Modeling and Simulation for Emergency Management

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Why model and simulate?

...Decision Support.... Planning... Training... Raising Community Awareness...

Process of modelling can:

- clarify ***who*** is involved, how they ***interact*** and what influences their ***decision processes***
- expose gaps in knowledge and provoke new lines of thought

Simulation of a scenario can:

- stimulate deeper understanding of complex interactions between people, infrastructure, climate, policy ….
- show emergent, system level phenomena which can't be seen by looking only at the individuals e.g traffic jams
- provide a platform for discussion between different disciplines or areas of expertise

Modularity

Using simulation to explore **emergency management scenarios** requires many different areas of expertise

Many simulators available for specific purposes but they don't explore complex interactions between different elements

Integrate different modules for different aspects of the scenario depending on

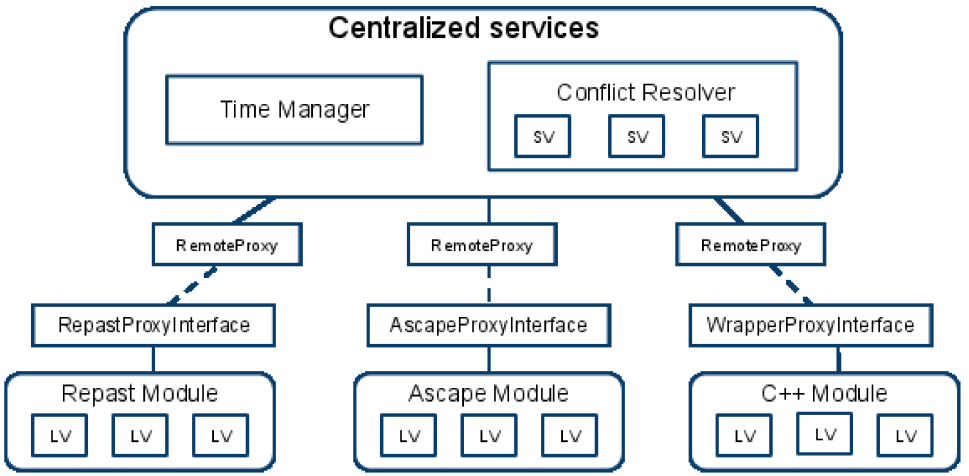
- level of abstraction required, e.g. control of individual vehicles
- information available, e.g. individual evacuation stories
- existing and accessible simulators, tools and data e.g. MATSim
- simulators, tools and data currently used by stakeholders e.g. phoenix fire simulator

Framework

Foundations support integration of multiple modules:

How to talk about common data?

How to synchronise event and time based modules?



... much more work still needed...

Conceptual Development

Adam Jenkins and Jessica Ngo. ***R&D, GIS Section, CFA***

Recommended exploration of “best possible” (lower bound) evacuation times with no fire suppression.

Fiona Burns. ***Acting Fire Planning Network Manager, Operations Directorate, CFA***

Planning documents, S.O.P. Breamlea evacuation data.

Alen Slijepcevic. ***Chief Officer, DSE***

Recommended use of Phoenix Fire Simulator.

Andy Ackland. ***Fire Behaviour Risk Analyst, DSE***

Provision of Phoenix fire maps.

Prototype Demo: Modules and Data

Traffic Evacuation Module

- Multiagent Transportation Simulation (MATSim)
- Agent based => able to program individual vehicles
- Underestimates congestion (no speed up)

Fire Module

- Fire map from Phoenix Fire Simulator used by DSE
- Actual fire used was selected and generated by DSE (Andy Ackland)

Household Module

- Individual household/vehicle evacutation decisions

Location: Breamlea

- Evacuation location as recommended by CFA
- Breamlea road networks from Open Street Maps (OSM)
  - CFA requested Navteq data but not financially viable
- Breamlea street addresses from DSE

Checked results against actual CFA Breamlea evacuation data

Prototype Demo: Scenario

- @1500hrs fire ignites
- One household departs from each local address
  - Time of departure is 1500hrs plus a delay
  - Delay is normally disctributed with mean of 30mins and sd 10 mins
- 1 in 3 households go to a second local address
  - The time spent at this address is normally distributed with a mean of 10 mins and sd 1 min.
- All households move to the evacuation location
- @1810 hrs it is assumed to be known & communicated that the evacuation location is not safe. All households immediately depart from the evacuation location in the opposite direction to the fire.


TIME: 03:05PM

Expert Panel

Workshop set for 25 May

- Will be meeting 1:1 with those unable to attend this date.

Prototype demonstration

Explore applicability of framework, current scenario and future scenario development

- What is the applicability of the current platform wrt bushfire and other scenarios requiring emergency management, in context of:
  - Decision support for event controllers, policy makers, ...
  - Training
  - Raising Community Awareness
- What they would like such a simulation platform to do
- What existing tools are being used; benefit of integrating these into simulation scenarios
- What key factors are considered in the planning and execution of bushfire evacuation in particular.

Panel

Office of the Emergency Services Comissioner (OESC)

- Craig Lapsley, Fire Comissioner
- Julie Hoy, Research Manager, Adaptation for the Vic Emergency Services Sector

CFA

- Geoff Conway, Deputy Chief Officer
  - Overall responsibility for CFA's evacuation planning
- Fiona Burns, Fire Network Manager
  - Works with Geoff in coordinating CFA's approach, including consultation with local government.
- Adam Jenkins, Manager R&D for GIS modelling and analysis
- Jessica Ngo, GIS Ayalyst
- Mike Wassing, Regional Commander Loddon-Mallee region
  - Incident controller and evacuation planning for this region.
  - Interested in supporting Incident Controllers to explore options
- Alan Rhodes, Manager Community Safety Research and Evaluation
  - Human behaviour, communication, warnings, etc

Dept. Planning and Community Development (DPCD)

- Peter Durkin, Senior Environmental Planner, Planning Polict – Planning and Policy Reform
  - Coastal planning and evacuation planning (for floods, king tides, etc)
- Emma Humann, Policy Office, Planning Policy - Planning policy and Reform

Victoria Police

- Brian Hillier, Inspector, Regional Emergency Management Unit (Eastern Region)
  - Vic Police have direct responsibility for coordinating evacuations
  - Awaiting ethics approval from Vic Police

Department of Sustainability and the Environment

- Alen Slijepcevic, Chief Officer, Office of Land and Fire
- Andy Ackland, Fire Behaviour Risk Analyst, Office of Land and Fire

Beureau of Meteorology (BoM)

- Shoni Maguire, Director
  - Climatology, government relations

Latrobe University and Bushfire CRC

- Jim McLennan, School of Psychological Science, Bushfire CRC Research Leader
  - Communicating Risk; human behaviour under stress
- Peter Hayes, School of Psychological Science
  - Effective Incident Management Teams

Bushfire CRC

- Noreen Krusel, Research Utilisation Manager

RMIT Centre for Risk and Community Safety

- Joshua Whittaker, NCCARF EM Research Fellow
  - Human behaviours during bushfire and evacuation
- Blyth McLennan, Research Fellow
  - Exploring principles/concepts of shared risk between government and communities

Western Alliance for Greenhouse Action (WAGA)

- Celeste Young, Executive Officer
  - Interested in simulation for community awareness

Next Steps

Bushfire evacuation planning tool?

- For CFA to use in work with local government
  - Evacuation points, feasibility, etc
- For incident controllers (CFA, DSE, other) to explore and discuss options

Community engagement tool?

- Help local communities engage in evacuation planning
- Raise awareness of specific geographical issues

Etc...

Bigger Picture

- Aiming for a substantial resource usable across the sector
- Framework, methodology, expertise for building a broad range of relevant simulations.
- Easy real-time interactivity of simulation modules with
  - User
  - Other modules
- A resource library of useful modules.
  - Example: Traffic evacuation module can be used to explore DPCD questions around emergency management of flooding and innundation

Further Work Needed..

Technical Framework

- Methodology for building and extending with different modules
- Increased interaction between pre-existing modules
- Testing robustness of models and validity of conclusions
- Mechanisms for more human-like behaviours
- Visualisation of multiple perspectives at once
  - Fire, traffic, an individual car
- Integrating modules with significantly different time steps
- ...

Further Work Needed..

Scenarios

- Extend current prototype
  - Better road data
  - More accurate traffic simulator, e.g. speed up/slow down
  - Different locations and evacuation scenarios
  - Additional modules, e.g. traffic control; communication between households.
- Development of other applications
  - Working with end-user groups
  - Working with simulation developers to apply framework

Questions?