

The Shetland Attack Pony

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Abstract

The Shetland Attack Pony (SAP) is an electronic compass and clinometer, designed for use in surveying caves. It is accurate to within a degree, and produces loop-closure errors that are usually slightly better than those obtained using traditional instruments (i.e. tape measure, sighting compass and clinometer). It is able to store information for some 2000 legs. It has an integral lithium polymer rechargeable battery, and is recharged through a mini-USB socket. It is also possible to retrieve data and adjust the settings via the USB cable. This article assumes that the reader is familiar with standard cave surveying techniques.

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1 Safety Note

This device contains a laser. While it is a low power device and is theoretically safe under normal usage conditions (exposure for less than 0.25s - human blink reflex time), it is strongly advised not to look directly into the beam. For this reason it is also recommended that, where possible, the person indicating the "to" station does so at arms length.

2 Basic Usage

2.1 Turning it on and off

To turn on the SAP, press the button twice in quick succession (this is to prevent it turning on accidentally in transport). To turn it off, press the button briefly (holding it down will record a leg). Also the

device will turn itself off after a minute of inaction. Note that the device will be unresponsive for 2 seconds after it has turned off.

2.2 General Use

You should see a bright red dot - this is your aiming point. The SAP measures the angle between the aiming point and the tip of the brass ring. The display will also light up, and will alternate between showing the compass bearing (e.g. 045, 210, 359), and the clino reading (e.g. +10, -05, +22); changing every 1/2 second or so. Note that the clino reading is always prefixed by a sign (+ or -), whereas the compass reading has no sign, and is always three digits long.

There is a slight delay to the measurements it takes a second for the device to fully catch up with any changes in direction. Unlike standard instruments, the SAP works equally well in all orientations, so there is no need to hold it level - if it is more comfortable to hold it with the display pointing down - that's fine.

2.3 Recording a leg

To record a leg, place the brass ring against your "from" station, and point the SAP so that the aiming point is on the "to" station. Hold down the button - the display will now read "SAVE". After 1 second the laser dot should briefly flick off and back on again - this indicates that the reading has been made. The reason why there is a delay is that the action of pressing down the button invariably moves the aiming point - the delay allows you time to correct this. Once the laser has "blipped", you can release the button. The display will now alternate between the compass and clino readings, and will no longer show the current bearing and inclination. It will also display a third number, prefixed by "L" - this is the leg number, and is used for retrieving the data later over the USB link. To record a further leg, simply hold down the button again. To return to the "real-time" readings you would need to turn the SAP off and then on again.

3 Advanced Features

3.1 Battery power display

Not currently operational - currently just shows "BATT" While turning the SAP on, continue to hold down the button on the second press. The display will show the estimated battery power left in the device. If the device's battery is so depleted that accurate readings cannot be guaranteed, it will simply display "BATT" and then turn itself off. All saved data will be preserved.

3.2 Temperature reading

If the button is held for longer while displaying the battery power, the display will change after a short time to show the temperature as measured by one of the internal chips. Please note that due to thermal heating from the battery, and also differences in external and internal temperatures, this reading may not reflect the temperature of the current environment.

3.3 Daylight mode

To save power the SAP normally runs the laser and display at less than maximum brightness. However, if using it on the surface or near large entrances, it can become difficult to read the display or see the aiming dot. While turning on the SAP, continue to hold down the button on the second press. This will cycle through the battery power and temperature displays. On returning to the battery power display, both the laser and the display will be set to maximum brightness. The device will revert to the preset laser and display brightness when it is next turned on.

4 Software usage

You can alter the settings for your SAP using a piece of software called PonyTrainer. All software is licensed using the Gnu Public License (<http://www.gnu.org/licenses/gpl.html>), and runs using

python. The latest version of PonyTrainer is available from <http://www.shetlandattackpony.co.uk/>, as is the latest version of this manual.

4.1 Installation

4.1.1 Windows

Simply download <http://www.shetlandattackpony.co.uk/files/shetland.exe>, and run it. This should install the relevant device driver, and also the PonyTrainer application will be placed in the Start Menu.

4.1.2 Linux

Dependencies You need to have a few packages installed before you can install PonyTrainer

- Python (this will almost certainly be installed already)
- wxPython
- gcc (on ubuntu, install the build-essentials package)

You should be able to obtain these using your distributions package manager.

Installation Download <http://www.shetlandattackpony.co.uk/files/shetland.tar.gz>, and unpack it. In the shetland directory, run:

```
$ sudo ./install
```

The installation prevents the cdc-acm kernel module being loaded; this may cause problems if you use a usb modem. If you have any problems, please contact me at phil@furbrain.org.uk <mailto:phil@furbrain.org.uk>

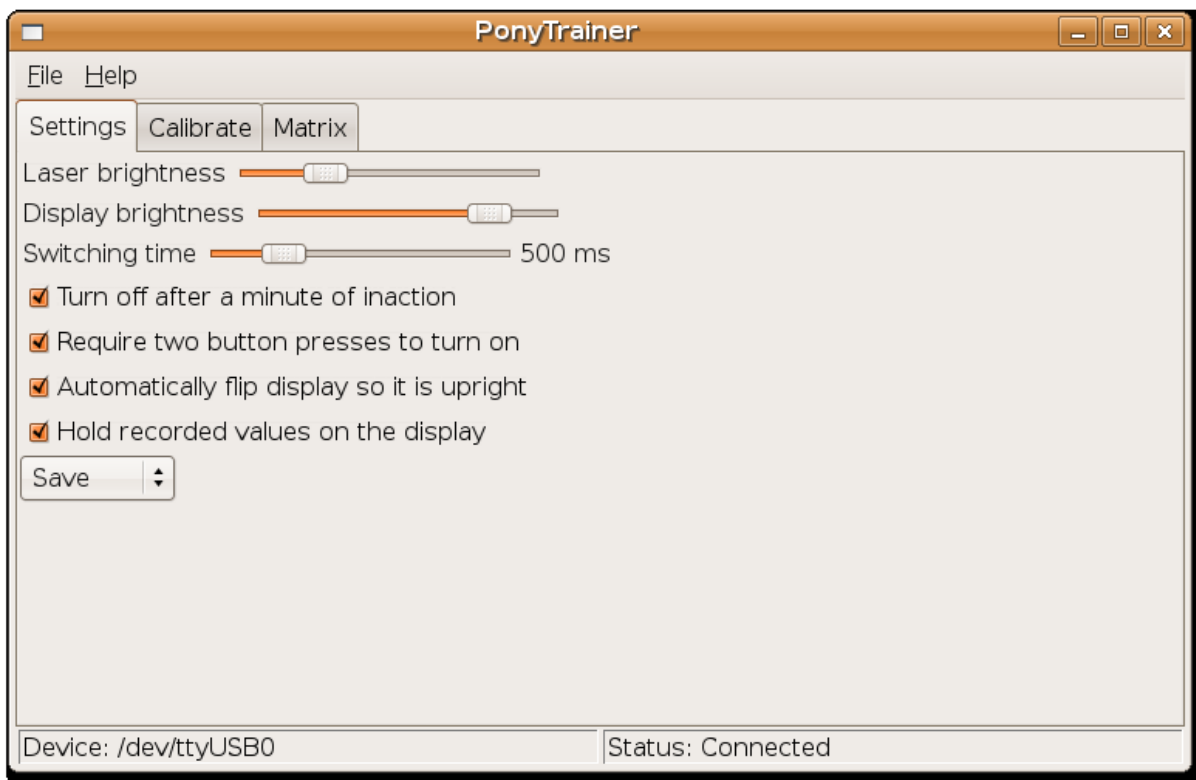
To run PonyTrainer, make sure the SAP is attached to your computer, and run

```
$ PonyTrainer.py
```

4.2 Using PonyTrainer

To use PonyTrainer, first plug in the SAP using a mini-usb cable (obtainable at all electrical stores, but you probably already have one if you have a digital camera). The port is accessed by removing the “battery cover” on the back of the SAP; the port is a little recessed, but will be obvious if you look closely. You also need to do this to recharge the battery.

4.2.1 Settings



As you can see there are several options which you can use to adjust the function of the SAP. None of these are made permanent unless you agree when closing the program.

- Adjusting the Laser Brightness and Display Brightness changes the brightness of the SAP in its usual mode (daylight mode is unaffected).
- The switching time adjusts the underlying “clock” of the SAP - this is the time taken to switch between the compass and clino readings. It also affects a couple of other time related phenomena - the first two button presses to turn the device on must be within two “clock ticks” of each other. The time that the SAP waits from pressing the button to recording a leg reading is also two “clock ticks”
- “Turn off after a minute of inaction” - if this is unchecked, then the SAP will stay on permanently until you turn it off.
- “Require two button presses to turn on” - if this is unchecked, then a single button press will turn the SAP on. Battery power, temperature, and daylight mode are all available by pressing the button for differing lengths of time on the first press.
- “Automatically flip the display so it is upright” - turn this off if you want to make the display hard to read.
- “Hold recorded values on the display” - If this is turned on, once you have taken a reading it will continue to be displayed until you take another reading. If turned off, the SAP will display the current compass and clino readings as soon as you stop pressing the button.

4.2.2 Data

This tab shows the data currently stored within the Pony.

4.2.3 Matrix

This tab shows the current calibration matrix for the device. This can be saved by `File | Save Calibration Data`, and loaded by `File | Apply Saved Calibration Data`

5 Calibration

Your SAP should arrive already calibrated. There are a few things that can invalidate the calibration. These are:

- Shaking loose the battery or laser within the device
- Removing the circuit board from the device
- Leaving the SAP next to something with a strong magnetic field.

To recalibrate it, you will need a sighting compass and clino. The whole process will take about 40-60 minutes. These are the steps you need to take:

1. Connect the SAP to your computer, save any data you want to keep, and set the mode to "Calibrate". Note that this will wipe any data legs currently stored on the device. Save your changes to the SAP, and disconnect it.
2. Find a largish space away from large metal objects (a decent sized living room would be large enough)
3. Create a fixed point - a wooden stake hammered into the ground, or a candle on a wooden table would be fine. It is important that there is no ferrous material nearby. This probably includes your watch.
4. Pick a target point at least 1.5m away, between +30 and -30 inclination.
5. Measure the compass and clino readings from your fixed point to the target point. Write it down.
6. Record a leg from the fixed point to the target point using the SAP (see Section 2.3). Do this with the display facing upwards. Do this again three more times, but with the display facing left, down and right. Write down the leg numbers you have just recorded (there should be four in total).
7. Repeat steps 4-6 another 11 times. Try to get a good spread of compass readings and clino readings
8. You should now have 48 separate readings. You need to enter these into a text file (Windows users use Notepad, Linux users use your favourite text editor). Each line should represent one of the legs. Enter the leg number, compass reading, and clino reading, in that order, separated by tabs. See Figure 1 on page 6 for an example.
9. Connect the SAP to your computer, and start PonyTrainer. You should now have a "Calibration" tab - select that.
10. Choose `File | Load Raw Calibration Data`, and select the file you have just created. The Columns labelled "Reading", "RCompass", and "RClino", should be filled with the data you have just created.
11. Press "Calculate Errors"
12. Go and have a cup of tea.
13. And maybe some toast, if your computer is slow...
14. All of the columns should now be filled with data. Look down the Errors column. Less than 1 is excellent, more than 3 suggests you've stuffed it up somehow. You can then go back and remeasure these if you want. Alternatively, you can exclude bad readings from the final calibration by unchecking the check-box in the "Include" column for particularly duff readings.
15. Press "Calibrate Pony" - this process shouldn't take too long. The average error should be less than 1.5 degrees.
16. Choose `File | Save Calibration Data` - it's worth keeping a record of your calibration matrices.
17. Change the mode to "Save" on the Settings page
18. Choose `File | Exit and Save Changes`
19. Your SAP is now ready to run again.

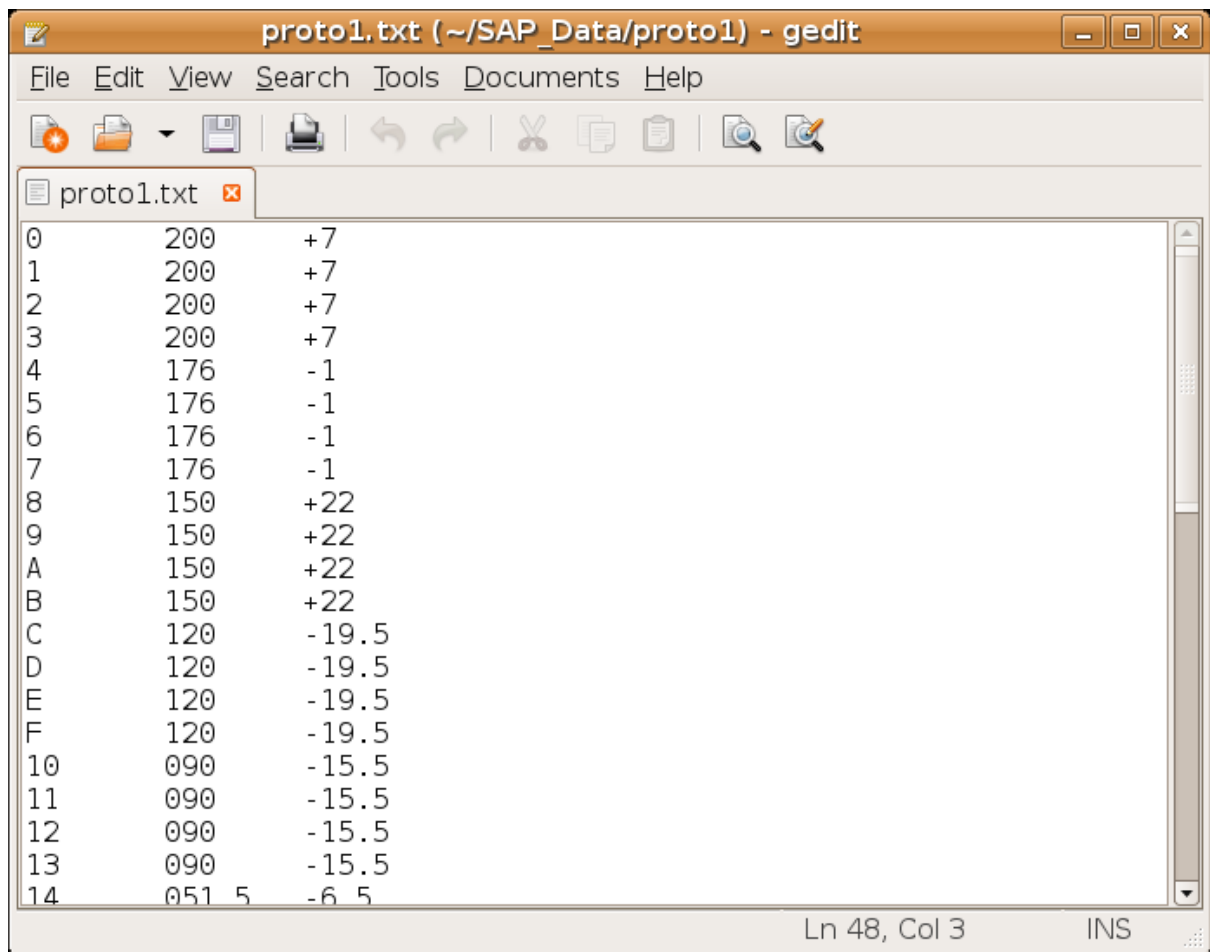


Figure 1: How to enter the calibration data. Note that the compass and clino readings come in groups of four