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PyScan: Interfacing Laboratory Instruments with Python



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Abstract

Laboratory instruments can be interfaced with and controlled from personal computers. Several programs to scan lasers and acquire data have been written by students in the Polik Lab. However, computer hardware and software change more rapidly (3-5 years) than instrument lifetime (20 years). Thus, programs must be replaced to run on modern computers and operating systems. This can be done to minimize dependence on specific hardware and software.

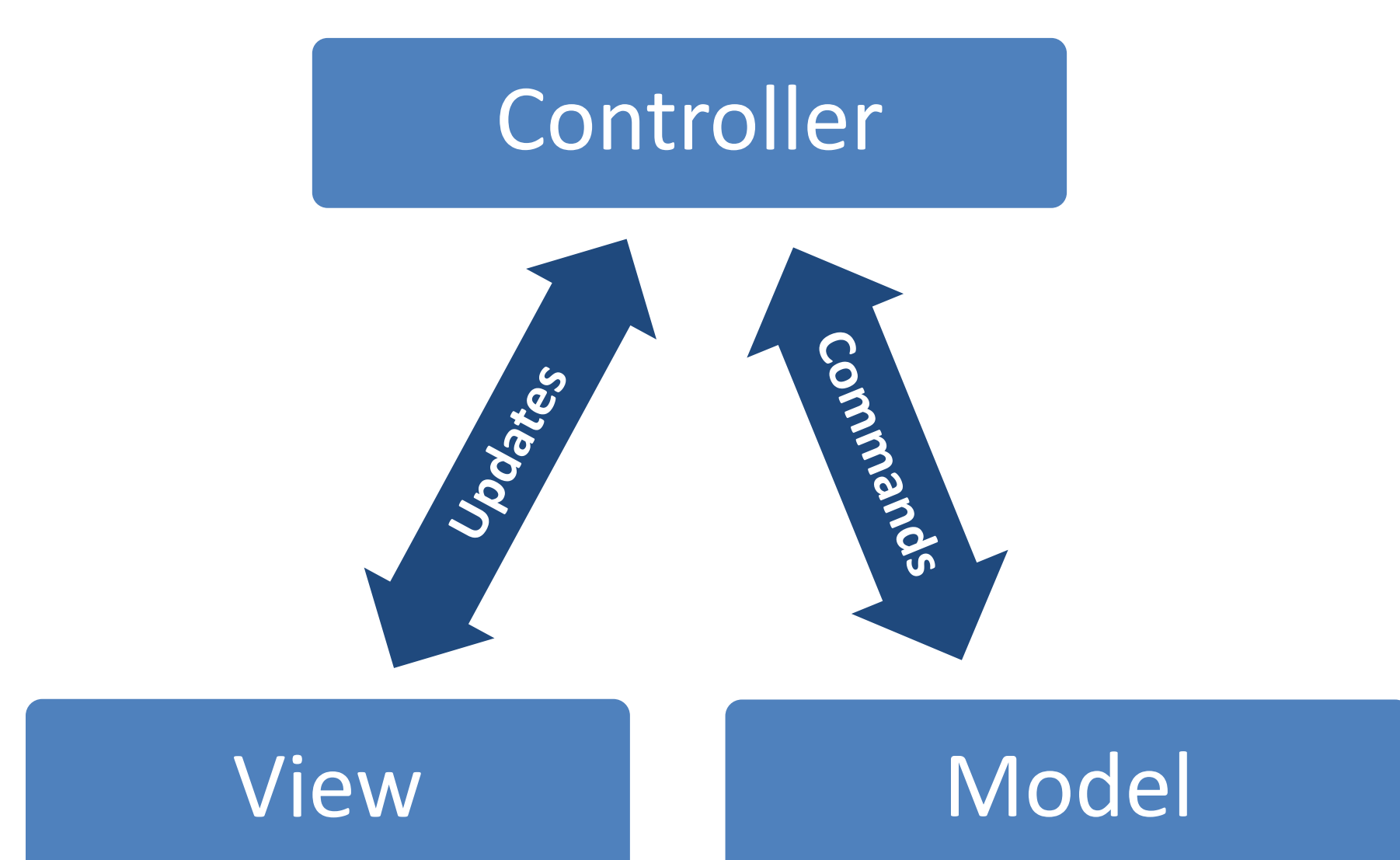
PyScan is a laser instrument interface program intended to replace the Polik Lab's current software. It allows the user to control the laser, setup a scan, acquire data, and store the data for subsequent analysis. PyScan is written in Python 3 in order to run on various computer platforms and access a variety of data acquisition products. This flexibility insulates it from future hardware and software changes.

Model-View-Controller (MVC)

Model-View-Controller is a software architecture pattern used to implement graphical user interfaces (GUIs). It divides a program into three separate, decoupled components:

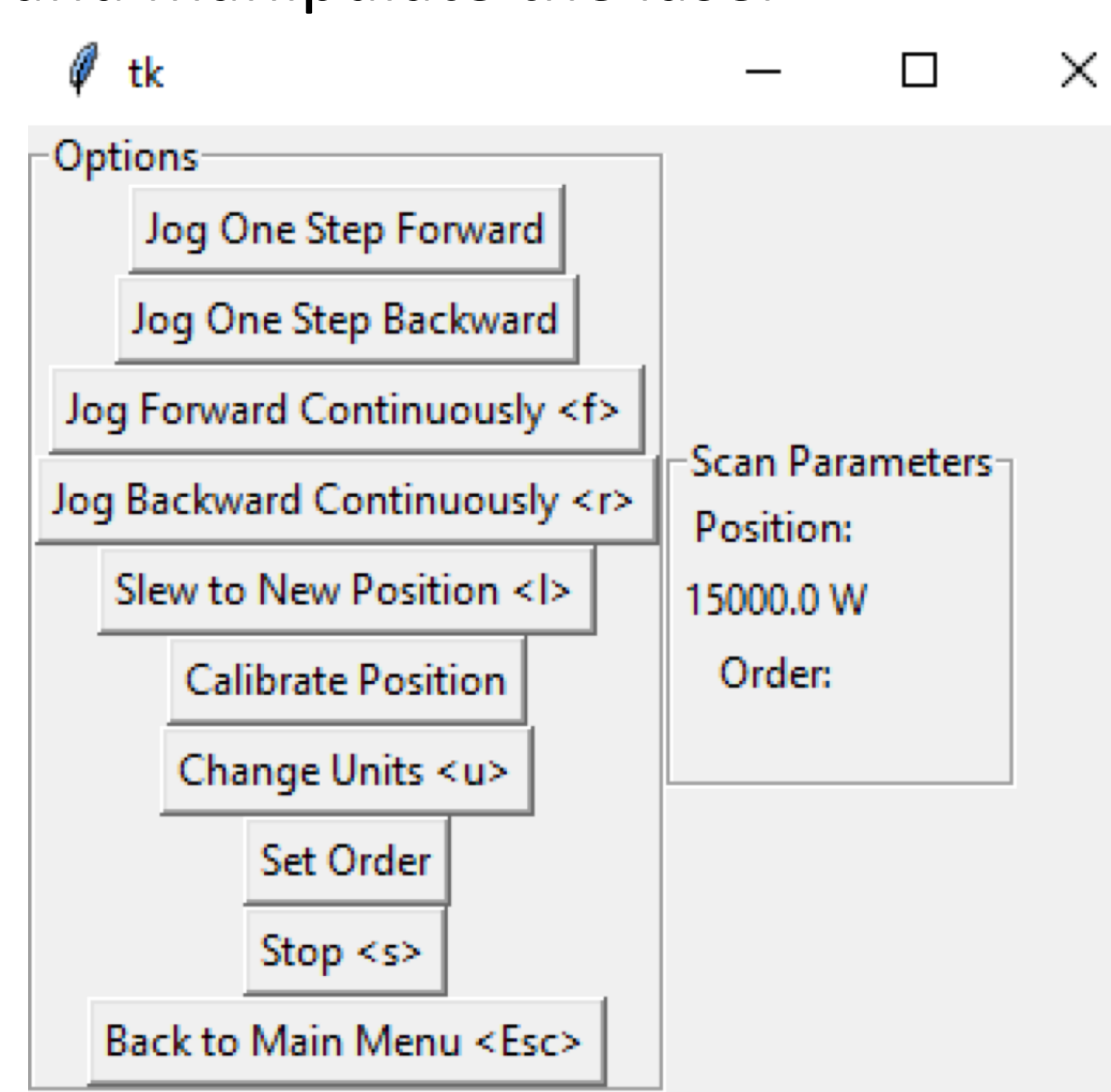
- The **Model** implements the logic and behavior of the program.
- The **View** defines the user interface components such as buttons, labels, or plots.
- The **Controller** manipulates the model and binds the view to the model.

The MVC pattern facilitates efficient code reuse, streamlines the addition of features, and simplifies debugging.

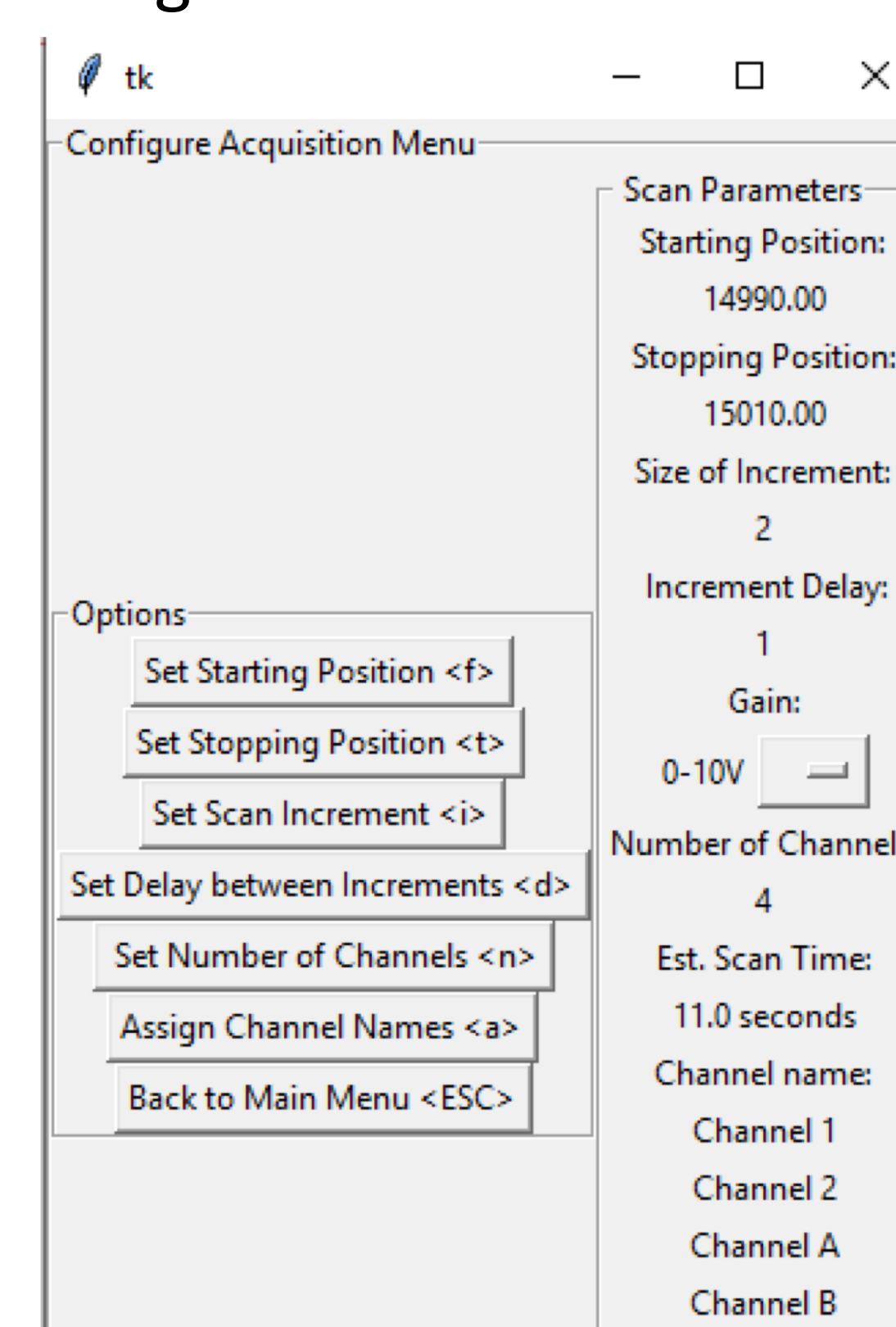


Capabilities

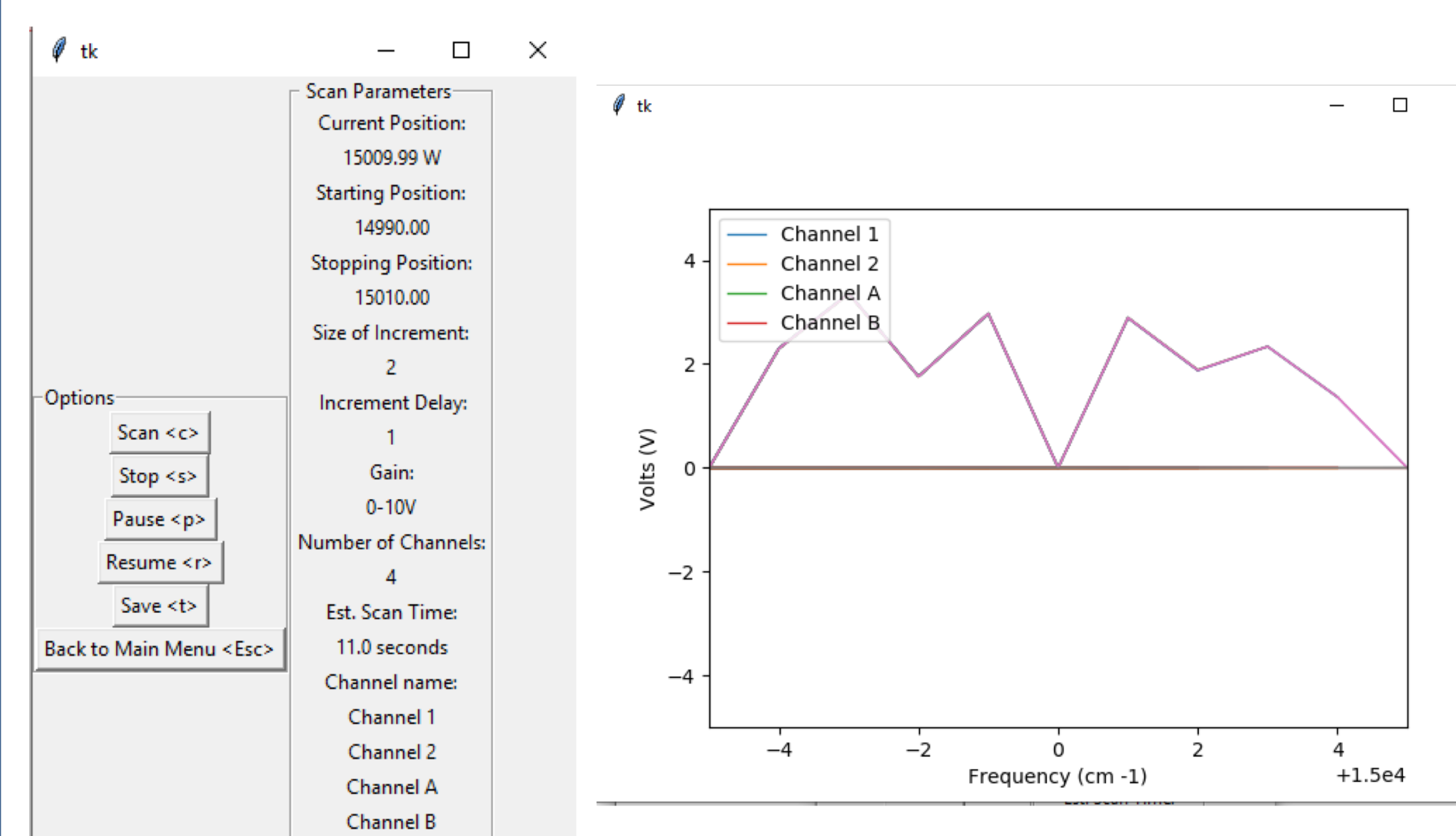
- Control and manipulate the laser



- Setup and configure a scan



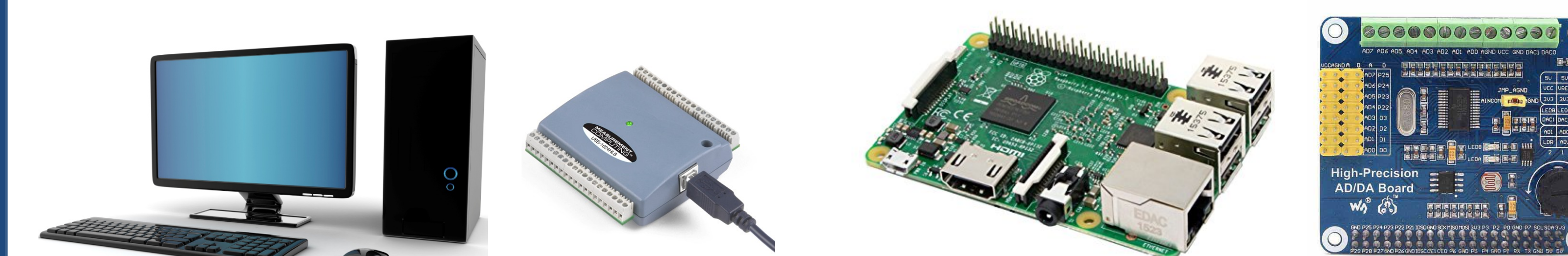
- Scan, acquire, store, and view data synchronously



Platforms

Python 3 runs on Windows, Linux, and Mac. This allows the scanning program to be implemented on a variety of computer platforms. Data acquisition can be done with a 12-bit or higher data acquisition card.

- Personal Computer (\$900)
- Measurement Computing USB (\$300)
- Raspberry Pi (\$35)
- WaveShare AD/DA Board(\$25)



Technologies

- Python 3** is an interpreted, multi-paradigm language and is a powerful tool for rapid development. Python was chosen because its broad support for graphics, communication, and data acquisition.
- Tkinter** is Python's default user interface library which binds to the Tcl/Tk standard GUI toolkit with basic components such as buttons, windows, and key bindings.
- Matplotlib** is a python data plotting library.
- PySerial** interfaces serial ports for a variety of operating systems.
- MCCULW** is a python wrapper for the Measurement Computing's Universal Library which allows access and control of Measurement Computing data acquisition cards. A wrapper was written for WaveShare's C library.



Future Work

- Add synchronous scanning for a laser doubling crystal
- Implement models for pulse and command instruments
- And of course bug fixes...

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