Export an inkscape line drawing to a survex file

- *v2.1 minor improvements*
- *v2.0 completely rewritten for Inkscape 1.0*
- *v1.1 for Inkscape 0.92*

Use-cases include:

- producing a plausible length estimate for a drawn-up survey;
- georeferencing a drawn-up survey (see below);
- generating a skeleton to hang data off in a resurvey project;
- giving 'armchair cavers' something useful to do.

A couple of example surveys (Inkscape traced drawings) are also included.

Installation

Copy the files `svx_export.py` and `svx_export.inx` into your local Inkscape extension folder (eg `$HOME/.config/inkscape/extensions/` on unix, or `%APPDATA%\inkscape\extensions\` on Windows).

Usage

The extension appears under Extensions → Export → Export drawing to .svx file...

The following conventions are observed:

- all (poly)lines of a given color (default red) are converted to traverses in the survex file;
- a line of a second color (default blue) determines the orientation (default S to N);
- a line of a third color (default green) sets the scale (eg from the scale bar).

Lines of any other color are ignored, as are other drawing objects. The default colors can be changed in the color tabs in the dialog box.

Exported (poly)lines are converted to traverses. If there is more than one traverse, each one is captured in a separate `*begin` and `*end` block in the survex file using Inkscape path name so that individual traverses can be matched up to the drawn paths. The survey as a whole is wrapped in a top level `*begin` and `*end` block with a name corresponding to the `.svx` file name following standard conventions.

Within each traverse, survey legs are generated in the format

```
*data normal from to tape compass clino
```

where:

- The `from` and `to` stations are integers generated automatically.

- The `tape` length is generated using the scale line as reference, which will usually be traced over a scale bar in the survey. The true length that the scale line represents is specified in the Parameters tab in the export dialogue box.
- The `compass` bearing is generated using the orientation line as reference, which for example will be traced over a North arrow in the survey (in the direction S to N; corresponding to bearing = 0.0 in the dialog box). If a North arrow is not used the true bearing represented by the orientation line should of course be specified in the Parameters tab in the export dialogue box.
- The `clino` reading is set to zero.

Survey stations that are closer than a given specification are assumed to be the same and given as an `*equate` at the start of the `.svx` file. The tolerance to select these (eg 0.2m) can be adjusted in the Parameters tab in the export dialogue box. Stations which feature in this `*equate` are automatically exported out of the underlying `*begin` and `*end` block by the appropriate `*export` commands.

Workflow

Usually the drawing will be made by tracing over a scannned image of a drawn-up survey. A typical workflow might be as follows:

- start a new Inkscape document;
- import (link or embed) a scanned survey as an image;
- optionally, lock the layer containing the image and create a new layer to work in;
- then do the following (the default *colors* here can be changed in the export dialog):
  - trace the scale bar in *red*, making a note of the distance this represents,
  - trace an orientation feature in *blue* (eg a North arrow, from S to N),
  - trace the desired survey traverse lines in *green*,
  - adjust the positions of nodes which are supposed to represent the same survey station until they are coincident (within the tolerance);
- optionally save the Inkscape file to preserve metadata;
- then do Extensions → Export → Export drawing to .svx file...

In the subsequent dialog box, under the Parameters tab:

- an existing directory should be selected;
- the `.svx` file should be set from one of the options;
- then specify:
  - the length of scalebar line (in m);
  - the bearing of orientation line (in degrees);
  - the tolerance to equate stations (in m);
- optionally restrict export to a named layer;
- click on Apply.

A box should appear reporting that the `.svx` file has been generated successfully. If the conversion encounters errors, they are similarly reported. A succesfully generated `.svx` file is immediately ready for processing by survex.

Notes:

1. The orientation and scalebar lines are picked up irrespective of the layer selection.
2. Path names in Inkscape can be set by Object → Object properties...
3. If survex complains with an error 'Survey not all connected to fixed stations', then it is most likely a pair of supposedly coincident survey stations are not close enough together. To diagnose this:
   - increase the tolerance until Survex no longer complains and the `.svx` file processes properly;
   - open the `.svx` file in a text editor and examine the list of `*equate` commands to see which stations were too far apart;
   - return to Inkscape and fix the problem.
4. It is suggested that magnetic N *not* be corrected for using the 'bearing' setting in the Parameters tab. Instead one can add a `*calibrate declination` line by hand to the top of the survex file, where the angle is positive for declination W. The NOAA website can be consulted to obtain declination data for a given location and year. Alternatively (better) the declination can be corrected automatically using `*cs` commands and a `*declination auto` command (with a `*date`). The design choice to export legs as `tape` and `compass` readings, rather than as cartesian changes in easting and northing, was made precisely to accommodate this.
5. Depth information can be added by hand by editing the `.svx` file. A convenient way to do this is to change the survey data type to `*data cylpolar from to tape compass depthchange`. The final column (which originally contained zero `clino` entries) can be edited to reflect the depth change between survey stations, whilst preserving the `tape` and `compass` entries which are presumably correct if taken from a drawn-up survey in plan view.
6. A large survey can be dealt with by partitioning the (poly)lines into different, named layers, keeping the same scale bar and orientation line, but generating a different survex files for each named layer. These survex files can be stitched together using a master file as illustrated below. Some hand editing has to be done to match up the corresponding stations in the different survey data files and it may be necessary to export these stations through the `*begin` and `*end` blocks in each file.

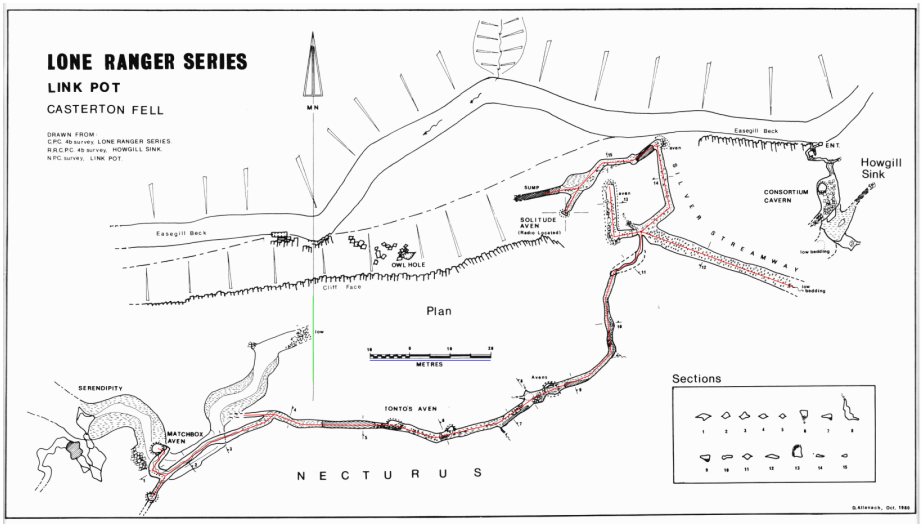

Figure 1: Inkscape: `lonerange_cpcj6-2.png` plus traced survey lines.

Examples

The file `loneranger_cpcj6-2.svg` is a tracing of a survey of the Lone Ranger series in Link Pot (Easegill) where the PNG image (`loneranger_cpcj6-2.png`) – originally published in CPC Journal 6(2) – is taken from CaveMaps. The scale line end-end distance is 30 m, so 'Length of scale line (in m)' in the Parameters tab should be set to 30.0 (obviously!).

Similarly, `farcountry_ulsaj89.svg` is a tracing of a survey of Far Country in Gaping Gill where the PNG image (`farcountry_ulsaj89.png`) – originally published in the ULSA '89 Journal – is likewise taken from CaveMaps. In this case the scale line end-end distance is 200 ft, so the 'Length of scale line (in m)' in the Parameters tab would be set to 60.96. To get an idea of the work involved here, the generated Survex file contains 176 survey stations, joined by 180 legs, with a total length of around 1.5km of passage: it took less than 30 mins of drawing in Inkscape to do.

Multiple layers The `loneranger.svg` tracing can also be used to illustrate the use of named Inkscape layers to break a survey into smaller pieces. The section from Matchbox aven to Tonto aven has been placed in a layer named `matchbox`, and the remaining passage beyond Tonto aven in a layer named `silverstream`. Thus the survex files `matchbox.svx` and `silverstream.svx` can be generated by exporting *twice*, using the option in the Parameters tab in the export dialogue to restrict export to each of these named layers in turn, taking the `.svx` file names from the selected layer name. These survex files can each be processed to a `.3d` file individually, but to stitch them together we note

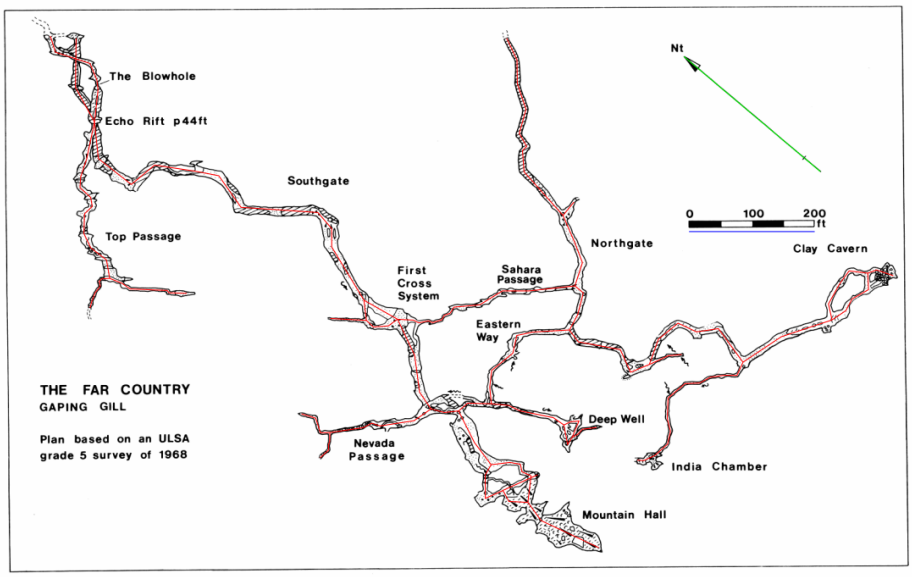

Figure 2: Inkscape: `far_country_ulsaj89.png` plus traced survey lines.

that Tonto aven is station 8 in `path4288` in `matchbox.svx`, and is also station 0 in `path4290` in `silverstream.svx`. Hence the following short survex file (here called `combined.svx`) will do the job:

```
; combined.svx
*include matchbox
*include silverstream
*equate matchbox.path4288.8 silverstream.path4290.0
```

As it stands this doesn't quite work because we have not yet exported these stations from the underlying survex `*begin` and `*end` blocks. This has to be done by hand: in `matchbox.svx`, add station 8 to the list of stations exported from the `path4288` block and `*export path4288.8` just below the top level `*begin matchbox` statement (both are needed, as stations must be exported from each layer in turn). Similar additions are required in `silverstream.svx`. Then one should be able to process `combined.svx` to a `.3d` file.

Georeferencing

Georeferencing refers to assigning a co-ordinate system to a map, in this case for example to a scanned hard copy of a survey. The actual steps require identifying so-called Ground Control Points (GCPs), which are identifiable features on the map for which actual co-ordinates are known. If the survey has a grid, or multiple entrances, these can be used. Frequently though the survey may only have one entrance, and just a scale bar and North arrow. In this case one can use the

survex export plugin to generate co-ordinates for additional GCPs in the cave. To do this one can either trace over the passages and export the survex file, or more simply trace a fake centerline which simply connects the extra GCPs to the entrance. Check the generated `.svx` file can be processed, and then add a `*fix` command to fix the entrance GCP to the known co-ordinates. Processing this file allows you to extract the co-ordinates of the GCPs.

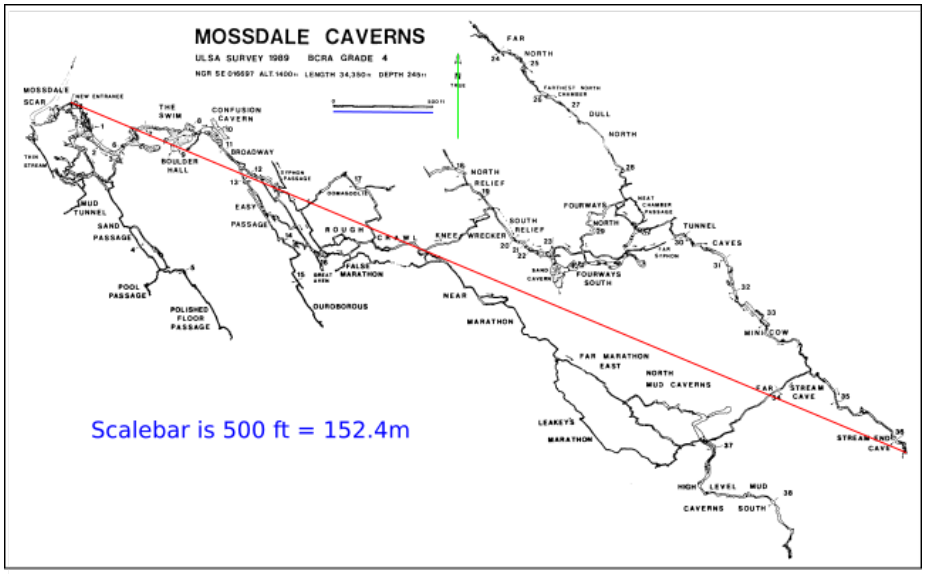

Figure 3: Inkscape: `mossdale_ulsaj89.png` plus artifical survey lines.

For example suppose one wanted to georeference the ULSA 1989 Mossdale survey, which is included here as `mossdale_ulsaj89.png`. The original of this was downloaded from CaveMaps. This version has some material cropped out and has been reduced to a binary (2-color) image. The image is imported into inkscape and the scale bar (500ft = 152.4m) and North arrow traced (conveniently, the survey uses true North, so magnetic declination need not be corrected). To georeference, the simplest approach is to add a single line connecting the entrance to a distant identifiable feature in the cave, for example the small chamber shown at the end of the Stream End Cave passage. This line will be exported as the survex centerline and the two stations will be our GCPs. The resulting inkscape drawing is included here as `mossdale_ulsaj89.svg`. The exported survex file, modified as described below, is `mossdale_ulsaj89.svx`.

We now need to establish the co-ordinates of the entrance, as the first GCP. To do this one can of course make a site visit with a GPS, or perhaps more conveniently make a virtual site visit using MagicMap website and use the 'Where am I?' option to find the entrance is at `(E, N) = (401667, 469779)`. This is the full 12-figure National Grid Reference (NGR) in the British National Grid (BNG).

The 6-figure NGR SE 016697 given on the survey is correct of course, but as it locates the entrance only to within a 100m square it's not really accurate enough.

These entrance co-ordinates are added to the survex file together with a a couple of `*cs` commands to georeference the same: choosing here to `*fix` the entrance using a 10-figure NGR in the SE square of BNG, and specifying the output spatial reference system (SRS) to be `EPSG:27700` for the fully numeric BNG. This may seem overkill but it gets the SRS meta-data into the `.3d` file in a form suitable for onward processing. Also I have adopted the convention of equating the entrance to a new station named `entrance` and fixing that. Finally, the entrance altitude (1400ft = 425m) has been added, although irrelevant for present purposes.

Thus the final file (`mossdale_ulsaj89.svx`) contains

```
*cs OSGB:SE
*cs out EPSG:27700

*fix entrance 01667 69779 425
*entrance entrance
*equate entrance mossdale_ulsaj89.0

*begin mossdale_ulsaj89

*data normal from to tape compass clino

0   1   1635.906   22.2 0

*end mossdale_ulsaj89
```

Note there is no inner `*begin` and `*end` for the path as only one path is exported.

On processing by `cavern` and `3dtopos` the result is

```
( Easting, Northing, Altitude )
(401667.00, 469779.00,   425.00 ) entrance
(401667.00, 469779.00,   425.00 ) mossdale_ulsaj89.0
(402285.11, 471293.64,   425.00 ) mossdale_ulsaj89.1
```

(saved as `mossdale_ulsaj89.pos`). The two entries give the co-ordinates of the GCPs in the `EPSG:27700` SRS and we can now proceed to georeference the image file, using for example QGIS. The final result, here provided as `mossdale_ulsaj89.tiff` in GeoTIFF format, can be directly imported into a GIS platform such as QGIS, and superimposed on Google satellite imagery, or the Environment Agency LIDAR data, for example. Note that an SRS is called a CRS (co-ordinate reference system) in QGIS.

Since it is also georeferenced (by the `*cs` commands) the survex centreline data can also be imported into QGIS using a QGIS plugin or a QGIS3 plugin. The

combined result, superimposed on an Open Street Map background, is here:

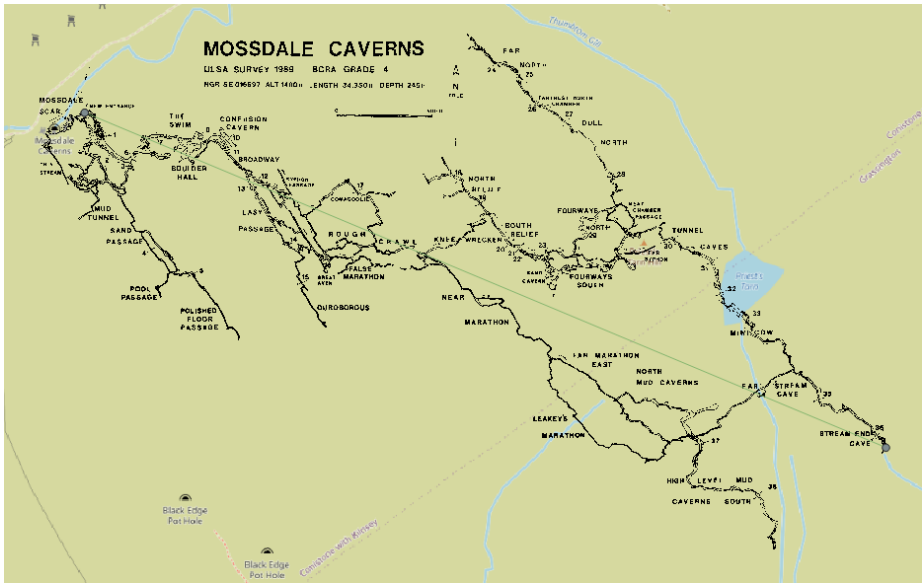

Figure 4: QGIS3: `mossdale_ulsaj89.tiff` plus artificial survey line and Open Street Map data

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