

# Standard Map DataBase and Develop Tools

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**Abstract.** GIS data and tools are one of key items that RoboCup Rescue Simulation will be used in practical applications. In this paper, we propose a standard DB that works as pivot for file conversion, show prototypes and its usages. We are planning following step to share advantages of them: In this half year, we would like to discuss these topics and specify a draft for standard DB. And latter half year, make tools, collect them and open as standard tool kits. This will help RoboCup Rescue teams simulate their own districts. We are looking forward to your comments and participation.

## 1 Introduction

We are of the opinion that RoboCup Rescue Simulation Project should be used in practical applications to save our lives [6], and think that participants to RoboCup Rescue Simulation league want to simulate their own districts. RoboCup Rescue Simulator employs plug-in architecture, so replacing components to ones that are fitted to districts makes it possible to simulate at your districts.

A simple scenario is useful to outline our proposal. At disasters, rescue activities are done and the areas will not be known in advance. The left figure shows two areas, city A and town B (Fig.1). Earthquakes occurs near the boundary between them. Local governments of city A and town B set up a rescue center collectively. At first, they make some rescue plans with RoboCup Rescue simulations on a combined one map (middle map). Soon they knows the most damage areas. They select the area (right one), predict damages by simulation and plan some effective rescues.

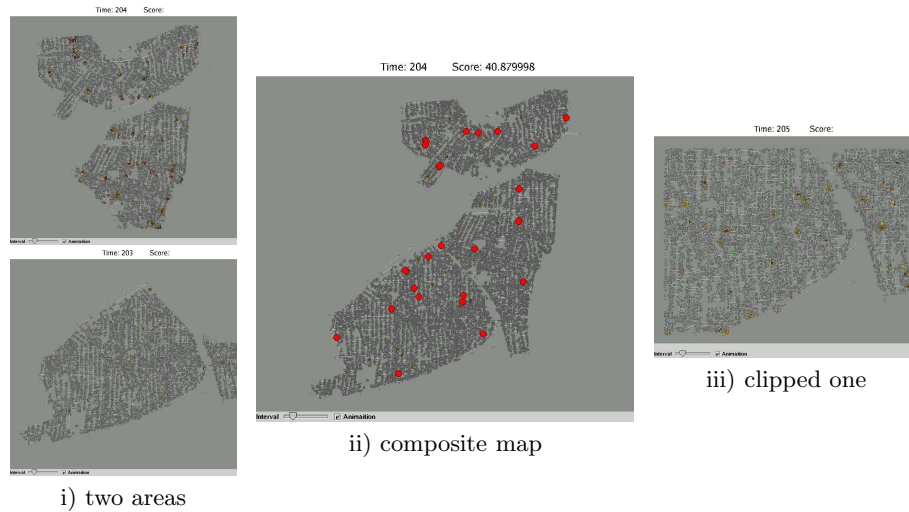
This is one example of practical RoboCup Rescue applications to save our lives [6]. We propose map tool environment to use DataBase as pivot, to development tools and finally to get GIS files easily.

## 2 proposal to use DataBase as pivot

There are tools for creating and editing GIS related files, JGISEdit <sup>1</sup>, and Random Map Generator [4][3][5]. We can create new maps from scratches or

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<sup>1</sup> JGISEdit has function to import/export to ACCESS files.



**Fig. 1.** Flow mage generation from open data to simulation target map.

edit existing maps using them. There are useful tools for small maps, however, it is hard to create a large one.

From 2005, we have been developing tools we show our tools that automatically generate three GIS related files - node.bin, road.bin and building.bin - from GIS data that are open to the public [7]. We are using digital data with 25,000 scale from Geographical Survey Institute national surveying and mapping organization (GSI), Japan. The data covers all Japan and are provided as a unit of administrative area.

Although organizations of countries provide free data for real urban road networks, the situation may be different by country[2][1]. Their formats are not necessary the same ones. Taking advantage of RoboCup community, it is better to set up a standard DataBase than developing similar tools (Fig. 2). Follows are basic steps to use any format file at RoboCup Rescue simulations.

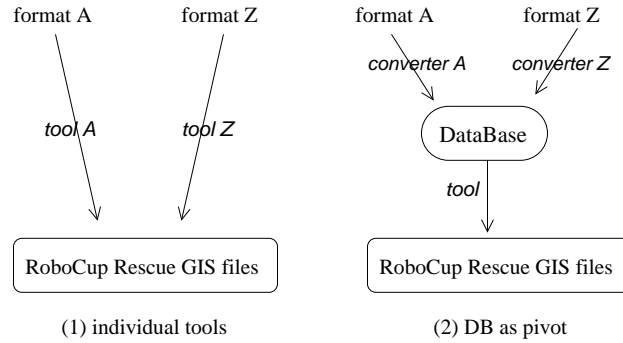
**step 1** : conversion tools from open data files to DB input files.

**step 2** : data selection, merging by SQL.

**step 3** : conversion from DB output to RoboCup Rescue file format.

### 3 Case Studies for specifying tables, files & tools

Specification of tables is a step of designing DB. This section introduces some cases that will be useful for designing DB, and the next section shows some examples using a prototypes.



**Fig. 2.** Developing tools individually and using DataBase as pivot

### 3.1 node and road files

GIS related files are `node.bin`, `road.bin`, `building.bin` and `gisini.txt`. Road network is specified with `node.bin` and `road.bin`, and they have two kinds of data,

- Primitive data on network such as vertexes and edges.
- Data related as social activities such as `road kind`, `repairCost`, so on.

Data in the first category are ones that are included in any open GIS data. Followings are an example of primitive data.

```

node := {node_id, position_x, position_y}
road := {head_node, tail_node, road_id, width(mm)}

```

IDs, `node_id` and `road_id`, are set to be unique in tables.

In **step 2**, maps are combined into one map, some nodes on boundaries are judged as identical ones. Uniqueness of node is required not only as primary key in DB but also geographic points. Coding to maintain the uniqueness in ID is difficult considering when maps are covered over a country or regions. Expressing `position_x` and `position_y` in terms of longitude and latitude serves to keep the uniqueness.

### 3.2 tools on building file & gisini.txt

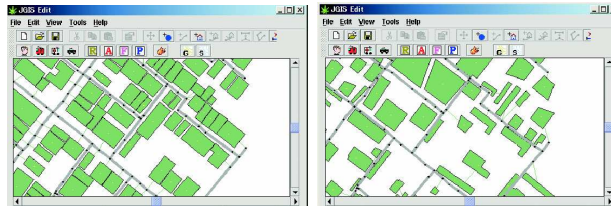
Houses are personal property, so they are not included in open data files. There are two ways to prepare them.

- a** : automatic generation form road networks.
- b** : combining exiting data.

As an example of **a**, Takahashi et. al proposed one automatic generation method of buildings. This corresponds to tool after DB in Fig. 2(2). Generated `building.bin` and `gisini.txt`[4].show similar statistics(Table 3.2), they look different(Fig. 3). And attributes of houses such as wood/concrete and floors, are set to default values. Initial locations of agents affect simulation results. While the tool has a parameter how many percentage of agents are in buildings at present, other parameter will be necessary for purposes of simulation. Improving quality of this kind is a problem of tools.

**Table 1.** comparison original and generated Map (Kobe)

	RCR map	generated maps		
no. building	740	603	733	512
building area/all building area	50.4%	49.5%	48.9%	22.2%
not_burned rate	61%	84%	86%	75%



**Fig. 3.** KobeMap of RCR(left) and generated map(right)

In a case of **b**, when data on houses are generated from real data there will be no trouble. When data on houses are generated by programs, houses on boundaries cause troubles. Houses generated on a map will be over road of the other map. Some specifications will be necessary.

## 4 examples of DB interface

**example 1** : extraction of sepcified area.

Following sequence is an SQL to insert data and select nodes in a squire area.

```
%creatin node table
create table node(id varchar(50) primary key,
                 x numeric(10,4) , y numeric(10,4));
%example node.txt and insertion
%1,28347301,17788379
```

```

% :
%3711,36240735,18268032
load data local infile'node.txt' into table node
      fields terminated by ',' (id , x , y);
%select node in clipping area
select * into outfile from node WHERE (Xmin< node.x and node.x < Xmax)
      and (Ymin < node.y and node.y < Ymax);

```

**example 2** : convection to RoboCup format.

A tool will create corresponding `node_id` and `road_id` files from DataBase output file.

```
java sakura.XMLtoBINwithSQL.ConvertToBin
```

## 5 Open questions and issues

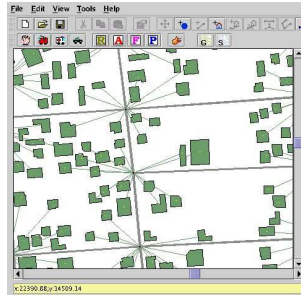
In this paper, we proposal of Usage of DataBase for making GIS maps and show our examples. These tools are made for our usages, therefore there are many issues to be brushed up;

**road length** : Expressing `position_x` and `position_y` in terms of longitude and latitude specifies a point in spherical polar coordinates. Radius determines length between nodes. Fig. 4 shows two maps generated with different radius. This difference is related to size of area.



**Fig. 4.** Two maps with the same network and different lengths )

**nodes to entrances** : While node information defined in open data is street crossing, links between house entrance to road are necessary in RoboCup Rescue environment. Fig. 5 shows all entrances are linked to street crossings. The numbers of node and edges of two areas in Fig. 2 are (6430, 4122) and (6044, 3766), so adding nodes of entrances to building makes the size of map several times big.



**Fig. 5.** links between house entrance to road

**combine vs. merge** : Our prototype combines separate areas to a map. In future, rescue simulation will be developed into 3D world where skyscraper towerings and underground malls are. There are objects with the same longitude and latitude.

We are planning followings: In this half year, we would like to discuss these topics and specify a draft on standard DB. And latter half year, make tools, collect them and open as standard tool kits. This will help you to proceed your projects. We are looking forward to your comments and participation..

Authors appreciate RoboCup Rescue community that provides a fine software environments and organizations that provide GIS data.

## References

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