



Micro Simulations in ORA

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<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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Simulation

- Networks are complicated!
- Hard if not impossible to find analytical solutions to some key network questions
 - How do nodes interact in a complex network?
 - How does something diffuse in a complex network?
 - How do conflicting ties play out in a complex network?
- Most practical approach is to try it out
 - Set up a probabilistic experiment
 - Repeat the experiment many times
 - Analyze the results

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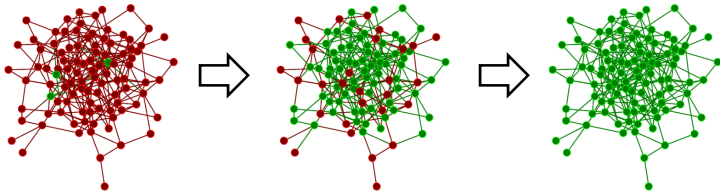
4



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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 / Output of Micro Sims In ORA

- Input:
 - A square network comprised of one node class
 - agent by agent, location by location, etc.
 - A subset of nodes to initialize the diffusion
 - Transmission Resistance
 - Number between 0 and 1
 - 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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Micro Simulation Outline in ORA

- The Diffusion Process
 - Agents with resources try to propagate them to their neighbors
 - Resources are diffused across a link if BOTH checks are passed
- The Link Activation Checks
 - A probabilistic process
 - Link weight check:
 - $p = \frac{\text{Link weight}}{\text{Maximum Link Weight}}$
 - Stronger Links -> More Likely to Diffuse
 - Transmission resistance check:
 - $p = 1 - \text{Transmission Resistance}$

CASOS Repeats for each time step




7

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Types of Micro Sims: 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



8



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Types of Micro Sims: 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 Sims: Disease Diffusion

- An agent can give the disease to other entities while it is infectious.
- An 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 Sims: 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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Key Takeaways

- Micro Simulations are random!
 - 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
 - Transmission resistant \uparrow , diffusion \downarrow
 - 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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Generate Network

Pick 'small world'

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ORA Small World Generation

Change Defaults settings

- Press 'Create' then
- Press 'Close'

1 2 3 4

Small World

Select where to create the random network:

Create a new meta-network with name: Small World

Add to the existing meta-network: Core Periphery

Select the nodeset for the new network:

Existing:

Create the nodeset:

Class: Agent

Name: 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 name:

Small World network

Create Close

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Visualize Network

ORA 3.0.9.66

File Edit Preferences Data Management Generate Networks Analysis Simulations Visualizations System Help

Meta-Network Manager

Meta-Network: Small World

Meta-Network Name: Small World

Meta-Network Time: Click to create...

Filename: Load...

Generate Reports... Visualize Measure Charts...

General statistics:

Source count: 0

Nodeset count: 1

Node count: 100

Network count: 1

Total density: 0.09296

Link statistics:

All links: 950

All link values: Binary

Non self-loops: 950

Non self-loop values: Binary

Self-loops: 0

Self-loop values: Binary

Click the "visualize" button

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Small World Visualization

100 Nodes, 950 Links No Timestamp Hyperbolic: 0 Zoom: -6

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Micro-Simulation in Visualizer

Under "Tools" menu, select "Micro Simulations"

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Select Nodeclass and Network for Diffusion

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

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Select Initial Agents

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

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Choose Simulation Parameters

Micro Simulation

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

Increase nodes size as it is hit

3

Export
Additional Tools
Cancel < Back Next >

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

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Run Simulation

2-D Visualizer

Micro simulation

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

Increase nodes size as it is hit

observe diffusion in action
(green shows diffusion)

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Run Simulation

Hide links with value: Less Than -99.00

Legend
File Select
 Agent
 Small World network

Step through time periods

Micro Simulation
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

Increase nodes size as it is hit

Export
Additional Tools

Cancel < Back Next >

Save simulation if desired

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Run Simulation

Hide links with value: Less Than -99.00

Legend
File Select
 Agent
 Small World network

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

Micro Simulation
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

Increase nodes size as it is hit

Export
Additional Tools

Cancel < Back Next >

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Run Simulation

Number of Simulations to Run: 2 | Number of Periods per Simulation: 10 | Run Simulations

Micro Simulation
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) increases the probability of a node accepting transmissions.
0.1
 Increase nodes size as it is hit

Export
Additional Tools
Cancel | Back | Help

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

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Results of Multiple Runs

Meta Network Manager
Small World
MicroSim
Run 1
Run 2

Dynamic Meta Network: MicroSim
Name: MicroSim
Filename:
Generate Reports... | Visualize | Measure Charts... | View Trails...
Keyframes and deltas time stamped by: Date | Period
Statistics:
Keyframe count: 1
Delta count: 49
Earliest date: 2018-05-26 17:27:36
Latest date: 2018-07-14 17:27:36

Run 1 and 2 results

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Diffusion of Money

Micro Simulation
Select a Simulation
Dispersion of Money
Set Transmission Resistance. A value of 0.0 denotes perfect transmission, meaning nodes will always take what is given to them. A high resistance (near 1.0) decreases the probability of a node receiving transmissions.
0.1
 Increase nodes size by a factor of 10

Rapid Simulation
Number of Simulations to Run: 1
Number of Periods per Simulation: 10
Run Simulation
Export
Additional Tools
Cancel

Set Parameters, Run, and View

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Diffusion of Disease

Micro Simulation
Select a Simulation
Dispersion of Disease
Set Transmission Resistance. A value of 0.0 denotes perfect transmission, meaning nodes will always take what is given to them. A high resistance (near 1.0) decreases the probability of a node receiving transmissions.
0.2
 Increase nodes size by a factor of 10
Number of Periods per Simulation: 10
Percent nodes removed: 0.0

Rapid Simulation
Number of Simulations to Run: 1
Number of Periods per Simulation: 10
Run Simulation
Export
Additional Tools
Cancel

Set Sim Parameters, Run, and View

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Adoption of Technology

The screenshot displays the CASOS software interface. On the left, there are two simulation control windows. The top window, titled 'Micro Simulation', has a dropdown menu set to 'Adoption of Technology' and a text area explaining 'Transmission Resistance'. Below it, a 'Rapid Simulation' window shows 'Number of Simulations to Run' set to 1 and 'Number of Periods per Simulation' set to 14. A yellow callout box on the right contains the text 'Set Sim Parameters, Run, and View' with arrows pointing to the 'Run Simulations' button (labeled '2') and the network graph (labeled '3'). The network graph itself consists of numerous nodes labeled 'Agent_1' through 'Agent_31' connected by blue lines. In the bottom left corner, there is a 'CASOS' logo with a mouse cursor icon.

31

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Agenda

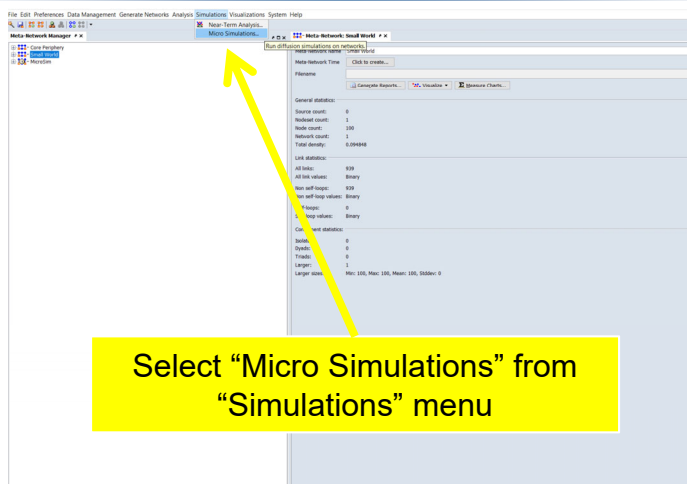
- Micro Simulations Background
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32



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Start the Microsimulation



The screenshot shows the NetLogo application window with the 'Micro Simulations' menu option highlighted by a yellow arrow. The interface includes a menu bar, a toolbar, and a main workspace area. The 'Micro Simulations' menu is open, showing various simulation options.

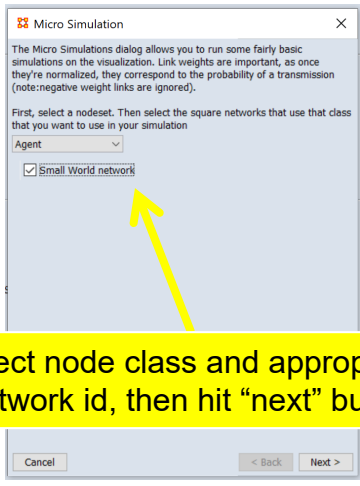
Select "Micro Simulations" from "Simulations" menu

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Select Network for Diffusion



The screenshot shows the 'Micro Simulation' dialog box. The 'Agent' dropdown is set to 'Small World network'. The 'Small World network' checkbox is checked and highlighted by a yellow arrow. The dialog box contains instructions for selecting a network and a 'Next >' button.

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

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Select Initial Agents

Micro Simulation

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

agent_66|agent_25

Node Name	Title
<input checked="" type="checkbox"/> Agent_25	
<input checked="" type="checkbox"/> Agent_66	

Select/Clear All Select/Clear Visible 2 / 100 Selected, 0 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 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 periods to run for.

50

Condition Number 1

Generate MicroSimulation Matrix

Cancel < Back Next >

Deprecated.

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Meta-Network Manager

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

Dynamic Meta Network: Small World Diffusion of Ideas, 0.1 resistance 50 runs 2 conditions

Generate Reports... Visualize View Trail...

Keyframes and deltas time stamped by:

Statistics:
Keyframe count: 1
Delta count: 49
Earliest date: 2018-05-26 17:27:25
Latest date: 2018-07-14 17:27:25

Good idea to add details to "ID" field
Consider saving files

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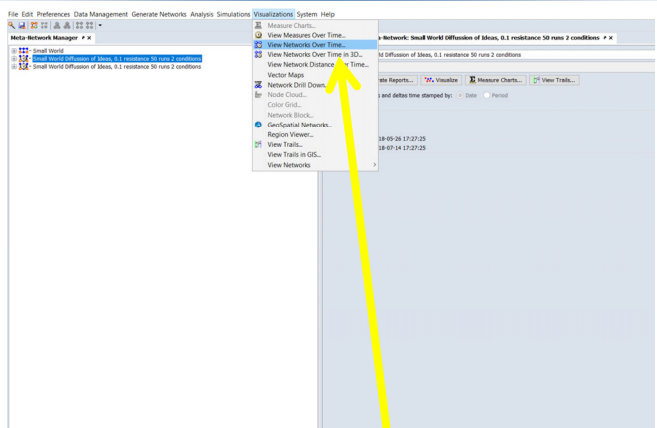
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Visualize Simulation Networks over Time



File Edit Preferences Data Management Generate Networks Analysis Simulations **Visualizations** System Help

- Measure Charts...
- View Measures Over Time...
- View Networks Over Time...**
- View Networks Over Time in 3D...
- View Networks Distance Over Time...
- Network Drill Down
- Node Cloud...
- Vector Maps
- Network Block...
- Color Grid...
- GeoCentral Networks
- Region Viewer...
- View Trails...
- View Trails in GIS...
- View Networks

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

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

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

View Trails... View Trails... View Trails...

and delta time stamped by: Link Period

19-09-26 17:27:25
19-07-14 17:27:25

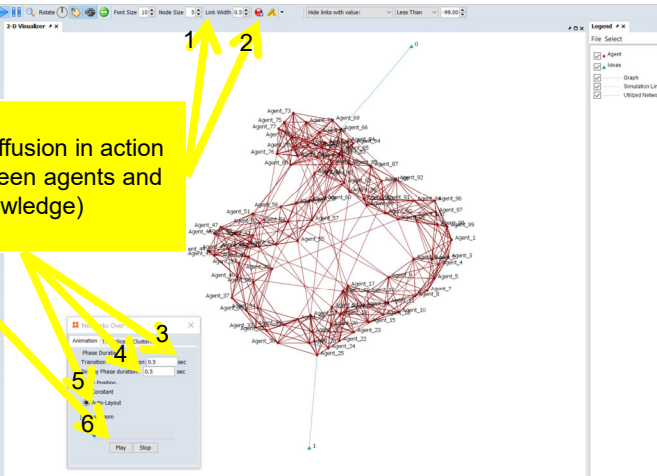
Observe diffusion in action
(links between agents and knowledge)

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Visualize Simulation Networks over Time



File Edit Preferences Data Management Generate Networks Analysis Simulations **Visualizations** System Help

Hide links with value: Less Than 49.00

Legend

- Agent
- Link
- Graph
- Simulation Link
- Unbound Network

1 2

Observe diffusion in action
(links between agents and knowledge)

3 4 5 6

Play Stop

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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

File Select
Agent
Idea
Graph
Simulation Links
Linked Network

Networks Over Time
Animation Timescales Clustering
Phase Duration
Transition Phase Duration: 0.5 sec
Agents Phase duration: 0.3 sec
Node Position...
 Constant
 Auto Layout
 Automove
Play Stop

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Visualize Simulation Networks over Time

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

File Select
Agent
Idea
Graph
Simulation Links
Linked Network

Networks Over Time
Animation Timescales Clustering
Phase Duration
Transition Phase duration: 1.5 sec
Agents Phase duration: 0.3 sec
Node Position...
 Constant
 Auto Layout
 Automove
Play Stop

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42



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Visualization of Trails

File Edit Preferences Data Management Generate Networks Analysis Simulations Visualizations System Help

Meta-Network Manager

- Measure Charts...
- View Measures Over Time...
- View Networks Over Time...
- View Networks Over Time in 3D...
- View Network Distance over Time...
- Vector Maps
 - Network Drill Down...
 - Nodes Class...
 - Color Grid...
 - Network Block...
 - GeoSpatial Networks...
 - Region Viewer...
 - View Trails...**
 - View Trails in GIS...
 - View Networks

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

Diffusion of Ideas, 0.1 resistance 50 runs 2 conditions

File Reports... Visualize Measure Charts... View Trails...

and diffies line stamped by: Period

18-03-30 17:27:36
18-07-14 17:27:36

Tracks nodes as they travel from location to location and determine co-location

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

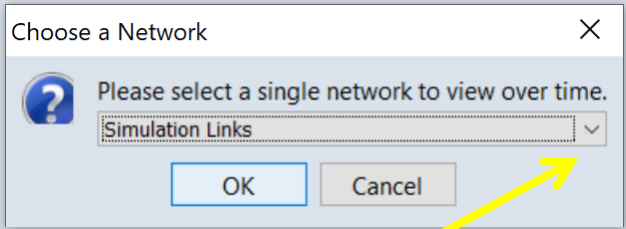
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Visualization of Trails



Choose a Network

Please select a single network to view over time.

Simulation Links

OK Cancel

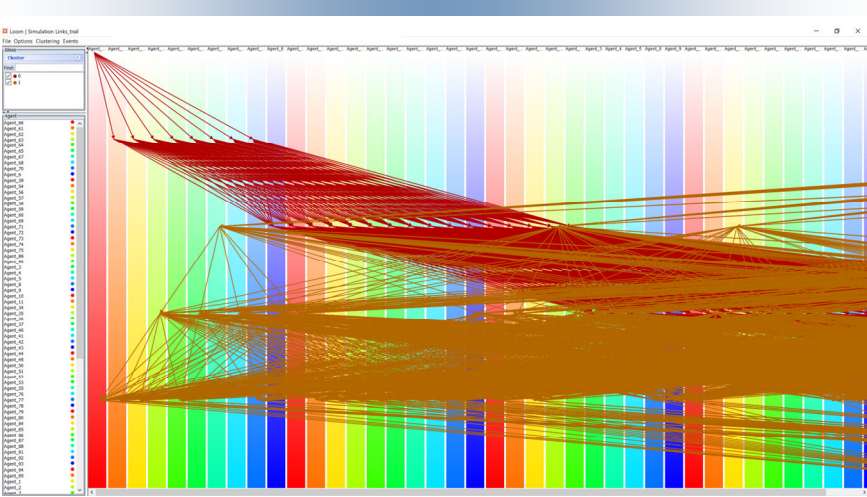
Change from 'Graph' to 'Simulation Links'

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Trails of Information over time



Layers | Simulation Links | .net

File Options Clustering Layout

46



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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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Questions?


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Backup Slides

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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

Select Measures	Set Measure Inputs
<input checked="" type="checkbox"/> Exclusivity	Complete false true East False
<input type="checkbox"/> Exclusivity Knowledge	false true East False
<input type="checkbox"/> Exclusivity Resource	false true East False
<input type="checkbox"/> Exclusivity Task	false true East False

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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

Measures Over Time - Small World

Measure Selector

Idea Level: Agent Level

Measure: Exclusivity

Networks: Simulation Links

Select one or more nodes to display:

Sort Select Select All Unselect All

Start: Mon, Jun 04 23:50:17 2012 Skip: 0 End: Mon, Jul 23 23:50:35 2012

Measure values: Fast Fourier Transform Change Detection Color

Value

Date

Date	Value (Blue)	Value (Red)
7-Jun	0.10	0.10
14-Jun	0.25	0.60
21-Jun	0.35	0.35
28-Jun	0.35	0.35
5-Jul	0.35	0.35
12-Jul	0.35	0.35
19-Jul	0.35	0.35
26-Jul	0.35	0.35

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55

