OMVis – A 3D Network Protocol Visualization Tool for OMNeT++

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Motivation

- Spatio-temporal behavior increasingly interesting due to integration of mobile devices into networks
- Result interpretation is tough and error-prone

- Support statistics with a 3D visualization tool for better understanding of simulation data
- Detect interesting areas at a glance

Introduction

OMVis visualizes simulation data in 3D

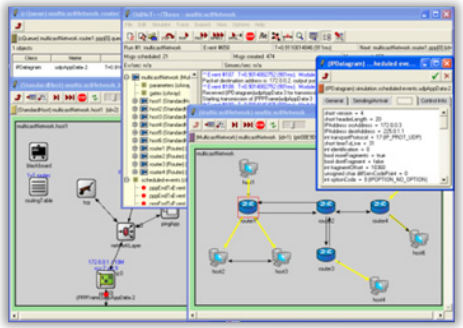
- Supports OMNeT++ and CSV data
- Visual cues are used to support understanding of data
- Results from multiple simulation runs can be combined in one or multiple views

Technical details

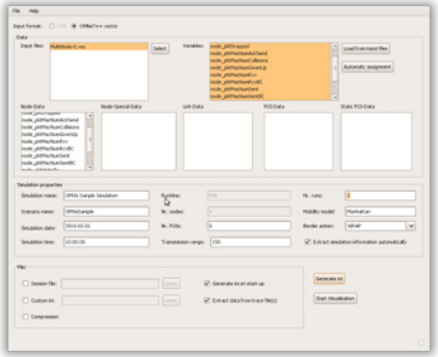
- Written in C++/Java
- Tested under Ubuntu 7.04-9.10, Windows XP/Vista/7
- Dependencies: OpenGL, freeglut, zLib, DevIL, GTK, PThreads

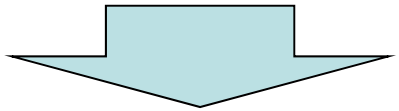
Workflow

OMNeT++ Traces

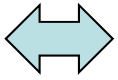


Setup of OMVis Control File

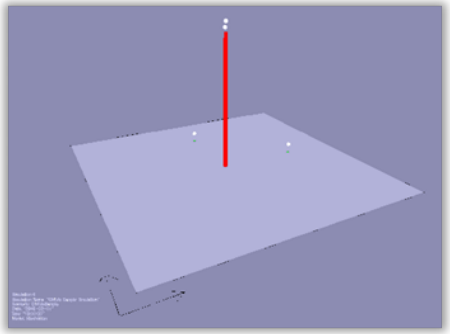




Selection of Visualization Cues



Visualization



Workflow Example

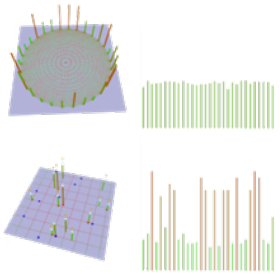
Data: cOutVector::record(pktSent, pktReceived, replicaInfo, nodePos) / MyCSVLogger::record(...)

Control file: select pktSent, nodePos, replicaInfo

Visualization: assign

- x,y: nodePos
- z: pktSent
- flag 0: no replica, flag 1: read-only, flag 2: write only, flag 3: read+write

Visualization Overview



Four basic views:

- 3D node view
- 3D link view: color, line thickness
- histogram, aggregated histogram

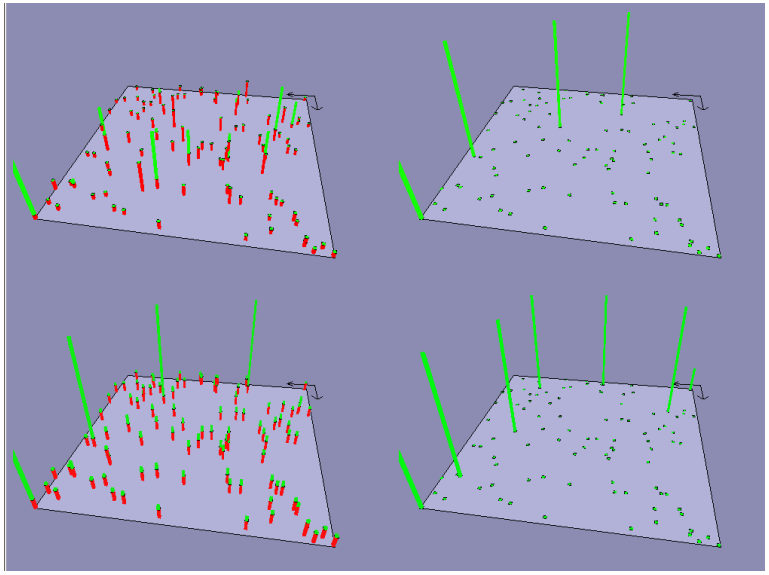
Navigation in 3D views with mouse (zoom, rotation, selection) and with time-slider

Measurements can be aggregated, filtered and highlighted

Views can be arbitrarily combined

Example: Combined Views

- "Unlimited" number of views can be added
- Views can be linked or independent
- Multiple simulations can be presented in one view



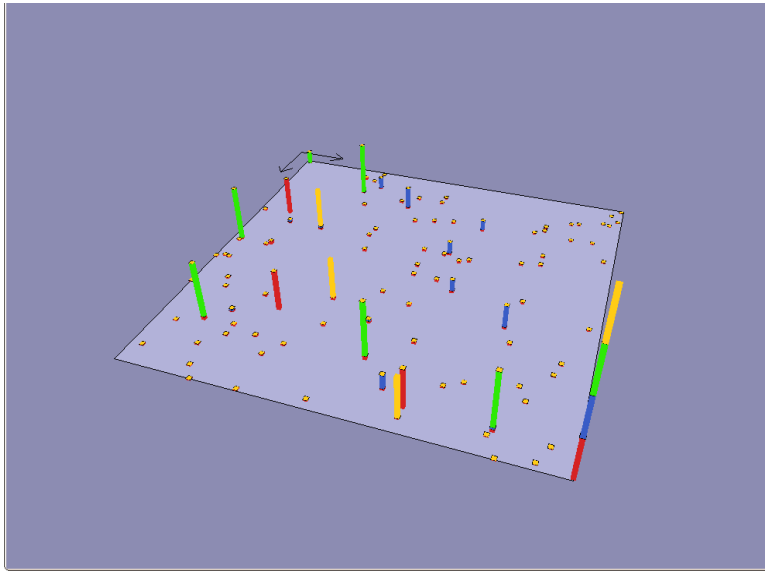


Fig.: Unicast and broadcast packets sent by OLSR, AODV, DSR, and DYMO routing protocols.

Example: Link View

- Link view uses color and line thickness as visualization cues
- Nodes can have additional statistics (z-axis)

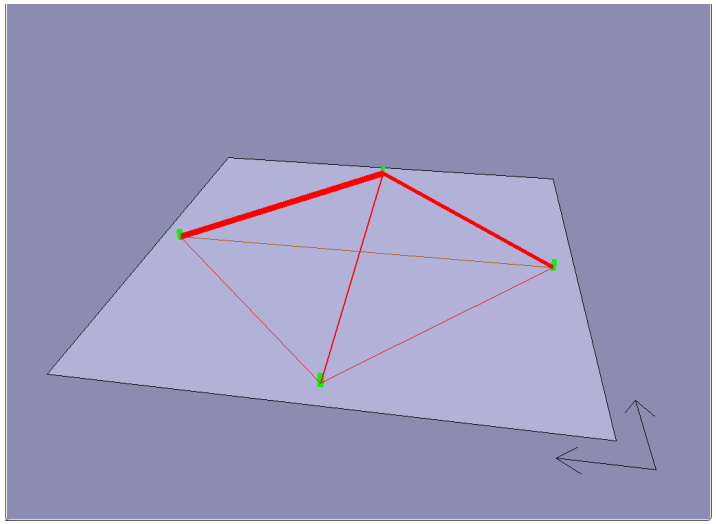


Fig.: Packets sent between 4 nodes.

3D Node View Visualization Cues

Entities: nodes, nodes with special state(s), points-of-interest (e.g. an access point)

Points-of-interest

- Discs (pie chart), bars, color

Nodes

- Discs, stacked bars, color
- Special states: cone floating above node with selected color

Mobility

- Aggregated positions drawn on floor
- Color indicates frequency of nodes at given location

Example: Special States

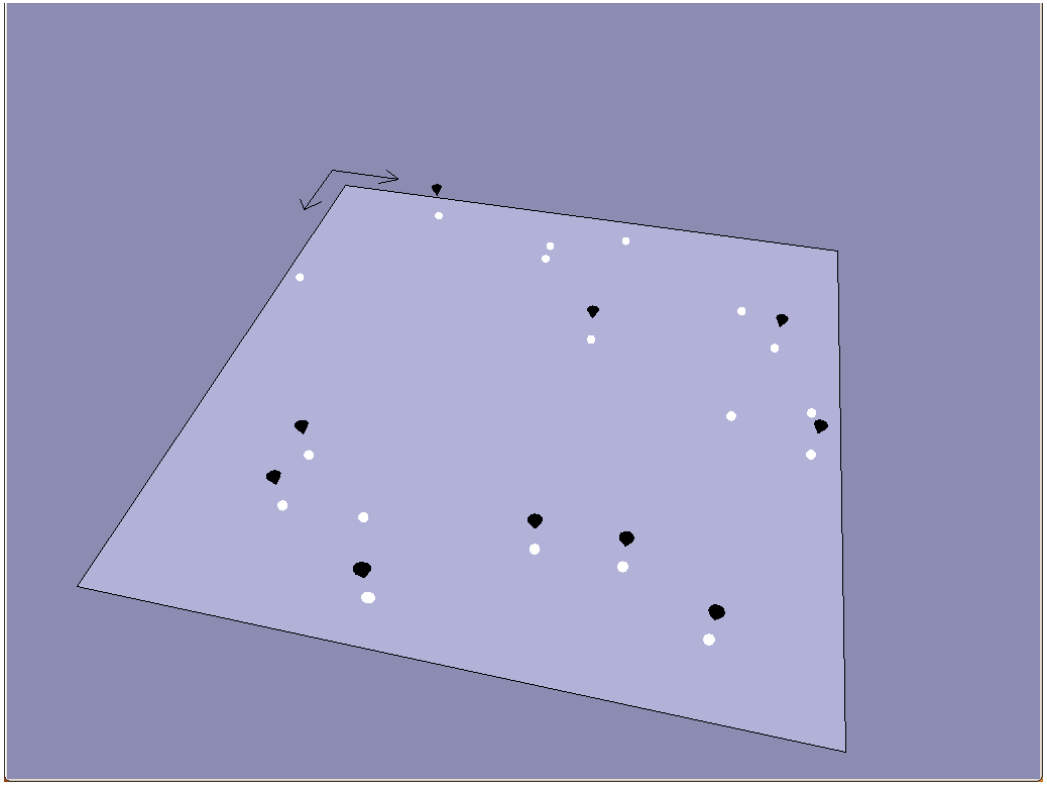


Fig.: Packet-Forwarding nodes

Example: Aggregated Mobility Traces

Erroneous implementation Correct implementation

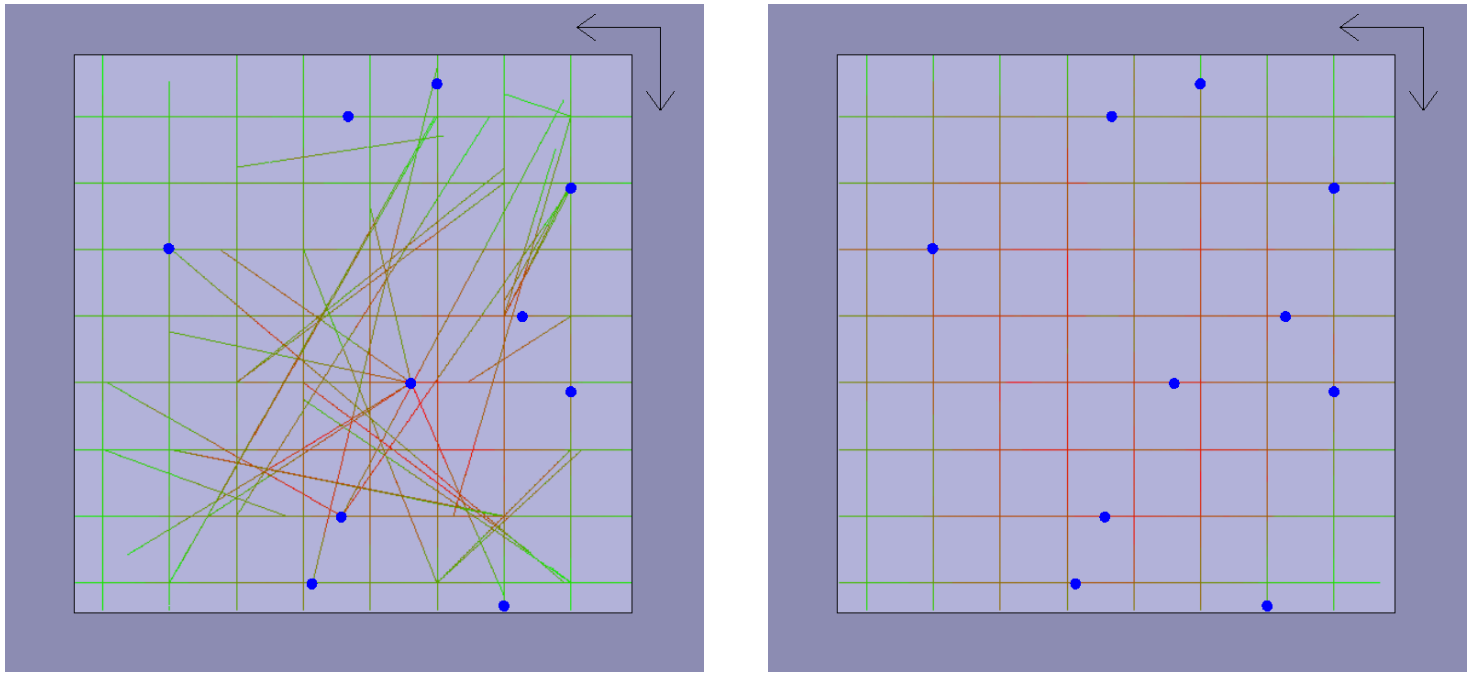
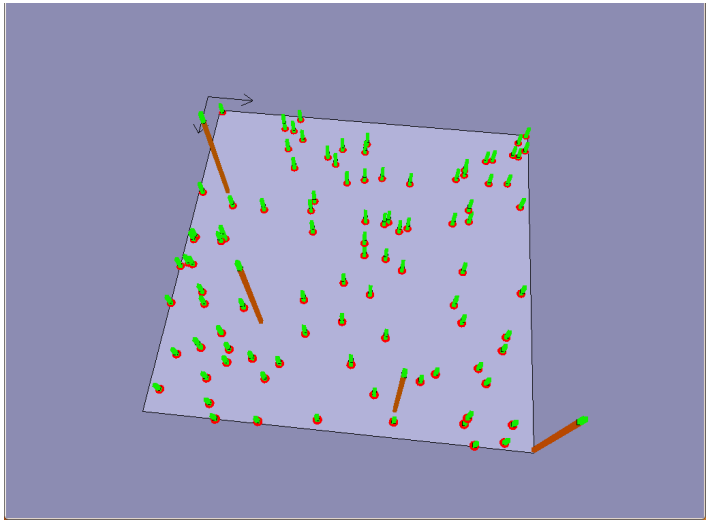


Fig.: Mobility traces of nodes moving according to modified Manhattan mobility model with navigation.

Example: Highlighting, Filtering

Highlighting



Filtering

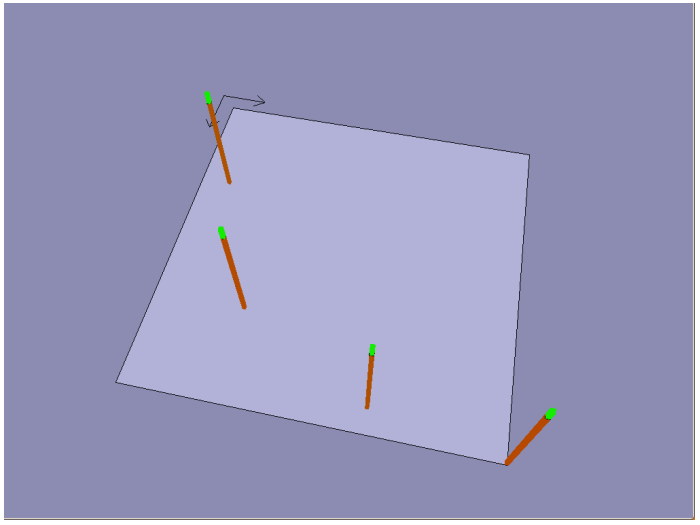


Fig.: Unicast and broadcast packets sent by DSR routing protocol.

Conclusion

OMVis is a platform independent visualization tool for simulation data

Generic assignment of measurement variables to visualization cues

Visualization cues are used to offer an intuitive way to support understanding of data

Multiple views and simulation runs can be linked and viewed side-by-side