

## Company Background

Dr. Owen Hildreth is an Assistant Professor in the Department of Mechanical Engineering at the Colorado School of Mines. His primary research is on nanometer to centimeter-scale additive manufacturing technologies. He has written numerous MacOS applications for custom data-collection and visualization as part of his research.

## Project Description

A few years ago, we sponsored a field session for students to write a Swift wrapper around the popular NI-VISA framework (<https://github.com/SwiftVISA/SwiftVISA>) so that we could write applications to control our instruments using an Apple Computer. This led to a larger project to write our own, pure-Swift VISA implementation (<https://github.com/SwiftVISA/SwiftVISASwift>) that has helped our group immensely. This Swift Package was originally limited to communication over TCP/IP. Last summer, we sponsored a CS Field Session to write a Swift Wrapper around the C-based libusb library (<https://libusb.info>). This works well, but it adds dependencies on external libraries and complicates the build process.

To bring full, self-hosted USB support to SwiftVISASwift, we are looking for a group of students to transition SwiftLibUSB from a wrapper around the libusb library to a stand-alone package. libusb is a cross-platform, open-source project and it should be possible to look at the macOS portion of libusb and translate these C-based system-calls to Swift. A pure, Swift-based USB controller package modernizing USB communication on macOS will help us communicate with USB devices easier than using C, while also improve code safety by taking advantage of Swift's modern language features. This project is an excellent opportunity for a student to directly contribute to an open-source project with broad, real-world applications. It will expose students to writing dll's, controlling hardware, and object-oriented programming. Students will be able to use this as a concrete demonstration of their skills when applying to future jobs or internships.

## Deliverables

- Final design report (mandatory for all teams)
- Working prototype SwiftlibUSB package
- Demonstrate the SwiftlibUSB works by controlling a USB connected power supplies (set voltage, read voltage, read current)

## Proposed Process

Since the students probably won't have experience with controlling instruments, the project will follow a simple progression to get the students familiar with the libUSB, Swift's protocols for serial communication, and reimplementing libUSB commands in Swift. The goal at each stage is to: set a power supply's voltage, read a voltage, read a current, and calculate the resistance across a resistor.

- Write a small, command-line utility in libUSB C to control a power supply
  - goals: become familiar with the libUSB, how to detect, connect, write-to, and read-from a USB device using VISA-compatible strings (I'll give those strings to you)
- Write a small, command-line utility wrapping the above C-code in a Swift function
  - goals: identify the correct Swift storage elements that map the underlying C-code unto Swift-compatible storage elements for serial communication
- Start translating the necessary components of libUSB to a SwiftlibUSB Package

## Summary

Develop the communication protocol that will be used on next-generation scientific and manufacturing equipment.

Desired Skill Set

Curious, self-motivated, interested in making an impact that will define how research equipment and machines are controlled for the next decade

Preferred Team Size

3-4 students

Internship Opportunity

Lab research opportunities continuing to support the SwiftLibUSB Package

Location for Work

Off-site and on-site at Colorado School of Mines.