Survex 1.0.40 Manual

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This is the manual for Survex - an open-source software package for cave surveyors.

1. Introduction

This section describes what Survex is, and outlines the scope of this manual.

1.1. About Survex

Survex is a multi-platform open-source cave surveying package. currently runs on UNIX, Microsoft Windows 95/NT and successors, Mac OS X, DOS, and Acorn RISC OS machines. We're investigating support for various palmtop devices.

We are well aware that not everyone has access to super hardware - often surveying projects are run on little or no budget and any computers used are donated. We aim to ensure that Survex is feasible to use on low-spec machines. Obviously it won't be as responsive, but we intend it to be usable. Please help us to achieve this by giving us some feedback if you use Survex on a slow machine.

Survex is capable of processing extremely complex caves very quickly and has a very effective, real-time cave viewer which allows you to rotate, zoom, and pan the cave using mouse or keyboard. We have tested it extensively using CUCC and ARGE's surveys of the caves under the Loser Plateau in Austria (over 11,500 survey legs, and over 66km of underground survey data). This can all be processed in a few seconds on a low-end Pentium machine. Survex is also used by many other survey projects around the world, including the Ogof Draenen (http://www.oucc.org.uk/draenen/draenenmain.htm) survey, the Easegill (http://www.easegill.org.uk/) resurvey project, the OFD survey, the OUCC Picos expeditions (http://www.oucc.org.uk/reports/surveys/surveys.htm), and the Hong Meigui China expeditions (http://www.hongmeigui.net/).

Survex is still actively being worked on. Version 1.0 is complete in some sense, but development continues - initially in reshaping Survex into a more integrated GUI package.

We encourage feedback from users on important features or problems, which will help to direct future development. Contact addresses are at the end of this manual.

1.2. About this Manual

If there's a part of this manual you find hard to understand, please do let us know. We already know Survex well, so it can be hard for us to spot areas where the manual doesn't given enough information, or doesn't explain things clearly enough to follow when you don't know what's going on. It's helpful is you can suggest a better wording, but don't worry if you can't, just explain the problem as precisely as you can.

The master version of this manual is an SGML document written using the docbook DTD (http://www.docbook.org/), and automatically converted to a number of other formats. If you are going to send us *major* changes, it's much easier to include them if you work from this master. You can get it from the source archive (docs/manual.sgml) or from the Survex website (http://survex.com/docs.html).

1.2.1. Terminology

Throughout this document we use British terminology for surveying.

station

: a point in the cave that you survey from and/or to

leg

: a line joining two stations

survey

: a group of legs surveyed on the same trip

2. Getting Started

This section covers how to obtain the software, and how to unpack and install it, and how to configure it.

2.1. Obtaining Survex

The latest version is available from the Survex website: http://survex.com/. If you do not have internet access or would prefer to get a copy by post, we are also happy to send out up-to-date copies on a floppy on receipt of a stamped, self-addressed envelope. See the end of this document for addresses.

There's also a CD containing versions of Survex for every supported platform. You can download an image for this from the website, or we'll send you a copy on a CD-R if you send us money to cover the costs.

2.2. Installing Survex

The details of installation depend greatly on what platform you are using, so there is a separate section below for each platform.

2.2.1. Linux

We supply pre-compiled versions for x86 Linux machines in RPM format (suitable for Redhat, Mandrake, and some other distributions). Survex Debian packages are available from Debian mirror sites in the usual way.

You'll need root access to install these prebuilt packages. If you don't have root access you will need to build from source (see the next section).

2.2.2. Other versions of UNIX

For other UNIX versions you'll need to get the source code and compile it on your system. Survex uses GNU automake and autoconf to streamline the compile process, so all you need to do is unpack the sources, then simply type **`./configure`** followed by **`make`** to build the programs and then **`make install`** to install them.

> If you're building to install in your home directory (for example if you don't have root access on the machine you wish to install Survex on) configure and build with **`./configure --prefix=/home/olly/survex`** then **`make`** to build and **`make install`** to install.

There's a GUI cave viewer called aven, which needs wxWidgets to build, which in turn needs GTK+ (or Motif or just X11, but we only regularly test with the GTK+ version).

2.2.3. Microsoft Windows 95/NT and successors

This version comes packaged with an installation wizard. Just run the downloaded package and it will lead you through the installation process. If installing on MS Windows NT, 2000, or XP we recommend you run the installer as administrator (or as a user with administrator rights) so that the file associations can be set up for all users.

This version includes a GUI cave survey viewer called aven, and a Survex printer driver (printwin) which uses the Windows printer system.

The installer creates a Survex group in the Programs sub-menu of the Start menu containing the following items:

- Aven

- Documentation
- Uninstall Survex

Icons are installed for `.svx`, `.3d`, `.err`, and `.pos` files, and also for Compass Plot files (`.plt` and `.plf`) (which Survex can read). Double-clicking on a `.svx` file loads it for editing. To process it to produce a `.3d` file, right click and choose "Process" from the menu. Double-clicking the resultant `.3d` file views it in aven. All the Survex file types can be right clicked on to give a menu of possible actions.

`.svx`

Open
: Load file into SvxEdit

Process
: Process file with cavern to produce `.3d` file (and `.err` file)

`.3d`

Open
: Load file into Aven

Print
: Send to the printer

Extend
: Produce extended elevation

Convert to DXF
: Convert to a DXF file (suitable for importing into many CAD packages)

Convert for hand plotting
: Produce a `.pos` file listing all the stations and their coordinates

`.err`

Open
: Load file into Notepad

Sort by Error

Sort `.err` file by the error in each traverse

Sort by Horizontal Error

Sort `.err` file by the horizontal error in each traverse

Sort by Vertical Error

Sort `.err` file by the vertical error in each traverse

Sort by Percentage Error

Sort `.err` file by the percentage error in each traverse

Sort by Error per Leg

Sort `.err` file by the error per leg in each traverse

2.2.4. MS Windows 3.1 and DOS (Intel 80386 or newer CPU)

For MS Windows 3.1 we suggest using the DOS version. This version is compiled with the free DJGPP C compiler (http://www.delorie.com/djgpp/) which uses DPMI to access memory above DOS's 640k. Windows has DPMI services built in, as do QEMM and Novell DOS 7. For those situations where DPMI services aren't available, we include the free `cwsdpmi.exe`, which will be used automatically if it's needed.

2.2.5. DOS (Intel 80286 or earlier CPU)

We also supply a version suitable for use on pre-386 machines. You might wonder why - the reason is that many surveying projects have little or no budget and can acquire such machines for free. This version is suitable for caves up to medium size - a few thousand stations - which typically equates to a few kilometres of survey. A very loopy cave may need more memory.

This version is built with Borland C. A feature of this is that the best way to force a program to terminate is with **Ctrl-Break**. **Ctrl-C** sometimes works, but is less reliable.

2.2.6. RISC OS

Survex for RISC OS comes in a zip archive. Installation is just a matter of opening the archive with !SparkPlug, !SparkFS, or similar and dragging the contents to where you want them installed. This version is known to work with RISC OS 3.1 or newer. We are unable to test compatibility with earlier versions of RISC OS.

2.3. Configuration

2.3.1. Selecting Your Preferred Language

Survex has extensive internationalisation capabilities. The language used for messages from Survex and most of the library calls it uses can be changed. By default this is picked up from the language the operating system is set to use (from "Regional Settings" in Control Panel on Microsoft Windows, from the LANG environment variable on UNIX, from the value passed to COUNTRY in `CONFIG.SYS` on MSDOS (but this doesn't distinguish between the different languages used in a country in most cases), or from the configured Territory on RISC OS). If no setting is found, or Survex hasn't been translated into the requested language, UK English is used.

However you may want to override the language manually - for example if Survex isn't available in your native language you'll want to choose the supported language you understand best.

To do this, you set the SURVEXLANG environment variable. Here's a list of the codes currently supported:

Code	Language
en	International English
en_US	US English
ca	Catalan
de	German
de_CH	Swiss German
de_DE	German German
es	Spanish
fr	French
it	Italian
pt	Portuguese
pt_BR	Brazillian Portuguese
sk	Slovak

Here are examples of how to set this environment variable to give messages in French (language code fr):

DOS

Put **SET SURVEXLANG=fr** in your `AUTOEXEC.BAT` script. You will need to restart DOS before it notices this setting - to set it for the current DOS session enter **SET SURVEXLANG=fr** at the MSDOS command prompt.

Microsoft Windows

For MS Windows 95 and 98 (and probably ME), you'll need to add a line containing **SET SURVEXLANG=fr** to your `AUTOEXEC.BAT` script. You need to reboot for the change to take effect.

For MS Windows NT4, 2000, and XP, you should proceed as follows (this description is written from MS Windows 2000 - it should be similar on NT4 and XP): Open the Start Menu, navigate to the Settings sub-menu, and open Control Panel. Open System (picture of a computer) and click on the Advanced tab. Choose ‘Environmental Variables’, and create a new one: name SURVEXLANG, value fr. Click OK and the new value should be effective immediately.

UNIX - csh/tcsh

```
setenv SURVEXLANG fr
```

UNIX - sh/bash

```
SURVEXLANG=fr ; export SURVEXLANG
```

RISC OS

Hold down **Shift** and double-click on `!Cavern`, then hold down **Shift** again and double-click on `!Boot`. Edit the line which says Set SurvexLang en and change the value to the code for the language you want from the table above. Save the file, and double-click on `!Boot`. This sets the language for all the Survex programs.

If Survex isn’t available in your language, you could help out by providing a translation. The initial translation is likely to be about a day’s work; after that translations for new or changed messages are occasionally required. Contact us for details if you’re interested.

2.3.2. Configuring the Printer Drivers

On Microsoft Windows, we recommend you print using printwin which uses the built in drivers and so requires no separate configuration - if you can print from other programs, you can print from Survex. The only thing you may want to configure is the colours used if you have a colour printer.

The drivers used for other platforms may require a small amount of configuration, which is described in the following section.

print.ini

Name

`print.ini` — survex printer settings

Description

The print.ini file contains printer descriptions for the Survex printer drivers.

File Format

The format of the `print.ini` file is similar to the `.ini` files used on Microsoft Windows. The file is divided into sections, each section corresponding to a separate printer description. A section starts with a section name in square brackets, e.g.:

```
[generic_pcl]
```

followed by some options of the form <option>=<setting>, e.g.:

```
pixels_across_page=960
```

Most options are preceded by a comment (indicated by a semicolon ';') briefly explaining the option.

Each section can contain a 'like' option. If present this contains the name of another section (possibly in another print.ini file). Options not specified in the current section will be taken from that section. This allows a printer definition to be based on that for another similar model of printer.

Here is an example of how this works:

```
[dm_9pin_12inch]
like=dm_11inch_9pin
lines_down_page=108
```

This says that the definition 'dm_9pin_12inch' (for a 9pin dot matrix printer using 12 inch paper), is just like the 11 inch definition for the same printer, except that there are more lines per page.

Each printer driver reads a different section - **printdm** (the Dot Matrix driver) reads:

```
[dm]
```

printhpgl (for HPGL plotters) reads:

```
[hpgl]
```

printpcl (for PCL printers) reads:

```
[pcl]
```

printps (for Postscript printers) reads:

```
[ps]
```

Several definitions are supplied for each printer driver, covering most commonly encountered printers of each type.

printdm

The definitions provided for printdm are: dm_8pin_a4, dm_8pin_11inch, dm_8pin_12inch, dm_9pin_a4, dm_9pin_11inch, dm_9pin_12inch, dm_24pin_a4, dm_24pin_11inch, dm_24pin_12inch, dm_panasonic_24pin, dm_lx86_9pin_11inch, and bj (for driving Canon BJ printers).

In the unlikely event that you need to change the printer control codes, here is a quick overview of the format: printable characters are literal, except for backslash. A backslash '\' indicates that the following character or characters are to be interpreted as a control code, as follows: \ followed by an 'x' followed by two hex digits represents the character with that hex value; a double backslash means a literal backslash; \0 is nul (0); \t is tab (9); \n is newline (10); \r is return (13); \[is escape (27); \? is delete (127); \A - \Z are (1) to (26).

This is all rather cryptic (printer codes inherently are) but the provided set-ups will work with nearly all dot matrix printers, so you are unlikely to need to fiddle with these runes.

printhpgl

The definitions provided for printhpgl are: hpgl_generic_a4landscape, hpgl_generic_a1landscape, and hpgl_generic_a0landscape.

printpcl

The definitions provided for printpcl are: pcl_generic_a4 and pcl_modern_a4.

Note that if you are using a PCL printer the defaults are set not to use advanced printer features for compatibility. If you want to try these (equivalent to HP Laserjet III or later), then you should use the modern_pcl_a4 printer definition (see below for how to do this). This will enable horizontal and vertical tabbing.

printps

There's only one definition provided at present: ps_generic_a4.

Customising Printer Settings

The only settings most users will want to customise are which printer definition is used, and where to send the output. If you're using a Dot Matrix Printer you will also need to set calibration details.

You shouldn't modify the master print.ini (located in /usr/share/survex on Unix, or in the same directory as the Survex program files on other systems), or your changes will be overwritten by upgrades. Instead create:

- /etc/survex/print.ini (Unix - system-wide settings)
- ~/.survex/print.ini (Unix - per user settings)
- myprint.ini in the directory where Survex is installed (other platforms)

The drivers look for the section "[dm]", "[ps]", "[pcl]" or "[hpgl]" as appropriate. The file you create should should contain something like this to select a particular printer:

```
[pcl]
like=pcl_modern_a4
```

For printdm, it should also contain calibration measurements (calibrate your printer by running **printdm --calibrate**):

```
[dm]
like=dm_24pin_a4
mm_across_page=202
mm_down_page=278
```

You can override other settings too, such as the output destination. This is usually inherited from [base], and can be overridden in [base] (where it'll apply to all printer drivers) or in a printer driver specific section (such as [dm]). The output destination is set by an option of the form output_<platform>=<device>, where device can be a device name (e.g. PRN, LPT1, LPT2 under DOS, `Printer:` under RISC OS) or a filename:

```
[dm]
output_msdos=LPT1
like=dm_24pin_a4
mm_across_page=202
mm_down_page=278
```

Under UNIX output may be piped into another command like so:

```
[base]
; send output to printer 'oak'
output_unix=|lpr -Poak
```

Note you can also override the output setting using the --output command line option.

If the output device isn't a device or a pipe command, it is taken as a filename to write the printer data to. This can then be sent to a printer later.

If you're using DOS you need to be careful when sending output to a file - printdm, printpcl and printhpgl all produce binary files, which *must* then be sent to the printer with **`COPY /B OUTPUT PRN`** where OUTPUT is the filename and PRN the device name. Do *not* use COPY without the /B. If you do, the output may be corrupted. Sorry, this is a deficiency of DOS, and there is nothing we can do about it.

If you send output straight to the printer, by putting `PRN` or `LPT1` in the configuration file, then this problem should not occur.

printps produces text files as output, and so should be unaffected by this problem.

printdm can also drive Canon bubblejets in native mode (which gives a higher resolution than in Epson emulation mode). To use this, set "like=bj" in the "[dm]" section - like so:

```
[dm]
like=bj
```

3. Survex Programs

3.1. Standard Options

All Survex programs respond to the following command line options:

--help

display option summary and exit

--version

output version information and exit

3.2. Short and Long Options

Options have two forms: short (a dash followed by a single letter e.g. **cavern -p**) and long (two dashes followed by one or more words e.g. **cavern --percentage**). The long form is generally easier to remember, while the short form is quicker to type. Options are often available in both forms.

Command line options are case sensitive, so "-B" and "-b" are different (this didn't used to be the case before Survex 0.90). Case sensitivity doubles the number of available short options (and is also the norm on UNIX).

3.3. Filenames on the Command Line

Filenames with spaces can be processed (provided your operating system supports them - UNIX does, and so do recent versions of Microsoft Windows). You need to enclose the filename in quotes like so: **`cavern "Spider Cave"`**

A file specified on the command line of any of the Survex suite of programs will be looked for as specified. If it is not found, then the file is looked for with the appropriate extension appended. So **`cavern survey`** will look first for `survey`, then for `survey.svx`.

3.4. Command Reference

cavern

Name

`cavern` — process raw survey data

Synopsis

cavern [options] {survex data file...}

Description

Cavern is the Survex data processing engine.

If multiple survey data files are listed on the command line, they are processed in order from left to right. Settings are reset to their defaults before processing each file.

Options

-p, --percentage

You can get cavern to display the percentage progress through the current file. As of Survex 0.90 this is disabled by default, but you can enable it if you want. Because the value given is for the *current* file, the values jump around for a multi-file survey project. Also note that displaying this information slows down processing a little.

-o, --output=OUTPUT

Sets location for output files.

-q, --quiet

Only show a brief summary (--quiet --quiet or -qq will display warnings and errors only).

-s, --no-auxiliary-files

do not create .err file.

-w, --warnings-are-errors

turn warnings into errors.

--log

Send screen output to a .log file.

-x, --chasm-format

Output data in chasm's 3dx format for use with Phil Underwood's Chasm application.

Output

Cavern reads in text files containing the survey data `.svx`) and outputs two files, with the extensions `.3d` and `.err`. By default these files are put in the current directory, with the same base filename as the first `.svx` file read, but a different extension. You can change the directory and/or base filename using the --output command line option.

E.g. if you process the data file `entrance.svx` with the command **`cavern entrance`** then the files `entrance.3d` and `entrance.err` will be created.

Cavern also gives a range of statistics at the end of a successful run:

- The highest and lowest stations and the height difference between them

- The total length of the survey (before and after adjustment). This total excludes survey legs flagged as SURFACE, DUPLICATE, or SPLAY.
- The number of stations and legs. Note that a *EQUATE is counted as a leg in this statistic.
- The East-West and North-South ranges, and the North-most, South-most, East-most, and West-most stations.
- The number of each size of node in the network (where size is number of connections to a station) i.e. a one node is the end of a dead-end traverse, a two-node is a typical station in the middle of a traverse, a three-node is a T-junction etc.
- How long the processing took and how much CPU time was used.

`.3d` - data describing the loop-closed centre line

This file contains details of the stations and legs, and any flags associated with them.

`.err` - loop closure statistics (%age errors, etc)

This file contains statistics about each traverse in the survey which is part of a loop. It includes various statistics for each traverse, such as the percentage error per leg. You should study this information to determine if any parts of the survey are of lower quality or contain gross errors.

Error Messages

There are a number of error messages that you may get when processing data. Most of these are self explanatory, and will be caused by such problems as typing mistakes, or by your survey data not being attached to fixed points (in this situation, Survex will list some of the stations that are not connected).

Along with the error message, the filename and line number of the offending line will be printed (or the filename for errors such as 'file not found'). The format of the filename and line number is that used by gcc, so if your editor can parse errors from gcc, you should be able to set it to allow you to jump to the file and line of each error.

Cavern will stop after more than 50 errors. This usually indicates something like the incorrect data order being specified. Deluging the user with error messages makes the actual problem less clear.

svxedit

Name

`svxedit` — enter survey data

Synopsis

svxedit [survex data file...]

Description

SvxEdit allows you to enter and edit survey data.

aven

Name

`aven` — sophisticated cave viewer for Unix and MS Windows

Synopsis

aven [options] {.3d file}

Description

Aven displays processed cave surveys in a window and allows you to manipulate the view.

Note that there is no perspective in the view. This means that it is impossible to tell which way round a cave is rotating, or whether you are viewing something from behind, or in front. So if you think the direction of rotation in wrong, or changes as you watch, this is just your brain being confused, not a bug!

Mouse Control

The best way to move the cave is with the mouse. If you hold down the right button then the cave is dragged when you move the mouse. If you hold down the left button, then the cave is rotated if you move left or right, and zoomed if you move up and down. If your mouse has a middle button then you can use it to tilt the cave.

By default the mouse moves the cave, but if you press **Ctrl-R**, then the mouse will move the viewpoint instead (i.e. everything will go in the opposite direction. This seems more natural to some people.

Keyboard Control

P and **L** select Plan and eLevation respectively. Changing between plan to elevation is animated to help you see where you are and how things relate. This animation is automatically disabled on slow machines to avoid user frustration.

Apostrophe **'**, and Slash **/** tilt up and down respectively. Tilt goes 180 degrees from plan view to a view from directly below (upside down plan).

Enter starts the cave spinning, and **Space** stops it. The speed of rotation for this, and tilt, is controlled by **Z** and **X**.

Crosses and/or labels can be displayed at survey stations. **Ctrl-X** toggles crosses and **Ctrl-N** station names. **Ctrl-L** toggles the display of survey legs.

Delete is useful if you get lost - it resets the scale, position, and rotation speed, so that the cave returns to the centre of the screen. There are also keyboard controls to use instead of the mouse:

```
Z, X : Faster/Slower Rotation
R: Reverse direction of rotation
Enter, Space: Start and stop auto-rotation
C, V: Rotate cave one step clockwise/anti-clockwise
' , /: Higher/Lower Viewpoint
] , [: Zoom in/Out
U, D: Set view to Up/Down
N, S, E, W: Set view to North, South, East, West
Delete: Reset to default scale, rotation rate, etc
P, L: Plan, Elevation
Cursor Left, Cursor Right: Pan survey Left/Right (on screen)
Cursor Up, Cursor Down: Pan survey Up/Down (on screen)
Ctrl-N: Toggle display of station names
Ctrl-X: Toggle display of crosses at stations
Ctrl-L: Toggle display of survey legs
Ctrl-F: Toggle display of surface legs
O: Toggle display of non-overlapping/all names
Ctrl-R: reverse sense of controls
```

A little experimentation should give a better understanding of how this works.

There is an auto-resizing scale bar along the bottom of the screen which varies in length as you zoom in or out. In the lower right corner is a compass pointer showing which way is North, and a clino pointer showing the angle of tilt.

caverot

Name

`caverot` — display `.3d` files on screen

Synopsis

caverot [options] {.3d file...}

Description

Caverot displays `.3d` files on screen and allows you to manipulate the view to understand the cave. Aven is a GUI caverot replacement which supports most of caverot's mouse and keyboard controls but offers many additional features.

The DOS version of caverot for 286 and earlier machines works with a wide range of graphics cards, and typically provides resolutions up to 640x480. Usually two copies of the screen are used, and one is drawn on while the other is displayed, to give smoother animation. Where the hardware does not allow this you may notice a flickering or flashing during movement which since you can see the screen being redrawn.

The standard DOS version can work with higher resolution screen modes, and always draws into a buffer which is then copied to the screen. It tries to pick a suitable screen mode, but if this fails you can bring up a dialog to choose a screen mode from by using the --mode-picker command line option.

The RISC OS version will pick the highest resolution screen mode that it can use two copies of the screen in, and that will work on the monitor in use. It will also use three bank animation for an even more flicker-free display if there is enough RAM.

CAVEROT reads in the data and then displays a help screen listing the control keys/mouse buttons. Hitting a key gives the default view. This is a plan scaled to fit on the screen, with no labels or station crosses. The view can be panned, rotated, zoomed, tilted, or set spinning. This should be fast enough to be almost instant with all but the largest surveys on the slowest of hardware. Pressing **H** at any point will give you the help again. **Escape** exits the program.

Colours and multiple data files

Caverot can read in multiple data files and display them in separate colours.

The syntax is given above. E.g. **caverot -c2,6 cave.3d surface.3d** would display `cave.3d` in colour 2 and `surface.3d` in colour 6. If you do not specify colours, a predefined set is used.

Colour values range between 0 (black) and 255 (white) - experiment to find which colours you like.

Note that there is no perspective in the view. This means that it is impossible to tell which way round a cave is rotating, or whether you are viewing something from behind, or in front. So if you think the direction of rotation in wrong, or changes as you watch, this is just your brain being confused, not a bug!

Mouse Control

The best way to move the cave is with the mouse. If you hold down the right button then the cave is dragged when you move the mouse. If you hold down the left button, then the cave is rotated if you move left or right, and zoomed if you move up and down. If your mouse has a middle button (and it is recognised by your mouse driver) then you can use it to tilt the cave.

By default the mouse moves the cave, but if you press **Ctrl-R**, then the mouse will move the viewpoint instead (i.e. everything will go in the opposite direction. This seems more natural to some people.

Keyboard Control

P and **L** select Plan and eLevation respectively. Changing between plan to elevation is animated to help you see where you are and how things relate. This animation is automatically disabled on slow machines to avoid user frustration.

Apostrophe **'**, and Slash **/** tilt up and down respectively. Tilt goes 180 degrees from plan view to a view from directly below (upside down plan).

Enter starts the cave spinning, and **Space** stops it. The speed of rotation for this, and tilt, is controlled by **Z** and **X**.

Crosses and/or labels can be displayed at survey stations. **Ctrl-X** toggles crosses and **Ctrl-N** station names. **Ctrl-L** toggles the display of survey legs.

By default, labels and crosses are not redrawn during movement, to improve responsiveness. With a small cave, or a fast computer, you can enable redraw of everything during movement with **Ctrl-A**. **Ctrl-O** toggles whether all names are displayed, or only non-overlapping ones.

Delete is useful if you get lost - it resets the scale, position, and rotation speed, so that the cave returns to the centre of the screen. There are also keyboard controls to use instead of the mouse - **Shift** helps here as it accelerates all movements:

```
Z, X : Faster/Slower Rotation
R: Reverse direction of rotation
Enter, Space: Start and stop auto-rotation
Ctrl-Cursor Left, Ctrl-Cursor Right: Rotate cave one step clockwise/anti-clockwise
Ctrl-Cursor Up , Ctrl-Cursor Down: Higher/Lower Viewpoint
] , [: Zoom in/Out
U, D: Set view to Up/Down
N, S, E, W: Set view to North, South, East, West
Delete: Reset to default scale, rotation rate, etc
P, L: Plan, Elevation
Cursor Left, Cursor Right: Pan survey Left/Right (on screen)
Cursor Up, Cursor Down: Pan survey Up/Down (on screen)
Ctrl-N: Toggle display of station names
Ctrl-X: Toggle display of crosses at stations
Ctrl-L: Toggle display of survey legs
Ctrl-F: Toggle display of surface legs
Ctrl-A: Toggle display of All/skeleton when moving
O: Toggle display of non-overlapping/all names
Ctrl-R: reverse sense of controls
Escape: quit program
Shift: accelerates all movement keys
H:  help screen giving these controls
```

A little experimentation should give a better understanding of how this works.

There is an auto-resizing scale bar on the left side of the screen. This varies in length as you zoom in or out. The current length is given just below the bearing. In the top left corner the current direction of view (for elevations), or direction up the screen (for plans) is displayed. In the top right is a compass pointer showing which way is North, and in the bottom right is a clino pointer showing the angle of tilt.

xcaverot

Name

`xcaverot` — basic cave survey viewer for X

Synopsis

xcaverot [options] {.3d file...}

Description

Xcaverot displays processed cave surveys in a window and allows you to manipulate the view. Aven is a more sophisticated cave survey viewer which runs under X and also on Microsoft Windows. We recommend you use Aven in preference.

Note that there is no perspective in the view. This means that it is impossible to tell which way round a cave is rotating, or whether you are viewing something from behind, or in front. So if you think the direction of rotation in wrong, or changes as you watch, this is just your brain being confused, not a bug!

Mouse control

The best way to move the cave is with the mouse. If you hold down the right button then the cave is dragged when you move the mouse. If you hold down the left button, then the cave is rotated if you move left or right, and zoomed if you move up and down. If your mouse has a middle button then you can use it to tilt the cave.

Keyboard Control

P and **L** select Plan and eLevation respectively.

Apostrophe **'**, and Slash **/** tilt up and down respectively. Tilt goes 180 degrees from plan view to a view from directly below (upside down plan).

Enter starts the cave spinning, and **Space** stops it. The speed of rotation for this, and tilt, is controlled by **Z** and **X**.

Crosses and/or labels can be displayed at survey stations. **Ctrl-X** toggles crosses and **Ctrl-N** station names. **Ctrl-L** toggles the display of survey legs. **Ctrl-O** toggles whether all names are displayed, or only non-overlapping ones.

Delete is useful if you get lost - it resets the scale, position, and rotation speed, so that the cave returns to the centre of the screen. There are also keyboard controls to use instead of the mouse:

```
Z, X : Faster/Slower Rotation
R: Reverse direction of rotation
Enter, Space: Start and stop auto-rotation
Ctrl-Cursor Left, Ctrl-Cursor Right: Rotate cave one step clockwise/anti-clockwise
Ctrl-Cursor Up , Ctrl-Cursor Down: Higher/Lower Viewpoint
] , [: Zoom in/Out
U, D: Set view to Up/Down
N, S, E, W: Set view to North, South, East, West
Delete: Reset to default scale, rotation rate, etc
P, L: Plan, Elevation
Cursor Left, Cursor Right: Pan survey Left/Right (on screen)
Cursor Up, Cursor Down: Pan survey Up/Down (on screen)
Ctrl-N: Toggle display of station names
Ctrl-X: Toggle display of crosses at stations
Ctrl-L: Toggle display of survey legs
Ctrl-F: Toggle display of surface legs
O: Toggle display of non-overlapping/all names
Q: quit program
Shift: accelerates all movement keys
```

A little experimentation should give a better understanding of how this works.

There is an auto-resizing scale bar on the left side of the screen. This varies in length as you zoom in or out. The current length is given at the top. In the top right is a compass pointer showing which way is North, and a clino pointer showing the angle of tilt.

Environmental Variables

There are two environmental variables which may be used to configure xcaverot, XCAVEROT_INDICATOR_RADIUS which sets the radius of the compass and clino indicators, and XCAVEROT_FONTNAME which tells xcaverot what font to use.

printdm

Name

`printdm` — print `.3d` files on a dot-matrix printer

Synopsis

printdm [options] {.3d file...}

Description

Printdm produces output suitable for most dot-matrix printers, and also for Canon BJ inkjet printers. It supports 8, 9, and 24 pin Epson-compatible dot-matrix printers. The 9 pin dump is about 10% faster than the 8 pin, but some old printers will not support it. Printdm supports printers which support Epson's ESC/P codes, and also those which support IBM's ProPrinter codes.

The configuration file `print.ini`, which sets various features for each printer. See the 'Printer Settings' section for details. Even if your printer is not standard you should be able get it to work by customising one of the supplied definitions.

Options

The command line options are:

--survey=SURVEY

  Only load the sub-survey SURVEY

-e, --elevation

  select elevation

-p, --plan

  select plan view

-b, --bearing=BEARING

  set bearing

-t, --tilt=TILT

  set tilt

-s, --scale=SCALE

  set scale

-n, --station-names

  display station names

-c, --crosses

  display crosses at stations

-B, --no-border

turn off the solid border around the edge of the survey. Printing to dot-matrix and inkjet printers can be significantly faster without this border as the printhead usually doesn't need to move all the way to the edge of the paper.

-C, --no-cutlines

If a printout takes more than one page, alignment ticks are printed where the page corners need to be joined. By default dash lines are also drawn along internal edges to facilitate trimming down the page with scissors. If you have a guillotine, the alignment ticks are sufficient for trimming the page and this option allows you to turn off the dashed lines.

-l, --no-legs

turn off display of survey legs

-S, --surface

turn on display of surface survey legs. By default only underground survey legs are shown.

-k, --skip-blanks

don't output blank pages With this option pages which are blank (apart from alignment marks and borders) will not be printed.

-o, --output=OUTPUT

set output file

--calibrate

print out calibration page

Interactive Use

When you run the printer driver you will be asked if you want a plan or elevation (enter **P**, or **E**) - the default is plan. Then enter values for the desired plot view. These values correspond to those displayed in the bottom right hand corner when using Aven (or the top right when using caverot). You would usually use Aven or caverot to pick the best view and then note the angles before running the Printer Driver. This will be integrated soon.

For a plan enter bearing up the page, in degrees, 0 indicating North at the top of the page (the default).

For an elevation enter the angle of view (i.e. the compass bearing from which the scene is viewed), and angle of tilt, where 0 is horizontal, - is looking down from above, and + is looking up from below, so -90 is the same as plan view.

For an extended elevation, no viewing angles are needed.

You'll be told the scale needed to fit the plot on one page, and be asked what scale you want to use. The you're told how many pages this will take (and the arrangement of those pages (e.g. 6 pages (2x3)) and have the opportunity to print, quit, or change the scale (so you can repeat this process until you have a scale and number of pages you are happy with).

You can then print all the pages, a range of pages, or any arbitrary list of pages and ranges (handy for when your printer mangles a page).

Printer Calibration

Dot Matrix printers do not print to an accurate size - you need to do to calibrate your printer in order to get correctly-scaled plots. Print out a calibration plot using **printdm --calibrate** and measure the width and height of the page border.

Then create an entry in `/etc/print.ini` or `.survex/print.ini` in your home directory (Unix) or `myprint.ini` in the installation directory (other platforms) with entries mm_across_page and mm_down_page containing your values. The entry should look something like this:

```
[dm]
like=dm_8pin_a4
mm_across_page=204.5
mm_down_page=278
```

Then run **printdm --calibrate** again, and check that the square is now 10cm wide and high. This calibration is particularly necessary for older dot-matrix printers as they vary significantly in scaling - even between two printers of the same make and model.

printhpgl

Name

`printhpgl` — print `.3d` files on a plotter supporting Hewlett Packard's HPGL

Synopsis

printhpgl [options] {.3d file...}

Description

Printhpgl produces output suitable for plotters that support Hewlett Packard's HPGL.

The configuration file `print.ini`, which sets various features for each printer. See the 'Printer Settings' section for details. Even if your printer is not standard you should be able get it to work by customising one of the supplied definitions.

Options

The command line options are:

--survey=SURVEY

Only load the sub-survey SURVEY

-e, --elevation

select elevation

-p, --plan

select plan view

-b, --bearing=BEARING

set bearing

-t, --tilt=TILT

set tilt

-s, --scale=SCALE

set scale

-n, --station-names

display station names

-c, --crosses

display crosses at stations

-B, --no-border

turn off the solid border around the edge of the survey. Printing to dot-matrix and inkjet printers can be significantly faster without this border as the printhead usually doesn't need to move all the way to the edge of the paper.

-C, --no-cutlines

If a printout takes more than one page, alignment ticks are printed where the page corners need to be joined. By default dash lines are also drawn along internal edges to facilitate trimming down the page with scissors. If you have a guillotine, the alignment ticks are sufficient for trimming the page and this option allows you to turn off the dashed lines.

-l, --no-legs

turn off display of survey legs

-S, --surface

turn on display of surface survey legs. By default only underground survey legs are shown.

-k, --skip-blanks

don't output blank pages With this option pages which are blank (apart from alignment marks and borders) will not be printed.

-o, --output=OUTPUT

set output file

Interactive Use

When you run the printer driver you will be asked if you want a plan or elevation (enter **P**, or **E**) - the default is plan. Then enter values for the desired plot view. These values correspond to those displayed in the bottom right hand corner when using Aven (or the top right when using caverot). You would usually use Aven or caverot to pick the best view and then note the angles before running the Printer Driver. This will be integrated soon.

For a plan enter bearing up the page, in degrees, 0 indicating North at the top of the page (the default).

For an elevation enter the angle of view (i.e. the compass bearing from which the scene is viewed), and angle of tilt, where 0 is horizontal, - is looking down from above, and + is looking up from below, so -90 is the same as plan view.

For an extended elevation, no viewing angles are needed.

You'll be told the scale needed to fit the plot on one page, and be asked what scale you want to use. The you're told how many pages this will take (and the arrangement of those pages (e.g. 6 pages (2x3)) and have the opportunity to print, quit, or change the scale (so you can repeat this process until you have a scale and number of pages you are happy with).

You can then print all the pages, a range of pages, or any arbitrary list of pages and ranges (handy for when your printer mangles a page).

printpcl

Name

`printpcl` — print `.3d` files on a printer supporting Hewlett Packard's PCL

Synopsis

printpcl [options] {.3d file...}

Description

Printpcl produces output suitable for printers that support Hewlett Packard's PCL (Printer Control Language), which include Deskjets and Laserjets (i.e. many Inkjets and Laser printers).

The configuration file `print.ini`, which sets various features for each printer. See the 'Printer Settings' section for details. Even if your printer is not standard you should be able get it to work by customising one of the supplied definitions.

Options

The command line options are:

--survey=SURVEY

Only load the sub-survey SURVEY

-e, --elevation

select elevation

-p, --plan

select plan view

-b, --bearing=BEARING

set bearing

-t, --tilt=TILT

set tilt

-s, --scale=SCALE

set scale

-n, --station-names

display station names

-c, --crosses

display crosses at stations

-B, --no-border

turn off the solid border around the edge of the survey. Printing to dot-matrix and inkjet printers can be significantly faster without this border as the printhead usually doesn't need to move all the way to the edge of the paper.

-C, --no-cutlines

If a printout takes more than one page, alignment ticks are printed where the page corners need to be joined. By default dash lines are also drawn along internal edges to facilitate trimming down the page with scissors. If you have a guillotine, the alignment ticks are sufficient for trimming the page and this option allows you to turn off the dashed lines.

-l, --no-legs

turn off display of survey legs

-S, --surface

turn on display of surface survey legs. By default only underground survey legs are shown.

-k, --skip-blanks

don't output blank pages With this option pages which are blank (apart from alignment marks and borders) will not be printed.

-o, --output=OUTPUT

set output file

Interactive Use

When you run the printer driver you will be asked if you want a plan or elevation (enter **P**, or **E**) - the default is plan. Then enter values for the desired plot view. These values correspond to those displayed in the bottom right hand corner when using Aven (or the top right when using caverot). You would usually use Aven or caverot to pick the best view and then note the angles before running the Printer Driver. This will be integrated soon.

For a plan enter bearing up the page, in degrees, 0 indicating North at the top of the page (the default).

For an elevation enter the angle of view (i.e. the compass bearing from which the scene is viewed), and angle of tilt, where 0 is horizontal, - is looking down from above, and + is looking up from below, so -90 is the same as plan view.

For an extended elevation, no viewing angles are needed.

You'll be told the scale needed to fit the plot on one page, and be asked what scale you want to use. The you're told how many pages this will take (and the arrangement of those pages (e.g. 6 pages (2x3)) and have the opportunity to print, quit, or change the scale (so you can repeat this process until you have a scale and number of pages you are happy with).

You can then print all the pages, a range of pages, or any arbitrary list of pages and ranges (handy for when your printer mangles a page).

printps

Name

`printps` — print `.3d` files on a PostScript printer or plotter

Synopsis

printps [options] {.3d file...}

Description

Printps produces PostScript output for use with PostScript printers and plotters. It's also the recommended way to print on Linux (the Linux printing system accepts PostScript and converts it to the format your printer needs.

The configuration file `print.ini`, which sets various features for each printer. See the 'Printer Settings' section for details. Even if your printer is not standard you should be able get it to work by customising one of the supplied definitions.

Options

The command line options are:

--survey=SURVEY

Only load the sub-survey SURVEY

-e, --elevation

select elevation

-p, --plan

select plan view

-b, --bearing=BEARING

set bearing

-t, --tilt=TILT

set tilt

-s, --scale=SCALE

set scale

-n, --station-names

display station names

-c, --crosses

display crosses at stations

-B, --no-border

turn off the solid border around the edge of the survey. Printing to dot-matrix and inkjet printers can be significantly faster without this border as the printhead usually doesn't need to move all the way to the edge of the paper.

-C, --no-cutlines

If a printout takes more than one page, alignment ticks are printed where the page corners need to be joined. By default dash lines are also drawn along internal edges to facilitate trimming down the page with scissors. If you have a guillotine, the alignment ticks are sufficient for trimming the page and this option allows you to turn off the dashed lines.

-l, --no-legs

turn off display of survey legs

-S, --surface

turn on display of surface survey legs. By default only underground survey legs are shown.

-k, --skip-blanks

don't output blank pages With this option pages which are blank (apart from alignment marks and borders) will not be printed.

-o, --output=OUTPUT

set output file

Interactive Use

When you run the printer driver you will be asked if you want a plan or elevation (enter **P**, or **E**) - the default is plan. Then enter values for the desired plot view. These values correspond to those displayed in the bottom right hand corner when using Aven (or the top right when using caverot). You would usually use Aven or caverot to pick the best view and then note the angles before running the Printer Driver. This will be integrated soon.

For a plan enter bearing up the page, in degrees, 0 indicating North at the top of the page (the default).

For an elevation enter the angle of view (i.e. the compass bearing from which the scene is viewed), and angle of tilt, where 0 is horizontal, - is looking down from above, and + is looking up from below, so -90 is the same as plan view.

For an extended elevation, no viewing angles are needed.

You'll be told the scale needed to fit the plot on one page, and be asked what scale you want to use. The you're told how many pages this will take (and the arrangement of those pages (e.g. 6 pages (2x3)) and have the opportunity to print, quit, or change the scale (so you can repeat this process until you have a scale and number of pages you are happy with).

You can then print all the pages, a range of pages, or any arbitrary list of pages and ranges (handy for when your printer mangles a page).

printwin

Name

`printwin` — print `.3d` files via the Microsoft Windows printer system

Synopsis

printwin [options] {.3d file...}

Description

Printwin prints files via the MS Windows printer system. It is the recommended way to print on MS Windows.

The configuration file `print.ini`, which sets various features for each printer. See the 'Printer Settings' section for details. Even if your printer is not standard you should be able get it to work by customising one of the supplied definitions.

Options

The command line options are:

--survey=SURVEY

    Only load the sub-survey SURVEY

-e, --elevation

    select elevation

-p, --plan

    select plan view

-b, --bearing=BEARING

set bearing

-t, --tilt=TILT

set tilt

-s, --scale=SCALE

set scale

-n, --station-names

display station names

-c, --crosses

display crosses at stations

-B, --no-border

turn off the solid border around the edge of the survey. Printing to dot-matrix and inkjet printers can be significantly faster without this border as the printhead usually doesn't need to move all the way to the edge of the paper.

-C, --no-cutlines

If a printout takes more than one page, alignment ticks are printed where the page corners need to be joined. By default dash lines are also drawn along internal edges to facilitate trimming down the page with scissors. If you have a guillotine, the alignment ticks are sufficient for trimming the page and this option allows you to turn off the dashed lines.

-l, --no-legs

turn off display of survey legs

-S, --surface

turn on display of surface survey legs. By default only underground survey legs are shown.

-k, --skip-blanks

don't output blank pages With this option pages which are blank (apart from alignment marks and borders) will not be printed.

Interactive Use

When you run the printer driver you will be asked if you want a plan or elevation (enter **P**, or **E**) - the default is plan. Then enter values for the desired plot view. These values correspond to those displayed in the bottom right hand corner when using Aven (or the top right when using caverot). You would usually use Aven or caverot to pick the best view and then note the angles before running the Printer Driver. This will be integrated soon.

For a plan enter bearing up the page, in degrees, 0 indicating North at the top of the page (the default).

For an elevation enter the angle of view (i.e. the compass bearing from which the scene is viewed), and angle of tilt, where 0 is horizontal, - is looking down from above, and + is looking up from below, so -90 is the same as plan view.

For an extended elevation, no viewing angles are needed.

You'll be told the scale needed to fit the plot on one page, and be asked what scale you want to use. The you're told how many pages this will take (and the arrangement of those pages (e.g. 6 pages (2x3)) and have the opportunity to print, quit, or change the scale (so you can repeat this process until you have a scale and number of pages you are happy with).

You can then print all the pages, a range of pages, or any arbitrary list of pages and ranges (handy for when your printer mangles a page).

3dtopos

Name

`3dtopos` — produce a `.pos` file from a `.3d` file

Synopsis

3dtopos [options] {.3d file} [.pos file]

Description

3dtopos takes a `.3d` file and produces a `.pos` file which contains a list of all the stations with coordinates (ordered x,y,z [East, North, Up]) and complete names.

The stations are sorted such that numbers occur in the correct order (so "2" before "10"). 3dtopos even sorts numbers with a prefix and/or suffix, so you'd get:

```
040.sv8
040.sv8a
040.sv8b
040.sv8c
040.sv9
040.sv10
040.sv11
40_entrance_tag
40b_entrance_tag
```

cad3d

Name

`cad3d` — convert a Survex `.3d` file into formats which can be read by CAD and drawing packages

Synopsis

cad3d [options] {.3d file} [output file]

Description

Cad3d can currently output DXF or Sketch files for import into CAD packages. It can also produce Compass .plt files, which are primarily intended for importing into Carto, but can also be used with Compass itself.

An alternative to cad3d is SpeleoGen, which can be found in the "Related Tools" section of the Survex web site. SpeleoGen is a Windows (3.1/95/NT) utility which reads in Survex `.3d` files, LRUD passage wall data (in `.cav` format) and surface topography info in `.csv` format. The results are combined, displayed, and saved out as a DXF file for import into CAD or drawing packages.

diffpos

Name

`diffpos` — compare the contents of two `.3d` files

Synopsis

diffpos { .3d file} {.3d file} [threshold]

Description

Diffpos reports stations which are in one file but not the other, and also stations which have moved by more than a specified threshold distance in X, Y, or Z. The threshold distance is given in metres and defaults to 0.01m if not specified.

For backward compatibility diffpos will also read the `.pos` files produced by earlier versions of cavern, or by 3dtopos.

extend

Name

`extend` — produce an extended elevation from a `.3d` file

Synopsis

extend [--specfile configuration .espec file] { input .3d file} [output .3d file]

Description

If no specfile is given, extend starts with the highest station marked as an entrance which has at least one underground survey leg attached to it. If there are no such stations, the highest deadend station in the survey (or the highest station if there are no deadends) is used. Extend puts the first station on the left, then folds each leg out individually to the right, breaking loops arbitrarily (usually at junctions).

If the output filename is not specified, extend writes its output to `extend.3d`.

This approach suffices for simple caves or sections of cave, but for more complicated situations human intervention is required. More complex sections of cave can be handled with a specfile giving directions to switch the direction of extension between left and right, to explicitly specify the start station, or to break the extension at particular stations or legs.

The specfile is in a format similar to cavern's data format:

```
;This is a comment

; start the elevation at station entrance.a
*start entrance.a  ;this is a comment after a command

; start extending leftwards from station half-way-down.5
*eleft half-way-down.5

; change direction of extension at further-down.8
*eswap further-down.8

; extend right from further-down.junction, but only for
; the leg joining it to very-deep.1, other legs continuing
; as before
*eright further-down.junction  very-deep.1
```

```
; break the survey at station side-loop.4
*break side-loop.4

; break survey at station side-loop.junction but only
; for leg going to complex-loop.2
*break side-loop.junction complex-loop.2
```

This approach requires some trial and error, but gives useful results for many caves. The most complex systems would benefit from an interactive interface to select and view the breaks and switches of direction.

sorterr

Name

`sorterr` — re-sort .err file by various criteria

Synopsis

sorterr [options] {.err file} [how many]

Description

Sorterr re-sorts a .err file by the specified criterion (or by the error ratio by default). Output is sent to stdout, or if --replace is specified the input file is replaced with the sorted version. By default all entries in the file are included - if a second parameter is given then only the top entries after sorting are returned.

4. Survex data files

Survey data is entered in the form of text files. You can use any text editor you like for this, so long as it has the capability of writing a plain ASCII text file. The data format is very flexible; unlike some other cave surveying software, Survex does not require survey legs to be rearranged to suit the computer, and the ordering of instrument readings on each line is fully specifiable. So you can enter your data much as it appears on the survey notes, which is important in reducing the opportunities for transcription errors.

Also all the special characters are user-definable - for example, the separators can be spaces and tabs, or commas (e.g. when exporting from a spreadsheet), etc; the decimal point can be a slash (for clarity), a comma (as used in continental Europe), or anything else you care to choose. This flexibility means that it should be possible to read in data from almost any sort of survey data file without much work.

Survex places no restrictions on you in terms of the ordering of survey legs. You can enter or process data in any order and Survex will read it all in before determining how it is connected. You can also use the hierarchical naming so that you do not need to worry about using the same station name twice.

The usual arrangement is to have one file which lists all the others that are included (e.g., `161.svx`). Then **cavern 161** will process all your data. To just process a section use the filename for that section, e.g. **cavern dtime** will process the dreamtime file/section of Kaninchenhöhle. To help you out, if all legs in a survey are connected to one another but the survey has no fixed points, cavern will 'invent' a fixed point and print a warning message to this effect.

It is up to you what data you put in which files. You can have one file per trip, or per area of the cave, or just one file for the whole cave if you like. On a large survey project it makes sense to group related surveys in the same file or directory.

4.1. Readings

Blank lines (i.e. lines consisting solely of BLANK characters) are ignored. The last line in the file need not be terminated by an end of line character. All fields on a line must be separated by at least one BLANK character. An OMIT character (default '-') indicates that a field is unused. If the field is not optional, then an error is given.

4.2. Survey Station Names

Survex has a powerful system for naming stations. It uses a hierarchy of survey names, similar to the nested folders your computer stores files in. So point 6 in the entrance survey of Kaninchenhöhle (cave number 161) is referred to as: 161.entrance.6

This seems a natural way to refer to station names. It also means that it is very easy to include more levels, for example if you want to plot all the caves in the area you just list them all in another file, specifying a new prefix. So to group 3 nearby caves on the Loser Plateau you would use a file like this:

```
*begin Loser
*include 161
*include 2YrGest
*include 145
*end Loser
```

The entrance series point mentioned above would now be referred to as: Loser.161.entrance.6

You do not have to use this system at all, and can just give all stations unique identifiers if you like:

1, 2, 3, 4, 5, ... 1381, 1382

or

AA06, AA07, P34, ZZ6, etc.

Station and survey names may contain any alphanumeric characters and additionally any characters in NAMES (default '_' and '-'). Alphabetic characters may be forced to upper or lower case by using the *case command. Station names may be any length - if you want to only treat the first few characters as significant you can get cavern to truncate the names using the *truncate command.

4.3. Numeric fields

[<MINUS>|<PLUS>] <integer part> [<DECIMAL> [<decimal fraction>]]

or [<MINUS>|<PLUS>] <DECIMAL> <dec fraction>

i.e. optional PLUS or MINUS sign in front, with optional DECIMAL character (default '.'), which may be embedded, leading or trailing. No spaces are allowed between the various elements.

All of these are valid examples: +47, 23, -22, +4.5, 1.3, -0.7, +.15, .4, -.05

4.4. Accuracy

Accuracy assessments may be provided or defaulted for any survey leg. These determine the distribution of loop closure errors over the legs in the loop. See *SD for more information.

4.5. Cavern Commands

Commands in `.svx` files are introduced by an asterisk (by default - this can be changed using the **set** command).

The commands are documented in a common format:

- Command Name
- Syntax
- Example
- Validity
- Description
- Caveats
- See Also

4.5.1. BEGIN

Syntax

*begin [<survey>]

Example

```
*begin littlebit
1 2 10.23 106 -02
2 3  1.56 092 +10
*end littlebit

; length of leg across shaft estimated
*begin
*sd tape 2 metres
9 10 6.   031 -07
*end
```

Description

*begin stores the current values of the current settings such as instrument calibration, data format, and so on. These stored values are restored after the corresponding *end. If a survey name is given, this is used inside the *begin/*end block, and the corresponding *end should have the same survey name. *begin/*end blocks may be nested to indefinite depth.

See Also

*end, *prefix

4.5.2. CALIBRATE

Syntax

*calibrate <quantity list> <zero error> [<scale>]

*calibrate default

Example

```
*calibrate tape +0.3
```

Description

*calibrate is used to specify instrument calibrations.

<quantity> is one of TAPE|COMPASS|CLINO|COUNTER|DEPTH|DECLINATION|X|Y|Z

Several quantities can be given in <quantity list>

Value = (Reading - ZeroError) * Scale (Scale defaults to 1.0)

You need to be careful about the sign of the ZeroError. The value of ZeroError is what the the instrument would read when measuring a reading which should be zero. So for example, if your tape measure has the end missing, and you are using the 30cm mark to take all measurements from, then a zero distance would be measured as 30cm and you would correct this with:

```
*CALIBRATE tape +0.3
```

If you tape was too long, starting at -20cm (it does happen!) then you can correct it with:

```
*CALIBRATE tape -0.2
```

Note: ZeroError is irrelevant for Topofil counters and depth gauges since pairs of readings are subtracted.

The magnetic deviation varies from year to year and it is often desirable to keep the compass zero error and the magnetic deviation separate. cavern calculates the true bearing as follows:

(magnetic bearing) = ((reading)-(compass zero err)) * (compass scale factor)

(true bearing) = ((bearing)-(declination zero err))

The scale factor for DECLINATION must be 1.0, otherwise an error is given.

The default is all quantities calibrated to scale factor 1.0, zero error 0.0

See Also

*units

4.5.3. CASE

Syntax

*case preserve|toupper|tolower

Example

```
*begin bobsbit
; Bob insists on using case sensitive station names
*case preserve
1 2   10.23 106 -02
2 2a   1.56 092 +10
2 2A   3.12 034 +02
2 3    8.64 239 -01
*end bobsbit
```

Description

*case determines how the case of letters in survey names is handled. By default all names are forced to lower case (which gives a case insensitive match, but you can tell cavern to force to upper case, or leave the case as is (in which case ’2a’ and ’2A’ will be regarded as different).

4.5.4. COPYRIGHT

Syntax

*copyright <date> <text>

Example

```
*begin littlebit
*copyright 1983 CUCC
1 2 10.23 106 -02
2 3  1.56 092 +10
*end littlebit
```

Validity

valid at the start of a *begin/*end block.

Description

*copyright allow the copyright information to be stored in a way that can be automatically collated.

See Also

*begin

4.5.5. DATA

Syntax

*data <style> <ordering>

Example

```
*data normal from to compass tape clino

*data normal station ignoreall newline compass tape clino
```

Description

<style> = DEFAULT|NORMAL|DIVING|CARTESIAN|TOPOFIL|CYLPOLAR|NOSURVEY

<ordering> = ordered list of instruments - which are valid depends on the style.

In Survex 1.0.2 and later, TOPOFIL is simply a synonym for NORMAL, left in to allow older data to be processed without modification. Use the name NORMAL by preference.

There are two variants of each style - interleaved and non-interleaved. Non-interleaved is "one line per leg", interleaved has a line for the data shared between two legs (e.g. STATION=FROM/TO, DEPTH=FROMDEPTH/TODEPTH, COUNT=FROMCOUNT/TOCOUNT). Note that not all interleavable readings have to be interleaved - for example:

```
*data diving station newline fromdepth compass tape todepth
```

In addition, interleaved data can have a DIRECTION reading, which can be "F" for a foresight or "B" for a backsight.

In NORMAL, DIVING, and CYLPOLAR data styles, TAPE may be replaced by FROMCOUNT/TOCOUNT (or COUNT in interleaved data) to allow processing of surveys performed with a Topofil instead of a tape.

DEFAULT

Select the default data style and ordering (NORMAL style, ordering: from to tape compass clino).

NORMAL

The usual tape/compass/clino centreline survey. For non-interleaved data the allowed readings are: FROM TO TAPE COMPASS CLINO BACKCOMPASS BACKCLINO; for interleaved data the allowed readings are: STATION DIRECTION TAPE COMPASS CLINO BACKCOMPASS BACKCLINO. The CLINO/BACKCLINO reading is not required - if it's not given, the vertical standard deviation is taken to be proportional to the tape measurement. Alternatively, individual clino readings can be given as OMIT (default "-") which allows for data where only some clino readings are missing. E.g.:

```
*data normal from to compass clino tape
1 2 172 -03 12.61
```

```
*data normal station newline direction tape compass clino
1
 F 12.61 172 -03
2
```

```
*data normal from to compass clino fromcount tocount
1 2 172 -03 11532 11873
```

```
*data normal station count newline direction compass clino
1 11532
 F 172 -03
2 11873
```

DIVING

An underwater survey where the vertical information is from a diver's depth gauge. This style can also be also used for an above water where the alititude is measured with an altimeter. DEPTH is defined as the altitude (Z) so increases upwards by default. So for a diver's depth guage, you'll need to use *CALIBRATE with a negative scale factor (e.g. *calibrate depth 0 -1).

For non-interleaved data the allowed readings are: FROM TO TAPE COMPASS BACKCOMPASS FROMDEPTH TODEPTH DEPTHCHANGE (the vertical can be given as readings at each station, (FROMDEPTH/TODEPTH) or as a change along the leg (DEPTHCHANGE)).

For interleaved data the allowed readings are: STATION DIRECTION TAPE COMPASS BACKCOMPASS DEPTH DEPTHCHANGE. (the vertical change can be given as a reading at the station (DEPTH) or as a change along the leg (DEPTHCHANGE)).

```
*data diving from to tape compass fromdepth todepth
1 2 14.7 250 -20.7 -22.4
```

```
*data diving station depth newline tape compass
1 -20.7
 14.7 250
2 -22.4
```

```
*data diving from to tape compass depthchange
1 2 14.7 250 -1.7
```

CARTESIAN

Cartesian data style allows you to specify the (x,y,z) changes between stations. It's useful for digitising surveys where the original survey data has been lost and all that's available is a drawn up version.

```
*data cartesian from to northing easting altitude
1 2 16.1 20.4 8.7
```

```
*data cartesian station newline northing easting altitude
1
 16.1 20.4 8.7
2
```

Cartesian data are relative to *true* North not *magnetic* North (i.e. they are unaffected by ***calibrate declination**).

CYLPOLAR

A CYLPOLAR style survey is very similar to a diving survey, except that the tape is always measured horizontally rather than along the slope of the leg.

```
*data cypolar from to tape compass fromdepth todepth
1 2 9.45 311 -13.3 -19.0
```

```
*data cylpolar station depth newline tape compass
1 -13.3
 9.45 311
2 -19.0
```

```
*data cylpolar from to tape compass depthchange
1 2 9.45 311 -5.7
```

NOSURVEY

A NOSURVEY survey doesn't have any measurements - it merely indicates that there is line of sight between the pairs of stations.

```
*data nosurvey from to
1 7
5 7
9 11
```

```
*data nosurvey station
1
7
5

*data nosurvey station
9
11
```

IGNORE skips a field (it may be used any number of times), and IGNOREALL may be used last to ignore the rest of the data line.

LENGTH is a synonym for TAPE; BEARING for COMPASS; GRADIENT for CLINO; COUNT for COUNTER.

The units of each quantity may be set with the UNITS command.

4.5.6. DATE

Syntax

*date <year>[.<month>[.<day>]][-<year>[.<month>[.<day>]]]

Example

```
*date 2001

*date 2000.10

*date 1987.07.27

*date 1985.08.12-1985.08.13
```

Validity

valid at the start of a *begin/*end block.

Description

*date specifies the date that the survey was done. A range of dates can be specified (useful for overnight or multi-day surveying trips).

See Also

*begin, *instrument, *team

4.5.7. DEFAULT

Syntax

*default <settings list>|all

Description

The valid settings are CALIBRATE, DATA, and UNITS.

*default restores defaults for given settings. This command is deprecated - you should instead use: *calibrate default, *data default, *units default.

See Also

*calibrate, *data, *units

4.5.8. END

Syntax

*end [<survey>]

Validity

valid for closing a block started by *begin in the same file.

Description

Closes a block started by *begin.

See Also

*begin

4.5.9. ENTRANCE

Syntax

*entrance <station>

Example

```
*entrance P163
```

Description

*entrance sets the *entrance* flag for a station. This information is used by aven to allow entrances to be highlighted.

4.5.10. EQUATE

Syntax

*equate <station> <station>...

Example

```
*equate chosspot.1 triassic.27
```

Description

*equate specifies that the station names in the list refer to the same physical survey station. An error is given if there is only one station listed.

See Also

*infer equates

4.5.11. EXPORT

Syntax

*export <station>...

Example

```
*export 1 6 17
```

Validity

valid at the start of a *begin/*end block.

Description

*export marks the stations named as referable to from the enclosing survey. To be able to refer to a station from a survey several levels above, it must be exported from each enclosing survey.

See Also

*begin, *infer exports

4.5.12. FIX

Syntax

*fix <station> [reference] [<x> <y> <z> [<x std err> <y std err> <z std err> [<cov(x,y)> <cov(y,z)> <cov(z,x)>]]]

Example

```
*fix entrance.0 32768 86723 1760
*fix KT114_96 reference 36670.37 83317.43 1903.97
```

Description

*fix fixes the position of <station> at the given coordinates. If the position is omitted it defaults to (0,0,0). The standard errors default to zero (fix station exactly). cavern will give an error if you attempt to fix the same survey station twice at different coordinates, or a warning if you fix it twice with matching coordinates.

You can also specify just one standard error (in which case it is assumed equal in X, Y, and Z) or two (in which case the first is taken as the standard error in X and Y, and the second as the standard error in Z).

If you have covariances for the fix, you can also specify these - the order is cov(x,y) cov(y,z) cov(z,x).

You can fix as many stations as you like - just use a *fix command for each one. Cavern will check that all stations are connected to at least one fixed point so that co-ordinates can be calculated for all stations.

By default cavern will warn about stations which have been FIX-ed but not used otherwise. This is unhelpful if you want to include a standard file of benchmarks, some of which won't be used. In this sort of situation, specify "REFERENCE" after the station name in the FIX command to suppress this warning for a particular station.

> X is Easting, Y is Northing, and Z is altitude. This convention was chosen since on a map, the horizontal (X) axis is usually East, and the vertical axis (Y) North. The choice of altitude (rather than depth) for Z is taken from surface maps, and makes for less confusion when dealing with cave systems with more than one entrance. It also gives a right-handed set of axes.

4.5.13. FLAGS

Syntax

*flags <flags>

Example

```
*flags duplicate not surface
```

Description

*flags updates the current flag settings. Flags not mentioned retain their previous state. Valid flags are DUPLICATE, SPLAY, and SURFACE, and a flag may be preceded with NOT to turn it off.

Survey legs marked SURFACE are hidden from plots by default, and not included in cave survey length calculations. Survey legs marked as DUPLICATE or SPLAY are also not included in cave survey length calculations; legs marked SPLAY are ignored by the extend program. DUPLICATE is intended for the case when if you have two different surveys along the same section of passage (for example to tie two surveys into a permanent survey station); SPLAY is intended for cases such as radial legs in a large chamber.

See Also

*begin

4.5.14. INCLUDE

Syntax

*include <filename>

Example

```
*include mission
*include "the pits"
```

Description

*include processes <filename> as if it were inserted at this place in the current file. (i.e. The current settings are carried into <filename>, and any alterations to settings in <filename> will be carried back again). There's one exception to this (for obscure historical reasons) which is that the survey prefix is restored upon return to the original file. Since *begin and *end nesting cannot cross files, this can only make a difference if you use the deprecated *prefix command.

If <filename> contains spaces, it must be enclosed in quotes.

An included file which does not have a complete path is resolved relative to the directory which the parent file is in (just as relative HTML links do). Cavern will try adding a `.svx` extension, and will also try translating "\" to "/" (or other appropriate tricks on RISC OS). And as a last resort, it will try a lower case version of the filename (so if you use Unix and someone sends you a DOS/Windows dataset with mismatched case, unzip it with "unzip -L" and unix cavern will process it).

The depth to which you can nest include files may be limited by the operating system you use. Usually the limit is fairly high (>30), but if you want to be able to process your dataset with Survex on any supported platform, it would be prudent not to go overboard with nested include files.

4.5.15. INFER

Syntax

*infer plumbs on|off

*infer equates on|off

*infer exports on|off

Description

"*infer plumbs on" tells cavern to interpret gradients of +/- 90 degrees as UP/DOWN (so it will not apply the clino correction to them). This is useful when the data has not been converted to have UP and DOWN in it.

"*infer equates on" tells cavern to interpret a leg with a tape reading of zero as a *equate. this prevents tape corrections being applied to them.

"*infer exports on" is necessary when you have a dataset which is partly annotated with *export. It tells cavern not to complain about missing *export commands in part of the dataset. Also stations which were used to join surveys are marked as exported in the 3d file.

4.5.16. INSTRUMENT

Syntax

<p>

*instrument <instrument> <identifier>

Example

```
*instrument compass "CUCC 2"
*instrument clino "CUCC 2"
*instrument tape "CUCC Fisco Ranger open reel"
```

Validity

valid at the start of a *begin/*end block.

Description

*instrument specifies the particular instruments used to perform a survey.

See Also

*begin, *date, *team

4.5.17. PREFIX

Syntax

*prefix <survey>

Example

```
*prefix flapjack
```

Description

*prefix sets the current survey.

Caveats

*prefix is deprecated - you should use *begin and *end instead.

See Also

*begin, *end

4.5.18. REQUIRE

Syntax

*require <version>

Example

```
*require 0.98
```

Description

*require checks that the version of cavern in use is at least <version> and stops with an error if not. So if your dataset requires a feature introduced in a particular version, you can add a *require command and users will know what version they need to upgrade to, rather than getting an error message and having to guess what the real problem is.

4.5.19. SD

Syntax

*sd <quantity list> <standard deviation>

Example

```
*sd tape 0.15 metres
```

Description

*sd sets the standard deviation of a measurement.

<quantity> is one of TAPE|COMPASS|CLINO|COUNTER|DEPTH|DECLINATION|DX|DY|DZ

<standard deviation> must include units and thus is typically "0.05 metres", or "0.02 degrees". See *units below for full list of valid units.

To utilise this command fully you need to understand what a *standard deviation* is. It gives a value to the 'spread' of the errors in a measurement. Assuming that these are normally distributed we can say that 95.44% of the actual lengths will fall within two standard deviations of the measured length. i.e. a tape SD of 0.25 metres means that the actual length of a tape measurement is within + or - 0.5 metres of the recorded value 95.44% of the time. So if the measurement is 7.34m then the actual length is very likely to be between 6.84m and 7.84m. This example corresponds to BCRA grade 3. Note that this is just one interpretation of the BCRA standard, taking the permitted error values as 2SD 95.44% confidence limits. If you want to take the readings as being some other limit (e.g. 1SD = 68.26%) then you will need to change the BCRA3 and BCRA5 files accordingly. This issue is explored in more detail in various surveying articles.

See Also

*units

4.5.20. SET

Syntax

*set <item> <character list>

Example

```
*set blank x09x20
*set decimal ,
```

Note that you need to eliminate comma from being a blank before setting it as a decimal - otherwise the comma in "*set decimal ," is parsed as a blank, and you set decimal to not have any characters representing it.

Description

*set sets the specified <item> to the character or characters given in <character list>. The example sets the decimal separator to be a comma.

xAB means the character with hex value AB. Eg x20 is a space.

The complete list of items that can be set, the defaults (in brackets), and the meaning of the item, is:

- BLANK (x09x20,) Separates fields
- COMMENT (;) Introduces comments
- DECIMAL (.) Decimal point character
- EOL (x0Ax0D) End of line character
- KEYWORD (*) Introduces keywords
- MINUS (-) Indicates negative number
- NAMES (_-) Non-alphanumeric chars permitted in station names (letters and numbers are always permitted).
- OMIT (-) Contents of field omitted (e.g. in plumbed legs)
- PLUS (+) Indicates positive number
- ROOT (\) Prefix in force at start of current file (use of ROOT is deprecated)
- SEPARATOR (.) Level separator in prefix hierarchy

The special characters may not be alphanumeric.

4.5.21. SOLVE

Syntax

*solve

Example

```
*include 1997data
*solve
*include 1998data
```

Description

Distributes misclosures around any loops in the survey and fixes the positions of all existing stations. This command is intended for situations where you have some new surveys adding extensions to an already drawn-up survey which you wish to avoid completely redrawing. You can read in the old data, use *SOLVE to fix it, and then read in the new data. Then old stations will be in the same positions as they are in the existing drawn up survey, even if new loops have been formed by the extensions.

4.5.22. TEAM

Syntax

*team <person> <role>...

Example

```
*team "Nick Proctor" compass clino tape
*team "Anthony Day" notes pictures tape
```

Validity

valid at the start of a *begin/*end block.

Description

*team specifies the people involved in a survey and what role they filled during that trip.

See Also

*begin, *date, *instrument

4.5.23. TITLE

Syntax

*title <title>

Example

```
*title Dreamtime
```

```
*title "Mission Impossible"
```

Description

*title allows you to set the descriptive title for a survey. If the title contains spaces, you need to enclose it in quotes (""). If there is no *title command, the title defaults to the survey name given in the *begin command.

4.5.24. TRUNCATE

Syntax

*truncate <length>|off

Description

Station names may be of any length in Survex, but some other (mostly older) cave surveying software only regard the first few characters of a name as significant (e.g. "entran" and "entrance" might be treated as the same). To facilitate using data imported from such a package Survex allows you to truncate names to whatever length you want (but by default truncation is off).

Figures for the number of characters which are significant in various software packages: Compass currently has a limit of 12, CMAP has a limit of 6, Surveyor87/8 used 8. Survex itself used 8 per prefix level up to version 0.41, and 12 per prefix level up to 0.73 (more recent versions removed this rather archaic restriction).

4.5.25. UNITS

Syntax

*units <quantity list> [<factor>] <unit>

*units default

Example

```
*units tape metres

*units compass backcompass clino backclino grads

*units dx dy dz 1000 metres ; data given as kilometres
```

Description

<quantity> is one of
TAPE|LENGTH|COMPASS|BEARING|CLINO|GRADIENT|COUNTER|DEPTH|DECLINATION|X|Y|Z

Changes current units of all the quantities listed to [<factor>] <unit>. Note that quantities can be expressed either as the instrument (e.g. COMPASS) or the measurement (e.g. BEARING).

<factor> allows you to easy specify situations such as measuring distance with a diving line knotted every 10cm (*units distance 0.1 metres). If <factor> is omitted it defaults to 1.0. If specified, it must be non-zero.

Valid units for listed quantities are:

TAPE, LENGTH, COUNTER, COUNT, DEPTH, dX, dY, dZ in
YARDS|FEET|METRIC|METRES|METERS

CLINO, BACKCLINO, GRADIENT, BACKGRADIENT in
DEG|DEGREES|GRADS|MILS|PERCENT|PERCENTAGE

COMPASS, BACKCOMPASS, BEARING, BACKBEARING, DECLINATION in DEG|DEGREES|GRADS|MILS|MINUTES

(360 degrees = 400 grads (also known as Mils))

Defaults are: Metres, Degrees, Degrees respectively.

See Also

*calibrate

5. Contents of `.svx` files: How do I?

Here is some example Survex data (a very small cave numbered 1623/163):

```
2 1 26.60 222  17.5
2 3 10.85 014   7
2 4  7.89 254 -11
4 5  2.98  - DOWN
5 6  9.29 271 -28.5
```

You can vary the data ordering. The default is:

from-station to-station tape compass clino

This data demonstrates a number of useful features of Survex:

Legs can be measured either way round, which allows the use of techniques like "leap-frogging" (which is where legs alternate forwards and backwards).

Also notice that there is a spur in the survey (2 to 3). You do not need to specify this specially.

Survex places few restrictions on station naming (see "Survey Station Names" in the previous section), so you can number the stations as they were in the original survey notes. Although not apparent from this example, there is no requirement for each leg to connect to an existing station. Survex can accept data in any order, and will check for connectedness once all the data has been read in.

Each survey is also likely to have other information associated with it, such as instrument calibrations, etc. This has been omitted from this example to keep things simple.

Most caves will take more than just one survey trip to map. Commonly the numbering in each survey will begin at 1, so we need to be able to tell apart stations with the same number in different surveys.

To accomplish this, Survex has a very flexible system of hierarchical prefixes. All you need do is give each survey a unique name or number, and enter the data like so:

```
*begin 163
*export 1
2 1 26.60 222  17.5
2 3 10.85 014   7
2 4  7.89 254 -11
4 5  2.98  - DOWN
5 6  9.29 271 -28.5
*end 163
```

Survex will name the stations by attaching the current prefix. In this case, the stations will be named 163.1, 163.2, etc.

We have a convention with the CUCC Austria data that the entrance survey station of a cave is named P<cave number>, P163 in this case. We can accomplish this like so:

```
*equate P163 163.1
*entrance P163
*begin 163
*export 1
2 1 26.60 222  17.5
2 3 10.85 014   7
2 4  7.89 254 -11
4 5  2.98  - DOWN
5 6  9.29 271 -28.5
*end 163
```

5.1. Specify surface survey data

Say you have 2 underground surveys and 2 surface ones with 2 fixed reference points. You want to mark the surface surveys so that their length isn't included in length statistics, and so that Aven knows to display them differently. To do this you mark surface data with the "surface" flag - this is set with "*flags surface" like so:

```
; fixed reference points
*fix fix_a 12345 56789 1234
*fix fix_b 23456 67890 1111

; surface data (enclosed in *begin ... *end to stop the *flags command
; from "leaking" out)
*begin
*flags surface
*include surface1
*include surface2
*end

; underground data
*include cave1
*include cave2
```

You might also have a survey which starts on the surface and heads into a cave. This can be easily handled too - here's an example which goes in one entrance, through the cave, and out of another entrance:

```
*begin BtoC
*title "161b to 161c"
*date 1990.08.06 ; trip 1990-161c-3 in 1990 logbook

*begin
*flags surface
```

```
02    01       3.09   249    -08.5
02    03       4.13   252.5  -26
*end

04    03       6.00   020    +37
04    05       3.07   329    -31
06    05       2.67   203    -40.5
06    07       2.20   014    +04
07    08       2.98   032    +04
08    09       2.73   063.5  +21
09    10      12.35   059    +15

*begin
*flags surface
11    10       4.20   221.5  -11.5
11    12       5.05   215    +03.5
11    13       6.14   205    +12.5
13    14      15.40   221    -14
*end

*end BtoC
```

Note that to avoid needless complication, Survex regards each leg as being either "surface" or "not surface" - if a leg spans the boundary you'll have to call it one or the other. It's good surveying practice to deliberately put a station at the surface/underground interface (typically the highest closed contour or drip line) so this generally isn't an onerous restriction.

5.2. Specify the ordering and type of data

The *DATA command is used to specify the data style, and the order in which the readings are given.

5.3. Deal with Plumbs or Legs Across Static Water

Plumbed legs should be given using 'UP' or 'DOWN' in place of the clino reading and a dash (or a different specified 'OMIT' character) in place of the compass reading. This distinguishes them from legs measured with a compass and clino. Here's an example:

```
1 2 21.54 - UP
3 2 7.36 017 +17
3 4 1.62 091 +08
5 4 10.38 - DOWN
```

U/D or +V/-V may be used instead of UP/DOWN; the check is not case sensitive.

Legs surveyed across the surface of a static body of water where no clino reading is taken (since the surface of the water can be assumed to be flat) can be indicated by using LEVEL in place of a clino reading. This prevents the clino correction being applied. Here's an example:

```
1 2 11.37 190 -12
3 2  7.36 017 LEVEL
```

```
3 4  1.62 091 LEVEL
```

5.4. Specify a BCRA grade

The *SD command can be used to specify the standard deviations of the various measurements (tape, compass, clino, etc). Examples files are supplied which define BCRA Grade 3 and BCRA Grade 5 using a number of *sd commands. You can use these by simply including them at the relevant point, as follows:

```
*begin somewhere
; This survey is only grade 3
*include grade3
2 1 26.60 222  17.5
2 3 10.85 014   7
; etc
*end somewhere
```

The default values for the standard deviations are those for BCRA grade 5. Note that it is good practice to keep the *include Grade3 within *Begin and *End commands otherwise it will apply to following survey data, which may not be what you intended.

5.5. Specify different accuracy for a leg

For example, suppose the tape on the plumbed leg in this survey is suspected of being less accurate than the rest of the survey because the length was obtained by measuring the length of the rope used to rig the pitch. We can set a higher sd for this one measurement and use a *begin/*end block to make sure this setting only applies to the one leg:

```
2 1 26.60 222  17.5
2 3 10.85 014   7
2 4  7.89 254 -11
*begin
; tape measurement was taken from the rope length
*sd tape 0.5 metres
4 5  34.50 - DOWN
*end
5 6  9.29 271 -28.5
```

5.6. Enter Radiolocation Data

This is done by using the *SD command to specify the appropriate errors for the radiolocation ‘survey leg’ so that the loop closure algorithm knows how to distribute errors if it forms part of a loop.

The best approach for a radiolocation where the underground station is vertically below the surface station is to represent it as a plumbed leg, giving suitable SDs for the length and plumb angle. The horizontal positioning of this is generally quite accurate, but the vertical positioning may be much less well known. E.g: we have a radiolocation of about 50m depth +/- 20m and horizontal accuracy of +/- 8m. Over 50m the +/-8m is equivalent to an angle of 9 degrees, so that is the expected plumb error. 20m is the expected error in the length. To get the equivalent SD we assume that 99.74% of readings will be within 3 standard deviations of the error value. Thus we divide the expected errors by 3 to get the SD we should specify:

```
*begin
*sd length 6.67 metres
*sd plumb 3 degrees
surface underground 50 - down
*end
```

We wrap the radiolocation leg in a *begin/*end block to make sure that the special *sd settings only apply to this one leg.

For more information on the expected errors from radiolocations see Compass Points Issue 10, available online at http://www.chaos.org.uk/survex/cp/CP10/CPoint10.htm

5.7. Enter Diving Data

Surveys made underwater using a diver's depth gauge can be processed - use the *Data command to specify that the following data is of this type.

5.8. Enter Theodolite data

Theodolite data with turned angles is not yet explicitly catered for, so for now you will need to convert it into equivalent legs in another style - normal or cylpolar are likely to be the best choices.

If there is no vertical info in your theodolite data then you should use the cylpolar style and use *sd command to specify very low accuracy (high SD) in the depth so that the points will move in the vertical plane as required if the end points are fixed or the survey is part of a loop.

6. General: How do I?

6.1. Create a new survey

You simply create a text file containing the relevant survey data, using a text editor, and save it with a suitable name with a `.svx` extension. The easiest way is to look at some of the example data and use that as a template. Nearly all surveys will need a bit of basic info as well as the survey data itself: e.g. the date (*date), comments about where, what cave, a name for the survey (using *begin and *end), instrument error corrections etc. Here is a typical survey file:

All the lines starting with ';' are comments, which are ignored by Survex. You can also see the use of 'DOWN' for plumbs, and *calibrate tape for dealing with a tape length error (in this case the end of the tape had fallen off so measurements were made from the 20cm point).

```
*equate chaos.1 triassic.pt3.8
*equate chaos.2 triassic.pt3.9
```

```
*begin chaos
*title "Bottomless Pit of Eternal Chaos to Redemption pitch"
*date 1996.07.11
*team "Nick Proctor" compass clino tape
*team "Anthony Day" notes pictures tape
*instrument compass "CUCC 2"
*instrument clino "CUCC 2"
;Calibration: Cairn-Rock 071 072 071,  -22 -22 -22
;       Rock-Cairn 252 251 252,  +21 +21 +21
;Calibration at 161d entrance from cairn nr entrance to
;prominent rock edge lower down. This is different from
;calibration used for thighs survey of 5 July 1996

*export 1 2

;Tape is 20cm too short
*calibrate tape +0.2

1 2 9.48 208 +08
2 3 9.30 179 -23
3 4 2.17 057 +09
5 4 10.13 263 +78
5 6 2.10 171 -73
7 6 7.93 291 +75
*begin
*calibrate tape 0
8 7 35.64 262 +86 ;true length measured for this leg
*end
8 9 24.90 - DOWN
10 9 8.61 031 -43
10 11 2.53 008 -34
11 12 2.70 286 -20
13 12 5.36 135 +23
14 13 1.52 119 -12
15 14 2.00 036 +13
16 15 2.10 103 +12
17 16 1.40 068 -07
17 18 1.53 285 -42
19 18 5.20 057 -36
19 20 2.41 161 -67
20 21 27.47 - DOWN
21 22 9.30 192 -29
*end chaos
```

6.2. Join surveys together

Once you have more than one survey you need to specify how they link together. To do this use *export to make the stations to be joined accessible in the enclosing survey, then *equate in the enclosing survey to join them together.

6.3. Organise my surveys

This is actually a large subject. There are many ways you can organise your data using Survex. Take a look at the example dataset for some ideas of ways to go about it.

6.3.1. Fixed Points (Control Points)

The *fix command is used to specify fixed points (also know as control points). See the description of this command in the "Cavern Commands" section of this manual.

6.3.2. More than one survey per trip

Suppose you have two separate bits of surveying which were done on the same trip. So the calibration details, etc. are the same for both. But you want to give a different survey name to the two sections. This is easily achieved like so:

```
*begin
*calibrate compass 1.0
*calibrate clino 0.5
*begin altroute
; first survey
*end altroute
*begin faraway
; second survey
*end faraway
*end
```

6.4. Add surface topology

We intend to allow import of terrain data in DEM format, and also any other formats in common use. But at present the simplest approach is to generate a `.svx` file with the surface mesh in and display it with the survey data.

It is possible to generate a mesh or contours overlaying your area by various means. In the USA, usable resolution data can be obtained for free. In other countries, it’s harder to come by. Reading heights from the contours on a map is one approach. It’s laborious, but feasible for a small area.

Details of several methods are given in the BCRA Cave Surveying Group magazine Compass Points issue 11, available online at http://www.chaos.org.uk/survex/cp/CP11/CPoint11.htm#Art_5

If you’re using another program to generate a `.svx` file for the surface mesh, it’s best to use the NOSURVEY data style. Simply fix all the grid intersections at the correct coordinates and height, and put legs between them using the NOSURVEY style. Here’s a grid of 4 squares and 9 intersections:

```
*fix 00 000 000 1070
*fix 01 000 100 1089
*fix 02 000 200 1093

*fix 10 100 000 1062
```

```
*fix 11 100 100 1080
*fix 12 100 200 1089

*fix 20 200 000 1050
*fix 21 200 100 1065
*fix 22 200 200 1077

*data nosurvey station

00
01
02

10
11
12

20
21
22

00
10
20

01
11
21

02
12
22
```

This is far simpler than trying to create fake tape/compass/clino legs of the right length for each line in the mesh. It's also very fast to process with cavern.

SpeleoGen can also help with this process if you want final output in DXF form. See the 'Related Tools' section of the Survex website for download links.

6.5. Overlay a grid

Aven is able to display a grid, but this functionality isn't currently available in caverot, xcaverot, or the printer drivers. You can achieve a similar effect for now by creating a `.svx` file where the survey legs form a grid.

6.6. Import data from other programs

Survex supports a number of features to help with importing existing data. You can specify the ordering of items on a line using *Data (see Survex Keywords above), and you can specify the characters used to mean different things using *Set (see Survex Keywords above).

The Ignore and Ignoreall options to the *Data command are often particularly useful, e.g. if you have a dataset with LRUD info or comments on the ends of lines.

6.6.1. Changing Meanings of Characters

e.g. if you have some data with station names containing the characters '?' and '+' (which are not permitted in a name by default) then the command:

```
*SET NAMES ?+
```

specifies that question marks and plus signs are permitted in station names. A-Z, a-z, and 0-9 are always permitted. '_' and '-' are also permitted by default, but aren't in this example.

If your data uses a comma ',' instead of a decimal point, then you use

```
*SET BLANK x09x20
*SET DECIMAL ,
```

to specify that ',' is no longer a blank character, and is now the decimal separator instead of '.'.

6.7. Export data from Survex

See Rosetta Stal in the Related Tools section of the Survex web site. This is a utility written by Taco van Ieperen and Gary Petrie. Note though that this only supports a subset of the svx format, and only work on Microsoft Windows. The Survex support is limited and doesn't understand the more recently added commands.

6.8. See errors and warnings that have gone off the screen

When you run Survex it will process the specified survey data files in order, reporting any warnings and errors. If there are no errors, the output files are written and various statistics about the survey are displayed. If there are a lot of warnings or errors, they can scroll off the screen and it's not always possible to scroll back to read them.

The easiest way to see all the text is to use **cavern --log** to redirect output to a `.log` file, which you can then inspect with a text editor.

6.9. Create an Extended Elevation

Use the Extend program. This takes `.3d` files and 'flattens' them. See 'Extend' for details.

7. Working with Larry Fish's Compass

Survex can read Compass survey data - both raw data (.DAT and .MAK files) and processed survey data (.PLT and .PLF files). You can even use ***include compassfile.dat** in a `.svx` file and it'll work!

One point to note (this tripped us up!): station names in DAT files are case sensitive and so Survex reads DAT files with the equivalent of ***case preserve**. The default in SVX files is ***case lower**. So this won't work:

```
*fix CE1 0 0 0
*include datfilewhichusesCE1.dat
```

Because the CE1 in the *fix is actually interpreted as ce1. This is what you have to do:

```
*begin
*case preserve
*fix CE1 0 0 0
*include datfilewhichusesCE1.dat
*end
```

8. Mailing List

The best way to contact the authors and other Survex users is the Survex mailing list - for details visit: http://survex.com/maillist.html

We'd be delighted to hear how you get on with Survex and welcome comments and suggestions for improvements.

And we'd love you to contribute your skills to help make Survex even better. Point out areas of the documentation which could be made clearer, or sections which are missing entirely. Download test releases, try them out, and let us know if you find problems or have suggestions for improvements. If there's no translation to your language, you could provide one. Or if your a developer, *"Say it with code"*. There's plenty to do, so feel free to join in.

9. Future Developments

Now that Survex has reached version 1.0, we are continuing progress towards version 2, in a series of steps, evolving out of Survex 1.0. The GUI framework is being based on aven, with the printer drivers and other utility programs being pulled in and integrated into the menus.

Aven is built on wxWidgets, which means that it can easily support Unix, Microsoft Windows, and Mac OS X.

More information on our plans is on the web site (http://survex.com/).