Introduction of flood evacuation route search using QGIS, PostGIS, GRASS and pgRouting



Yoichi Kayama

Self-introduction



- A member of OSGeo.JP
- A member of GISA Japan(also a member of FOSS4G SIG)
 GISA 地理情報システム学会
- Coordinator of QGIS Japanese GUI translators
- Working as GIS programmer and researcher at Aero Asahi Corporation



Flood area simulation map

• In Japan, since 2001, MLIT(The Ministry of Land, Infrastructure, Transport and Tourism) and prefectural governments made maps of flood area simulation about major rivers.

Flood area simulation map



http://www.ktr.mlit.go.jp/tonejo/saigai/sinsuisoutei/tonegawa_zentai.pdf

Hazard map (made by local government)



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http://www.town.itakura.gunma.jp/kurashi/kinkyuu/hazard.html

Water depth calculated unit

making flood area simulation maps



http://www.mlit.go.jp/river/shishin_guideline/bousai/press/200507_12/050705/050705_manual.pdf

50m grid overlay



2m grid overlay



50m grid overlay



Compare 2m grid and 50m grid





using 2m grid, we could find that such a road on bank is submerged or not





Using fine grid is better

How can we get such a fine grid elevation data?

We can get fine grid elevation data using LiDAR system



LiDAR System

ALMAPS(Asahi Laser MAPping System/Aerial Lidar Mapping)





Using 2m grid elevation data from LIDAR, we could make fine flood area simulation maps



We could get fine flood area map using LIDAR mapping



There are many flood area simulation data by 10 minute every assumed place where bank overtopping



We can see assumed flood area vary with time











180 minutes later overflow



Using such fine flood area data

• If we have network data of roads, I thought perhaps I could make a program of searching route system, without roads of submerged.



How can I make such system?



When we would make a system about searching route,

• I think, using pgRouting is a best solution.



This project's main objective is to provide routing functionality to BPostGIS / B PostgreSOL, pgRouting is part of B PostLBS, which provides core tools for Location Based Services (LBS) as Open Source Software (OSS). Its tools are similar to those found on proprietary software.

Get pgRouting

- pgRouting 1.03 ⇒ source .tgz
- pgRouting 1.02 ⇒ source .tgz | win32 .zip
- pgRouting 1.01 bugfix release ⇒source .tgz
- pgRouting 1.0 release ⇔source .tgz | ⇔win32 .zip
- ReleaseNotes
- Older versions

Get support

- Developer forum: http://pgrouting.postlbs.org/discussion
- Users Mailing List: ⇒http://lists.osgeo.org/mailman/listinfo/pgrouting-users NEW
- Developers Mailing List: ⇒http://lists.osgeo.org/mailman/listinfo/pgrouting-dev NEW

account and login.



Quick Links:

- Documentation -- Overview
- Installation
 - Data Preparation
 - Data Processing
 - Data Output

pgRouting is a excellent program for searching shortest path route



We can add any conditions to the pgRouting search functions as SQL

- Those conditions must be described as SQL of PostGIS/PostgreSQL.
- We can use many spatial relation function at PostGIS.
- So we can add spatial conditions to the search function of pgRouting by using functions of PostGIS.

But !!

- Using stable version of PostGIS, we can use only vector type geometries.
- We have no functions in PostGIS about raster data now.
- LIDAR data and flood area data are raster.
- So we could not use raster flood area data for spatial functions in PostGIS.

Raster Data How can I use it with pgRouting?

- If I can change raster of flood area to vector, such as polygon, I could use the polygon data for pgRouting function.
- Are there any program , have such function ?

GRASS

• GRASS has many functions about raster and vector spatial data.

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GRASS GIS 6.4.0svn Reference Manual

Geographic Resources Analysis Support System, commonly referred to as GRASS, is a Geographic Information System (GIS) used for geospatial data management and analysis, image processing, graphics/maps production, spatial modeling, and visualization. GRASS is currently used in academic and commercial settings around the world, as well as by many governmental agencies and environmental consulting companies.

This reference manual details the use of modules distributed with Geographic Resources Analysis Support System (GRASS), an open source (GNU GPL'ed), image processing and geographic information system (GIS).

Go back to help overview

raster commands:

r.average	Finds the average of values in a cover map within areas assigned the same category value in a user-spe	ecified base map.
r.basins.fill	Generates a raster map layer showing watershed subbasins.	
r.bilinear	Bilinear interpolation utility for raster map layers.	
r.bitpattern	Compares bit patterns with a raster map.	
r.blend	Blends color components of two raster maps by a given ratio.	
r.buffer	Creates a raster map layer showing buffer zones surrounding cells that contain non-NULL category value	S.
r.carve	Takes vector stream data, transforms it to raster and subtracts depth from the output DEM.	
r.category	Manages category values and labels associated with user-specified raster map layers.	kubi
r.circle	Creates a raster map containing concentric rings around a given point.	インターネット アクセス
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後 一時停止されました..

Data conversion process



Import raster of flood area to GRASS mapset

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🍓 GRASS GIS Map Display: 1 - Location: kantoKasen

r.in.gdal



Select the pixels from raster these are submerged =($depth \ge 0.3m$).

Create a new raster using selected pixels with value 1 and other pixels with null.

r.mapcalc "D_SINSUI_NEW = if (D_SINSUI_ORG >= 0.3,1,null())"

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🎕 GRASS GIS Map Display: 1 - Location: kantoKasen

Convert the raster to the vector

🍓 GRASS GIS Map Display: 1 - Location: kantoKasen 🗌

> r.to.vect --overwrite --verbose input=D_SINSUI_NEW output=D_SINSUI_POLYGON feature=area



Details of created polygon



-23909.40, 23454.40

Export the vector of flood area to shape file

⊗ v.out.ogr [ベクトル、エクスポート]	
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入力するベクトルマップ名: (input, string))
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Load shapfiles to PostGIS/Postgresql database

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Now we can search using such SQL

SELECT vertex_id, edge_id, cost FROM

shortest_path_astar(-- shortest path A star 'SELECT a.gid as id, source, target, cost as cost, x1, y1, x2, y2 FROM ways as a where a.gid not in(select b.gid from ways as b, suishin_polygon_all as c where c.minute = 30-- after 30 minute from bank break and ST_Intersects(b.the_geom,c.the_geom))' -- is geometries intersect? a function of PostGIS

,4799, 3962, false, false)

/* source id, target id, directed, has reverse cost */

Using pgRouting

- We can search route with network data
- But there are query results strings.
- There are no maps of route using only pgRouting.
- How we can see the maps of routes ?

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There are may ways of make a map for pgRouting

- Web Mapping such as OpenLayers are cool method.
- There are some good desktop GIS tools such as QGIS, uDig, gvSIG, Open JUMP etc.....

• Perhaps we can see a map ,that contain result of using pgRouting, with such good FOSS4G products.

I used QuantumGIS for this system

- Stand alone use(without internet) is required
- There are Japanese GUI(we transrated)
- We can add functions as external plug-in program to QuantumGIS.



A system using pgRouting



Route to a shelter



There are no route to any shelter







Driving distance calculation



without submerged road

Demo?

Using FOSS4G products

- Without FOSS4G we would have been difficult to obtain tools for such spatial data usage.
- pgRouting, PostGIS/PostgreSQL, GRASS, QGIS have excellent functions for our works.
- I think when we want to use some functions about spatial data, make combination of some FOSS4G product is best solution.

 This system made for The Ministry of Land, Infrastructure, Transport and Tourism Japan, Kanto Regional Development Bureau.

Thanks for your attention



Monday 6th through Thursday 9 September, 2010