Lyte Probe Manual - ICECAPS-MELT 2024

Draft 1: 16 April 2024, split from ICECAPS snow science doc
Draft 2: 18 June 2024, some field usage advice added. Waiting on new calibration coefficients for Probe 1.

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Lyte Probe Manual

Probe was developed by Micah Johnson and team at Adventure Data. Its intended purpose has been to have an accurate field probe for back country travelers that will help quickly assess snow structure.

In collaboration with Micah J. and HP Marshall, we are finding the LyteProbe useful for scientific purposes.

Resources:

A list of necessary resources for Linux and/or Windows platforms to use the Lyte Probe for field science applications. Von Walden also has data acquisition and processing capabilities on his laptop, but this is only for backup.

Table 1. Resources located on the ESR Lyte Probe Surface and online.

Resource name	**link**
Adventure Data Website	https://github.com/adventuredata/
Lyte Probe command line interface data acquisition and probe settings software	https://github.com/AdventureData/radicl
Lyte Probe command line interface data acquisition and probe settings software for research projects	https://github.com/AdventureData/study_lyte
Windows Surface USB probe driver install	C:/Users/micha/lyteProbe/programs/driver_install.bat
Windows Surface GPS driver install	C:/Users/micha/lyteProbe/programs/ubloxGnss_sensorDevice_windows_3264_v2.24.exe
Windows data acquisition software	C:/Users/micha/lyteProbe/programs/Lyte Probe for Research - ESR.exe
Windows lyte probe settings software	C:/Users/micha/lyteProbe/programs/RADICL-ESR.exe
Field data *Profile* quality code (use with Spyder)	C:/Users/micha/lyteProbe/programs/lyteProfile_ICECAPS.py
Field data *Transect* quality code (use with Spyder)	C:/Users/micha/lyteProbe/programs/lyteTransect_ICECAPS.py

Dependencies:

Python 3.11 - Lyte Probe data acquisition software depends on Pandas. Pandas can currently only be used with Python 3.11. Many computers are coming with Python 3.12 installed as the default. If you are starting from scratch with a new daq computer, please check this dependency.

Upgrade pip to 23.3.2.

This dependency has been sorted for the ESR Surface that comes with the ESR Lyte Probes.

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LyteProbe Setup and Software Installation

LyteProbe Basics:

The LyteProbe to be used for ICECAPS came with three sensors and one empty channel.

Sensor 1 - Force
Sensor 2 - NIR Passive
Sensor 3 - NIR Active
Sensor 4 - empty channel

The force calibration information is listed below. *The probe diameter is 0.005 m* +/- (unknown). We are waiting on tolerances for the diameter measurement. We can measure ourselves with calipers when available.

Our sensor was initially setup with the accelerometer range as +/- 16gs. We are currently taking g = 9.81 m/s2. This may be an assumption to revisit later.

Adjusting Probe Setup:

0. NOTE: You should not need to do this. Both probes have been set with appropriate settings for this experiment.
1. Plug probe into computer (green light will turn on, then red light)

2. Start RADICL-ESR from C:\Users\micha\lyteProbe\programs\

```
WELCOME TO THE LYTE PROBE CLI

WARNING:
        Warning: This CLI is not meant to run with the mobile app.
        Please make sure your RAD app is closed out.


Things you can do with this tool:


        * Plot various data from the probe.
        * Write various data to a file. (In development)
        * Modify probe settings.  (In development)
        * Update the firmware (In development)

radicl.serial INFO No COM port provided. Scanning for COM ports...
radicl.serial INFO Using /dev/ttyACM0
radicl.api INFO Attached device: PB3, Rev=1, FW=1.46.5.0

What do you want to do with the probe? (daq, settings, update, help, exit)
```

3. Choose settings from the following list, with the ideal settings for our work in parentheses.

===== Probe Settings =====
accrange (16)
accthreshold (0)
acczpfo (0)
alg (1)
appp (2)
calibdata (Sensor 1) = [0, 4095]
calibdata (Sensor 2) = [0, 4095]
calibdata (Sensor 3) = [0, 4095]
calibdata (Sensor 4) = [0, 4095]
help
ir (1)
ppmm (2)
samplingrate (16000 Hz)
tcm (1)
usertemp (None)
zpfo (2)
home
help
exit

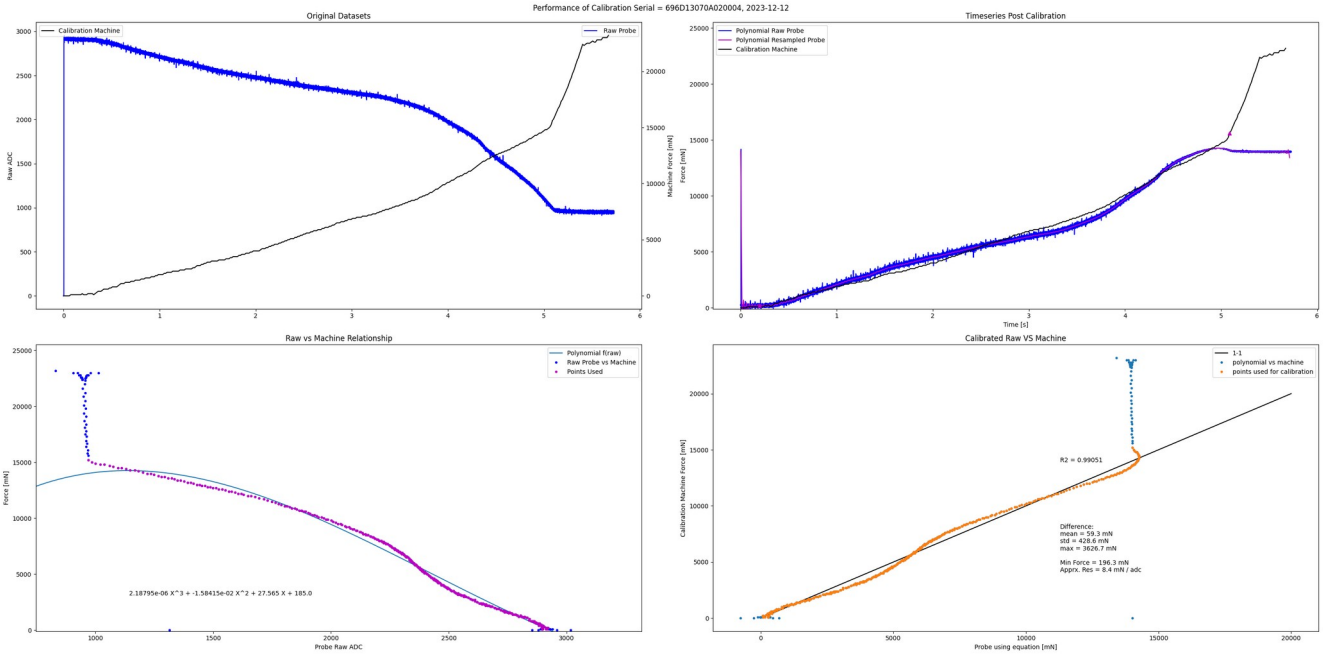
Force Calibration:

Calibration of the force sensors are in Table 2. These are embedded in the code used to process the data after it has been collected.

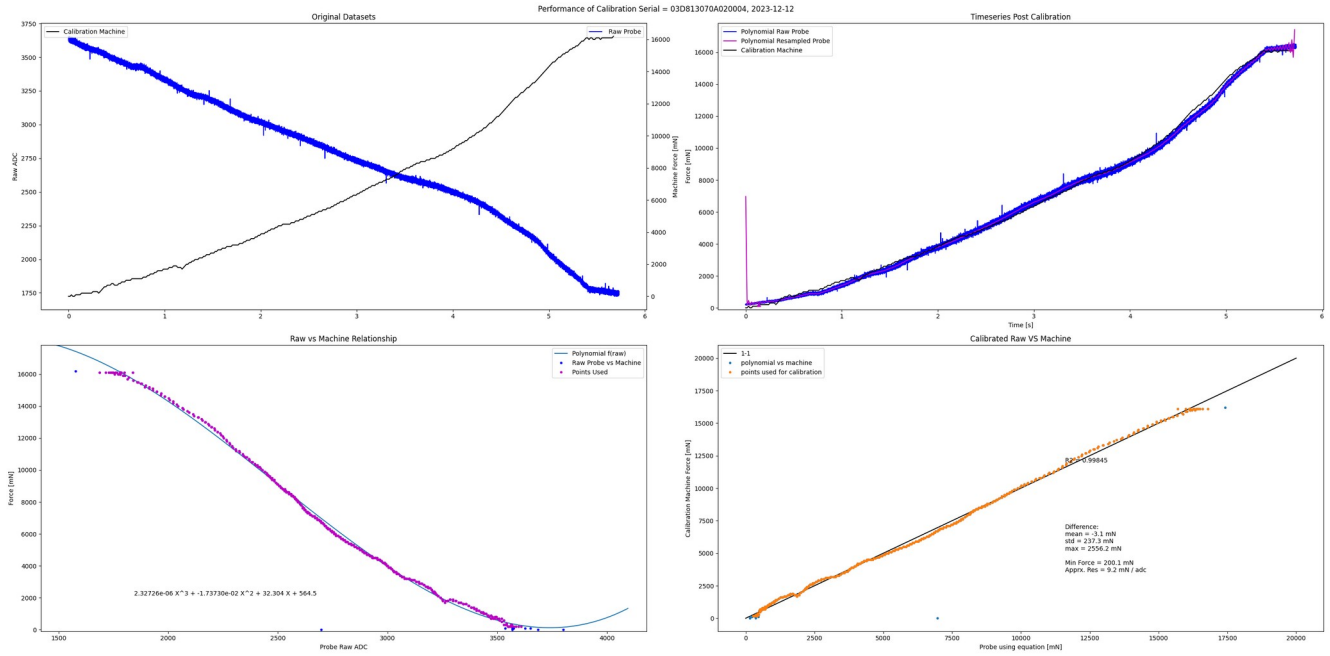
Table 2. Calibration coefficients for ESR Lyte Probes. Converts force sensor signal (Sensor 1) to force in Newtons. Range should be up to ~0-15 N.

Probe #	Serial Number	Calibration equation (converts to Newtons)	Range
1	696D13070A020004	F = 2.18795E-06 x^3 + -1.58415E-02 x^2 + 27.565 x + 185.0	0-14 N
2	03D813070A020004	F = 2.32726E-06 x^3 + -1.73730E-02 x^2 + 32.304 x + 564.5	0-16 N

Probe 1:



Probe 2:



Probe Operation:

BEFORE SAMPLING:
0. Record site information/location in field notebook.
Probe number (1 or 2), Date, Time, Location, Purpose of collection, description of snow surface or other environmental conditions, Name of Experiment (YYYYMMDD_X). Measure full length of probe.
1. Lay out strike data collection table(s) in field notebook for your measurement. Example below

Strike #	**Transect location**	**Length to collar**	**Hilt height**	**Notes**
1	0 m	61 cm	5.5 cm	hard surface crust, ended at slight angle
2	2 m	N/A	N/A	ghost strike
3	2 m	57 cm	10 cm	hard surface crust, sudden stop at end

Notes may include: surface structure, angle input, sudden accelerations during strike, NIR sensors clogged with snow (before or after strike), any 'ghost strikes' (times when the user hits the action button accidentally, etc...

Hilt height - this measurement is used to help check on the total distance traveled by the probe.
Length to collar - this measurement is use to help check the total distance traveled by the probe. The probe may 'shorten' if it hits a hard crust or frozen layer.

DURING SAMPLING:
0. Power on the MS Surface computer (Code = 1918). Secure to body with strap and case.

1. Remove the quick release basket from the probe.
2. Power on the probe by pressing the *action button* on side of handle
    green light when not plugged into the computer
    red light when plugged into the computer
3. Connect the probe and G-Mouse GPS to your computer via USB splitter (long, white USB cable to probe). Mini-usb connection is on the top of the probe.
    NOTE: Probe draws charge while connected to computer.
4. Click on the 'Lyte Probe for Research' icon on the desktop  taskbar. Wait for Command Prompt Screen.
5. Use Surface keyboard (on screen or flip-keyboard) to hit '**enter**' to being measurement. **Wait** for software to respond.
6. Hold the probe above the surface, *turn NIR sensors away from the Sun*, and **press the action button** (the LED will flash).
    Use two hands, but be careful to not push the action button before you want to start strike, or or during the strike (ending your measurement early).
    Do not bend the usb cable at the top.
7. **Wait for 2 seconds** for collection to begin in the probe.
8. **Insert the probe** into the snow somewhere **around 1 m/s**, it should feel "natural"
    Drive to full desired depth then stop and let go. OK to push through layers. Try not to experience 'sudden' stops.
9. **Wait 1-2 seconds** at bottom of strike.
10. **Press the action button** again **to stop** (LED will flash again)
11. The **software will download the data** and save it to a file **in the directory with the 'Lyte Probe for Research'** exe.
    Examine field plot the data to make sure y-acceleration is flat on both ends of strike. If not, repeat strike.
    This strike information will be cleared automatically after a few seconds.
12. Clear snow out of NIR holes between strikes
13. **Repeat** the **process** starting from **number 6**.
14. When finished, hit **ctrl-c** to stop data collection.

Things to note (and some troubleshooting advice):
* The probe LED is **red** when the battery is low.
* Power off the probe by holding the action button for a few seconds (LED will turn off)
* The LED will be **orange** if something has gone wrong, almost always fixable by a power cycle.
* The probe can take data (one strike) prior to informing the computer to listen with a key stroke. This looks like turning the probe on (button push, then **green** light), then button push (start) and strike and button push (stop). The data will automatically download and display when the computer is told to listen. *These data have not proven to be reliable. Do not follow this proc unless told otherwise.*
* The Lyte Probe LED light also lights up **green** when plugged into the laptop because it is charging. This does not mean that the Lyte Probe is on. It always needs to be turned on by pressing the 'action' button.
* **For an angled strike** - point the NIR sensors horizontally away from the striker (and away from the Sun).
* When making **horizontal probe strikes**, you may encounter an **error** to do with surface detection (**type 0**). **Don't worry**, data has still been collected. If you encounter a *'comms' error*, then the *data cable has become unseated*.

* If the NIR profiles are constant, check if the sensors are clogged with dirt or other debris. Clogging with snow should *not* result in constant NIR profiles.
* When going through hard surfaces, it is better to **use 'constant' pressure** rather than quick, blunt force. *The main thing is to avoid high accelerations* (> 14 gs).
* When using large amounts of force, **please keep hands and body away from the data cable** connections.

AFTER SAMPLING
0. Data are stored in C:\Users\micha\lyteProbe\programs\. Move files to appropriate directory for more permanent storage (two USB drives provided in 'tea container'). Suggest naming folders YYYYMMDD_X, where X may be the number of the experiment for the day.
Review data, rename files if necessary.
1. Plot data with field scripts to check what happened.
2. Upload data or visual output/check to cloud if possible.