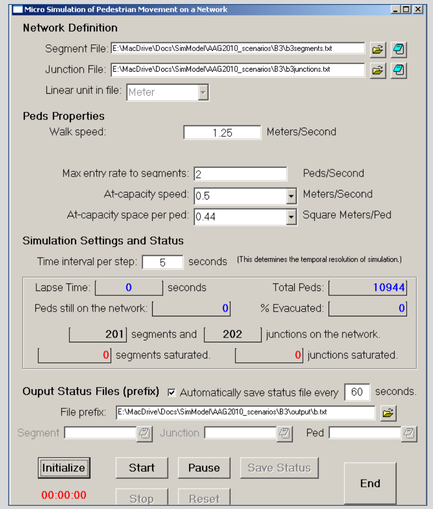
Simulating a Tsunami Pedestrian Evacuation from Seaside, Oregon

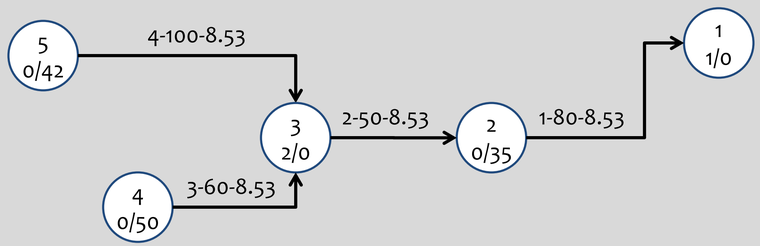
Lesley Bross and Jiunn-Der (Geoffrey) Duh - Geography, Portland State University

Running the simulation

A simple interface controls the micro-simulation providing access to properties such as pedestrian walking speed (default or at-capacity) and entry rate. At-capacity speed is used when a segment becomes saturated.



Network object model



Junctions: a / b/c

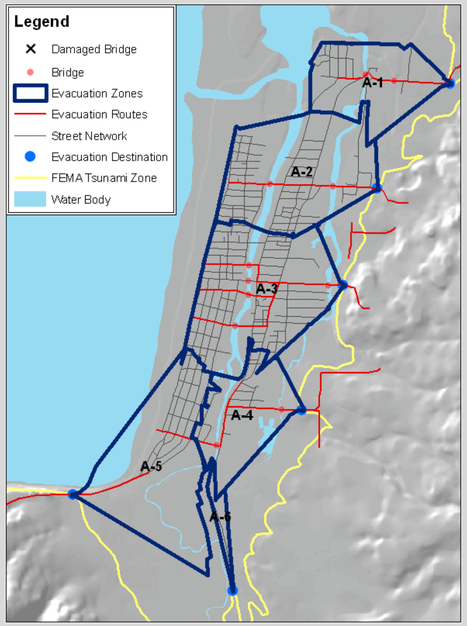
Segments: d-e-f

Attribute	Description
a	Junction ID
b	Type: 0=Entry; 1=Exit; 2=Connection
c	Pedestrians to be evacuated

Attribute	Description
d	Segment ID
e	Segment Length
f	Segment Width

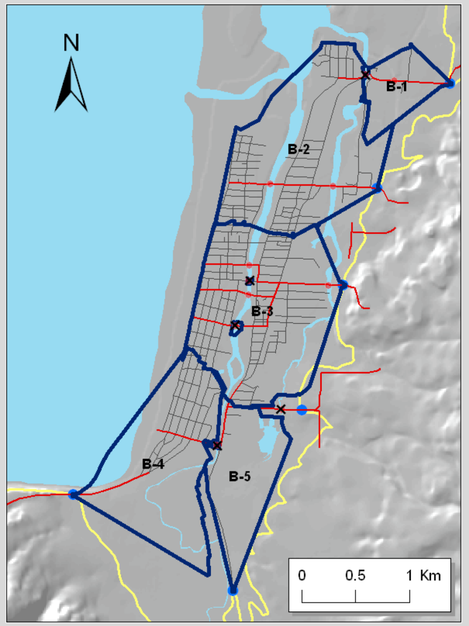
The network model allows for individual movement with pre-defined behavior on a coarse network comprised of junctions and segments. Individual pedestrians do not make "intelligent" decisions in this model.

Scenario A: All bridges intact



Zone	Total Peds	Evacuated (15 min)	%	Evacuated (20 min)	%
A-1	850	360	42%	835	98%
A-2	4,753	1,082	23%	3,141	66%
A-3	10,641	2,099	20%	6,152	58%
A-4	941	211	22%	756	80%
A-5	3,610	1,038	29%	2,505	69%

Scenario B: 5 damaged bridges



Zone	Total Peds	Evacuated (15 min)	%	Evacuated (20 min)	%
B-2	5,464	1,082	20%	3,164	58%
B-3	10,944	1,836	17%	6,125	56%
B-4	4,205	1,038	25%	2,683	64%

Oregon coastal communities like Seaside are at risk for local tsunamis caused by nearby offshore earthquakes. These tsunamis typically reach land 15 to 20 minutes after an earthquake.

Network models were built for two scenarios based on the 2007 Seaside Tsunami Evacuation Plan. Evacuation zones A-6, B-1, and B-5 were excluded due to low populations.

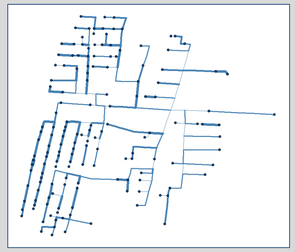
The micro-simulation shows that evacuation plans for zones A-3, B-2, and B-3 should be re-examined as just over 50% of pedestrians can evacuate within the target time of 20 minutes. Zone A-3 is the only zone where a segment becomes saturated.

Using Scenario A, Seaside can completely evacuate in 26.7 minutes. Scenario B takes 31.9 minutes. Both scenarios exceed the 20 minute target.

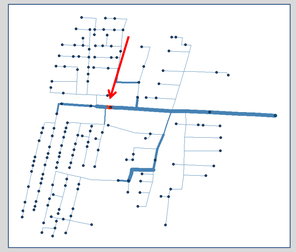
Zone A-3: Animation example

The micro-simulation model includes the capability to generate animation in animated .gif format. The thicker the line, the higher the pedestrian load on the segment.

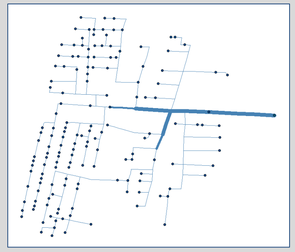
This visualization shows the distribution of pedestrians on the network as the evacuation proceeds. It also pinpoints bottlenecks that should be addressed by evacuation plans.



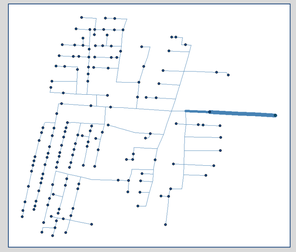
5 minutes



10 minutes -- the red segment near the middle is saturated.



15 minutes



20 minutes

For more information

Visit http://web.pdx.edu/~jduh/seasidegis/. Contact Lesley Bross at lbross@pdx.edu or Jiunn-Der (Geoffrey) Duh at jduh@pdx.edu.

Technologies used are ArcGIS (Utility Network Analyst, ModelBuilder, and VBA) and Microsoft Visual Basic.

Acknowledgement: The project is supported by the PSU Faculty Enhancement Grant.

Portland State UNIVERSITY