

Creating and Maintaining Street Orienteering Maps using OpenStreetMap

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1 Introduction

Street orienteering (street-O) is an informal form of the competitive navigational sport of orienteering. Meets are typically held in urban or suburban areas on weekday evenings, and require the competitor to visit as many checkpoints (controls) as possible within a certain time, typically one hour. At each control, a question on the competitor's "clue sheet" accompanying their map can be answered. Success at a street-O race requires the ability to plan and execute an efficient route between as many higher scoring controls as possible, while avoiding being penalised for a late return to the start.

The map used is very minimalistic - mainly black-and-white and typically only showing roads and paths. Street names, point features and contours are not normally included. Areal features are only shown if very significant, such as major rivers. Unlike regular orienteering maps, there is no de jure standard for street-O mapping and designs vary from club to club. A typical scale is around 1:10000 and the map is normally printed on an A4 sheet of paper.

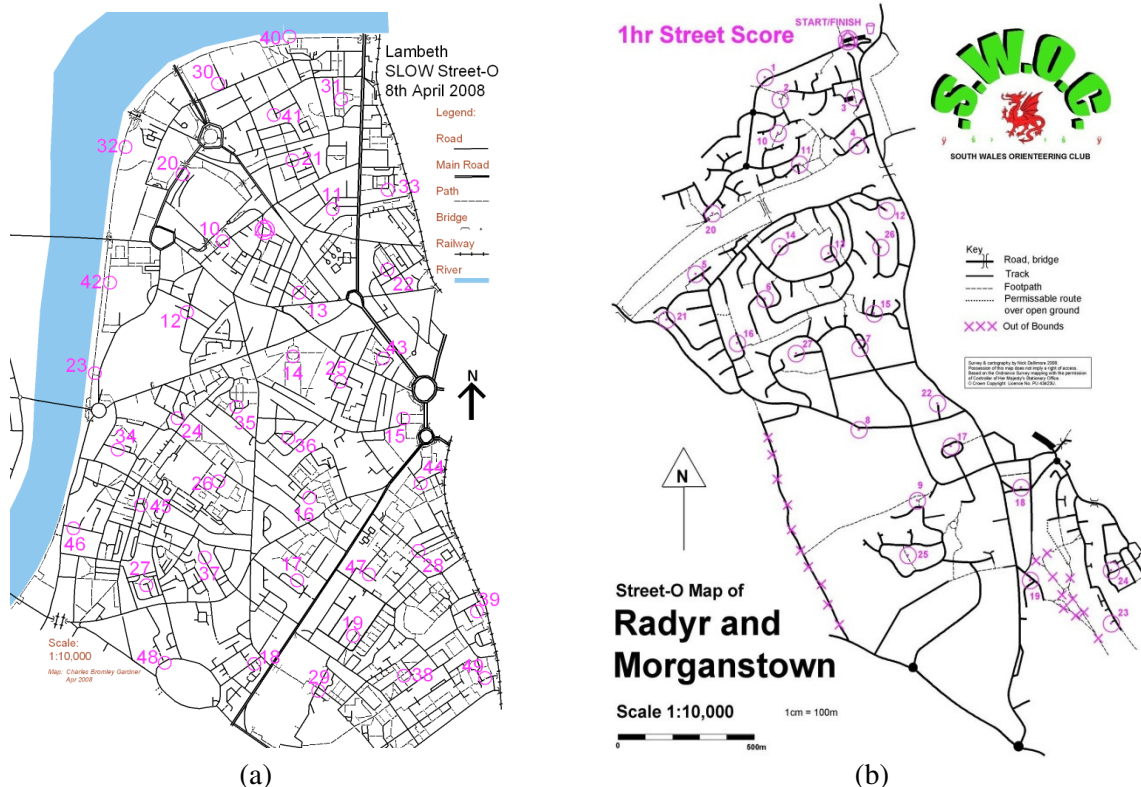


Figure 1. Sample street-O maps. (a) Lambeth, central London. Cartography: Charles Bromley-Gardner. (b) Radyr and Morganstown in Cardiff. Cartography: Nick Dallimore.

2 Street-O Map Production

Street-O maps have traditionally been produced using an application called OCAD (OCAD AG, 2005), in a three stage process. Firstly a base-map is scanned from a street-atlas or taken from screenshots of Ordnance Survey or Google Maps data. The street network is then digitised. These manually constructed representations are then evaluated by a field-survey, which identifies extra geographic features (e.g. alleyways) which are missing from the map and assesses suitable locations for controls. Once the ground truthing is complete, a final course layout can be created and the event maps produced. Manual street-O map production is therefore a laborious and time consuming process. The research presented in this paper aims to demonstrate, through the implementing of a GIS, an efficient and automated way in which maps suitable for street-O can be created.

Using a GIS to process and create street-O maps allows the direct use of vectored and spatially referenced base data, thus avoiding manual digitisation from a base raster. Additionally, use of a GIS enables spatial metadata not intended for the final printed map to be stored. Examples could include possible future control sites, previously used start venues with comments as to their suitability, and comments about possible road traffic conditions. Additionally, at the planning stages of course design spatial calculations could be conducted in a GIS to examine optimum route possibilities. Post-race, this information might also be used by competitors to analyse their actual route run and improve their route planning skills for future races.

3 The Street-O GIS Architecture and Implementation

A number of open-source desktop GIS applications are in active development, and are very promising for the display and production of simple maps from spatially-referenced data. Quantum GIS (QGIS) is used in this paper as it has a straightforward user interface and is compatible with multiple operating systems. Additionally, it also has a map composer, allowing for creation of cartographically simple maps directly within the application.

A PostGIS database is used to store the orienteering-specific data, such as controls and course annotations. It has good integration with QGIS and is free to use. Although in this paper a local database is used, if this were available across a network it could allow such data to be easily shared between mappers within a club or wider community.

OpenStreetMap (OSM) is used as the data source for the base-map. The quality and completeness of its coverage is variable (Haklay, 2008) but it is rapidly improving, and is already sufficient, for the application outlined in this paper, in most areas of London and in many other cities in Britain.

OSM data is obtained using the XML export function on their website. A custom Python script filters out non-relevant features, rewrites the XML using the GML specification (OGC, 2008a), and converts significant areal features into polygons (OSM stores areas as closed directional polylines). The script simplifies and enhances the way that overlapping features are indicated, to ensure that such features are stacked appropriately on the orienteering map. For example, water overlapping with a road is assumed to normally be below it, except where it is specifically on a bridge passing above the road.

Any errors or omissions in the OSM data that are discovered during the ground truthing of the initial maps can be corrected using the Potlatch Flash-based editor on the OSM website, and the data re-exported. This benefits the wider OSM community and minimises non-orienteering data (i.e. corrections to base maps) stored on the orienteering system.

GML layer files are created to record each feature with topological height information. These data are then imported into a map in QGIS as layers, projected and styled appropriately. QGIS's styling is relatively unsophisticated, not yet making use of the OGC's Style Layer Descriptor (OGC, 2008b) specification, but is sufficient for street-O maps. A duplicate layer for bridged roads is used and styled to emulate the normal cartographic representation of bridges.

Orienteering-specific data can be added by connecting to and editing various tables set up in a PostGIS installation – one each for controls, start/finish locations, out-of-bounds areas and annotations. The latter table's data would not appear on the final printed map – for the others, an appropriate field (e.g. event date) could be used in the filter to pull the appropriate subset of data for the event concerned.

4 Case Study: Putney

The method has been tested with the QGIS application and a PostGIS database locally installed on a computer running Mac OS X, as a prototype. The Putney area in south-west London has an existing street-O map, allowing a comparison to be made (Figure 2.) The data is obtained from OSM via the web interface described above and filtered. The resulting layer files are added to a new QGIS project, re-projected using the British National Grid, scaled and styled.

A number of cartographic problems arise which can be managed, relating to “end-capping” of the strokes, lack of generalisation and unconnected polylines. Comparison with the existing street-O map and online mapping reveal some data discrepancies, although, after ground truthing, the OSM-derived data was found to be more correct in the majority of cases.

Next, the relevant tables in PostGIS are included in the project, and the start and controls added. Control questions and answers can also be added, which could simplify production of the clue sheet.

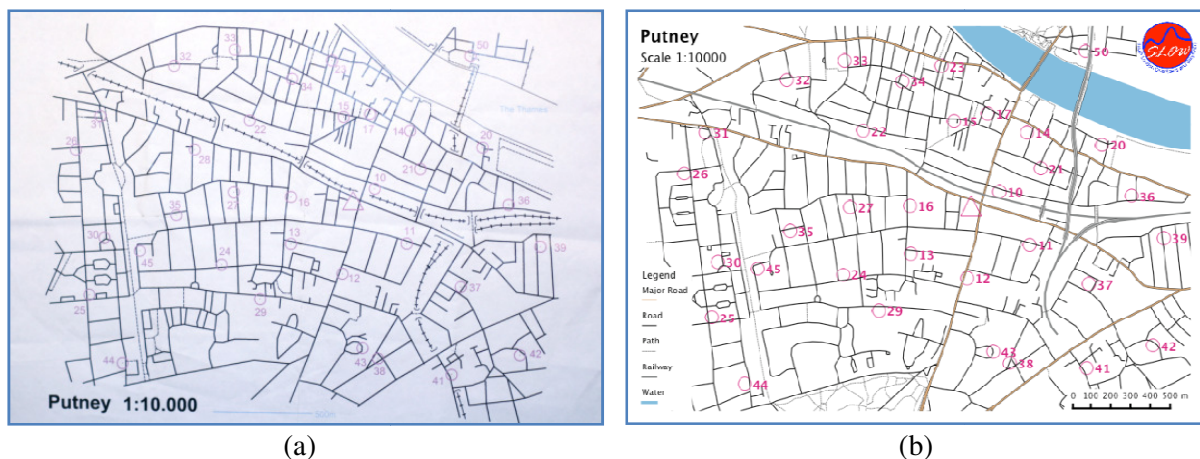


Figure 2. Street-O maps of Putney, south-west London. (a) The original map. Cartography: Dorte Torpe Hansen. (b) Map produced from OpenStreetMap data using Quantum GIS.

Finally, QGIS's Print Composer is used to select the appropriate portion of the map and add adornments, including an automatically generated legend based on the styling present, a title, scale, scale bar and club logo. The map can be saved as an SVG, PDF, or printed directly.

5 Future Work

The application as presented is sufficient for creating street-O maps, however in the future it may be beneficial to evaluate a range of other data including:

5.1 Contours

Managing the orienteering and base-map data in a GIS allows spatial data from other sources to be added. Contours can be added quite easily - the digital elevation model (DEM) data supplied by the NASA Shuttle Radar Topography Mission (SRTM) in 2000 can be converted to contours and the resulting shapefiles added to the map (Allan, 2008). The contours produced using this method however are not “smoothed” and tend to contain anomalous features, and therefore would only be useful for areas that include particularly large or steep hills.

5.2 Blue Plaques

One common source of clue questions for the London-based street-O maps is the inscriptions on the “blue plaques” managed by English Heritage (EH). To provide a quick way to identify potential control sites without first visiting the area, a script can be written to scrape the EH website’s list of plaques, geocode them using the Google Local web service, and create a GPX file containing their location and inscription. These can be seen as a layer of blue circles in Figure 3.

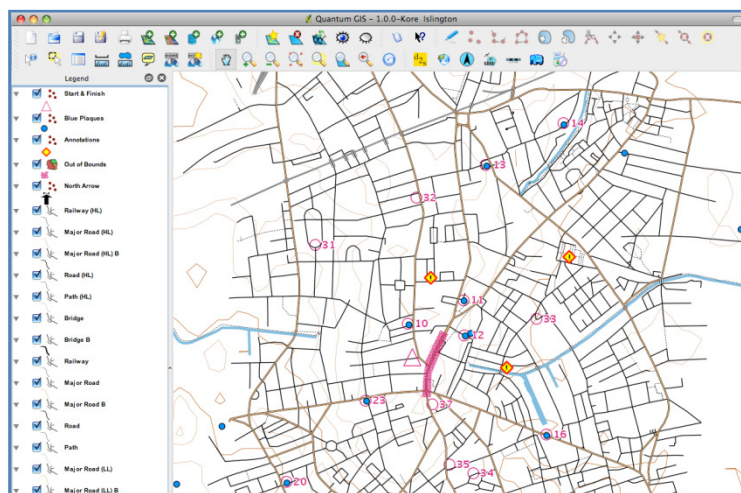


Figure 3. Screenshot of QGIS showing contours, blue plaque locations and annotations, added to a street-O map of Islington, north London.

6 Routing and the Orienteering Problem

Optimum routing calculations can be performed on the data – this could potentially be of interest to competitors during post-race analysis –for example, they may have failed to spot the best routes between certain pairs of controls. The “pyrouelib” OSM library developed by White (2007) can be used to find theoretically optimum routes, once the control locations are added as appropriate nodes on the adjacent polyline segments on the network – this is achieved with a Python script.

Computing a best route for the whole race, assuming a fixed running speed and limit, is known as the Orienteering Problem (Tsiligrades, 1984 p797), a variant of the Travelling Sales Problem (Gutin, 2002) and is hard to do computationally (Chekuri, 2008) as heuristics are needed for large numbers of controls. The research field studying combinatorial optimisation problems like these is very active.

7 Conclusions

The process described above provides a fast and accurate way to create street-O maps of areas, where OSM coverage is sufficiently complete and accurate. As OSM’s contributions continue, it will become

feasible to produce street-O maps for more and more areas. Both the orienteering and OSM communities would benefit from field-checking observations, while a separate but centralised store of orienteering data would prove particularly useful for organisers in subsequent years. The process is still not as easy as it needs to be for widespread adoption in the community – however the automation capabilities of QGIS and further development of open-source GISes and source data will simplify and enhance the process.

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Author Biography

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