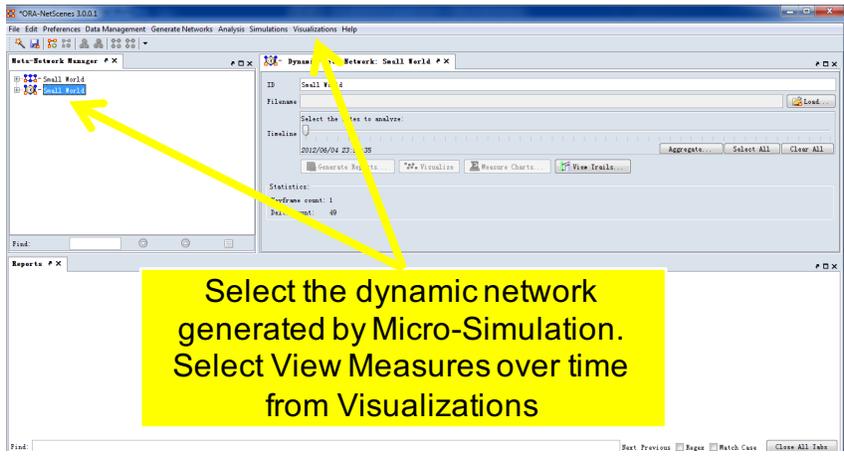
Backup Slides

CASOS

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Exclusivity of Disease/Resource Diffusion Overtime



Select the dynamic network generated by Micro-Simulation. Select View Measures over time from Visualizations

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Exclusivity of Disease/Resource Diffusion Overtime

1. Choose click to select
2. In the pop up window, enter exclusivity
3. Choose Exclusivity
4. Click OK and Compute

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Exclusivity of Disease/Resource Diffusion Overtime

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

Date	Value
7-Jun	0.00
14-Jun	0.35
21-Jun	0.55
28-Jun	0.35
5-Jul	0.35
12-Jul	0.35
19-Jul	0.35
26-Jul	0.35

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