Improvement of RCRS

<table>
<thead>
<tr>
<th></th>
<th>RCRS Ver. 0.49</th>
<th>RCRS Ver. 1.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agents</td>
<td>100 [s] for 10[min] sim.</td>
<td>200 [s] for 10[s] sim.(150)</td>
</tr>
<tr>
<td>Area</td>
<td>0.159 [km²]</td>
<td>0.159 [km²]</td>
</tr>
<tr>
<td>Kobe</td>
<td>Kobe</td>
<td></td>
</tr>
<tr>
<td>Representation of Components</td>
<td>network model</td>
<td>open space model</td>
</tr>
<tr>
<td>Time Resolution</td>
<td>minutes</td>
<td>seconds</td>
</tr>
<tr>
<td>Space Resolution</td>
<td>1.0 [m]</td>
<td>1.0 [mm]</td>
</tr>
</tbody>
</table>

- All the module is written in Java
- New perception system is added

This table shows the improvement of RoboCup Rescue. The most important change is that the Representation of components is changed from network model to open space model. Related to this change, Time resolution and Space resolution would be detailed.

Version 1.0 (Traffic Simulation)

- Open Space Simulation
- Congestion

\[
m_i \frac{d\mathbf{v}_i}{dt} = m_i \mathbf{v}_i^0(t)\mathbf{e}_i^0(t) - \mathbf{v}_i(\mathbf{T}_i)
\]
Open space simulation provides agility to simulate these congestions. The left figure shows a situation that a lot of agents are exiting this small entrance.

Social Issues

- Example of large disasters
  - Fire at subway station (Daegu subway fire)
  - Fire at high rise building (9.11 WTC)

- Social issues
  - Reduce evacuation time
  - Plan a rescue strategy

- Requirements of evacuation simulation
  - Evacuate time, cost and risk for some scenarios and rescue strategies

Representation of evacuation and rescue activities

We focused on these disasters. One is fire at subway station in Daegu subway in Korea. Another is fire at high rise building September 11. And there are many report of WTC terror. Most important, social issues are reducing time spent on evacuation and plan a rescue strategy. Requirements of evacuation simulation are evaluating time, cost and risk for some scenarios and strategies. So representation of evacuation and rescue activities are very important.
Real disaster

<table>
<thead>
<tr>
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<th>Real Disaster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agents</td>
<td>100 (1s for 10[min] sim.)</td>
<td>200 (1s for 10[min] sim. (150))</td>
<td>15,000 (WTC)</td>
</tr>
<tr>
<td>Area</td>
<td>0.159 [km^2] Kobe</td>
<td>0.159 [km^2] Kobe</td>
<td>1,000 [km^2]</td>
</tr>
<tr>
<td>Time Resolution</td>
<td>minutes</td>
<td>seconds</td>
<td>realtime</td>
</tr>
<tr>
<td>Space Resolution</td>
<td>1.0 [m]</td>
<td>1.0 [mm]</td>
<td>continuous</td>
</tr>
<tr>
<td>Representation of Components</td>
<td>network model</td>
<td>open space model</td>
<td>3D</td>
</tr>
<tr>
<td>Rescue Operation (Rescue agent)</td>
<td>Clear Load/Unload Communication</td>
<td>-</td>
<td>Complex</td>
</tr>
<tr>
<td>Evacuation behavior (Civilian)</td>
<td>Just escape to refuge</td>
<td>-</td>
<td>Complex</td>
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How about the real disaster. How do you compare! There are so many people and wide area. And resolution and representation of components are the same thing. The real world is very complex. but now what RoboCup Rescue can do is only clear, load/unload, commu.

Our proposal for Next Step

<table>
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<tr>
<th></th>
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<th>Real Disaster</th>
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<tr>
<td>Agents</td>
<td>100 (1s for 10[min] sim.)</td>
<td>1,000 (1s for 10[min] sim. (150))</td>
<td>10,000 distributed simulation</td>
<td>15,000 (WTC)</td>
</tr>
<tr>
<td>Area</td>
<td>0.159 [km^2] Kobe</td>
<td>0.159 [km^2] Kobe</td>
<td>1.0 [km^2] distributed simulation</td>
<td>1.0 [km^2]</td>
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<tr>
<td>Representation of Components</td>
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<td>open space</td>
<td>layered open space</td>
<td>3D</td>
</tr>
<tr>
<td>Rescue Operation (Rescue agent)</td>
<td>Clear Load/Unload Communication</td>
<td>-</td>
<td>Evacuation guidance</td>
<td>Complex</td>
</tr>
<tr>
<td>Evacuation behavior (Civilian)</td>
<td>Just escape to refuge</td>
<td>-</td>
<td>Evacuate with family</td>
<td>Complex</td>
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Then what is the next step of RoboCup Rescue. I think traffic simulator should be support layered open space simulation to simulate inside buildings.
Problems and Improvements

- Ability to simulate rescue operation
- Evacuation guidance
  - Public sign and broadcasting
  - Police force
    - civilian might or might not follow
- Civilian
  - share knowledge by face to face communication
  - feel endanger, anxious about someone
  - provide helps, show exits evacuation direction to others

We propose to improve ability to simulate rescue operation. There are many kinds of evacuation guidance in real disaster:
- one is by public sign and broadcasting:
- second is by police force and of course civilian might or might not follow the guidance
- the last is by civilian, there are many types of hurrian in disaster:
  - some people feel endanger:
    - some people can provide direction
    - some people feel anxious about someone

Example of Implements

- Action decision
  - differ by mental state of the agent
    - Feeling danger
    - Feeling anxious about someone (family, friends...)
  - Normal state
- Factor of changing mental state
  - Surrouning environment
  - Whether there is nearby someone to trust to
    - Family
    - Friends
  - If disaster occur now, what will you think and what will you do?

example of implementats of people like some people feel endanger and feel anxious about someone. [?] action decision is different by mental state of an agent.
and factor of changing mental state are
If disaster happen now, what will you think and what will you do?

Civilian class with mental state
Evacuate when the agent feel danger
- The building is in danger of fire or collapsing
- Hope escaping from the danger
- Evacuate

Anxious about someone (Family, Friends,...)
- A member of family is in dangerous building
- Hope their lives
- Escape with them

generally, mental state is represented by BDI model.
The acting like "evacuating when the agent feel danger" is
 Desire is ...
Intension ...

**Experiment (Scenario A)**

**Physical and mental force model**

**Scenario and Map**
- Venue of RoboCup Junior
- Upper area is dangerous building of fire
- Bottom area is refuge

**Agent**
- Left group
  - 50 stuffs
  - 50 parents
- Right group
  - 50 children
This is a simple experiment of mental model. Imagine kinder, right is children, left is adults and parents.

Result of Scenario A

- Physical force model [video]
- Physical and mental force model [video]

Different action caused by mental state
Parents decided more dangerous planning to protect their child

Experiment (Scenario B)

- Realistic Map
  - Location: Meijo University
    - Parent and their child is in different building
      - A: Parents: 50, Children: 50
      - B: Parents: 50, Children: 50

Result
- Parents go to their child in the different buildings make crowd situation
  [video]

Proposal

- Propose
  - Agents that have mental state
    - Caused by family relation
    - First step of crowd simulation

- Future work
  - Supply evacuation gidanse
Lsummarise our proposal. To make real agent can control flow of civilian.