Aerodynamics Master Program Guide

For collecting and analyzing aerodynamic data.

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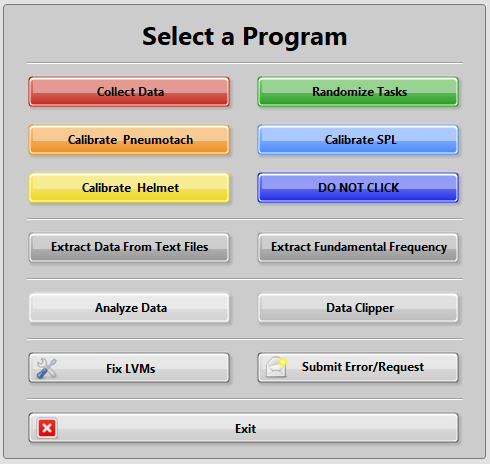
[Block Diagram 14](#_Toc78461088)

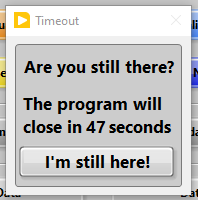
# Master Aero Program

The Master Aero program contains all of the collection and calibration programs used with our aerodynamic devices. This includes the complete/mechanical interrupter, the incomplete interrupter, the airflow redirector, and the singing helmet.

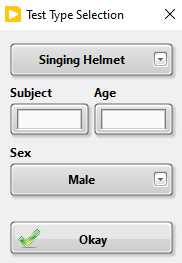
## Front Panel Guide

### Main Menu

The Master Aero program contains all of the collection, calibration, and analysis programs for our aerodynamic devices. The Front Panel is simply an array of different buttons. You can hover over each button for a short description of its function.

If the user spends more than two minutes without clicking any buttons, the timeout prompt will trigger. If there is no input after another minute, the program will close.

### Collect Data

The first thing that occurs when this VI is opened, the user will be prompted to select a folder where their data will be saved. This should default to the Saved Data folder on the Aero Drive.

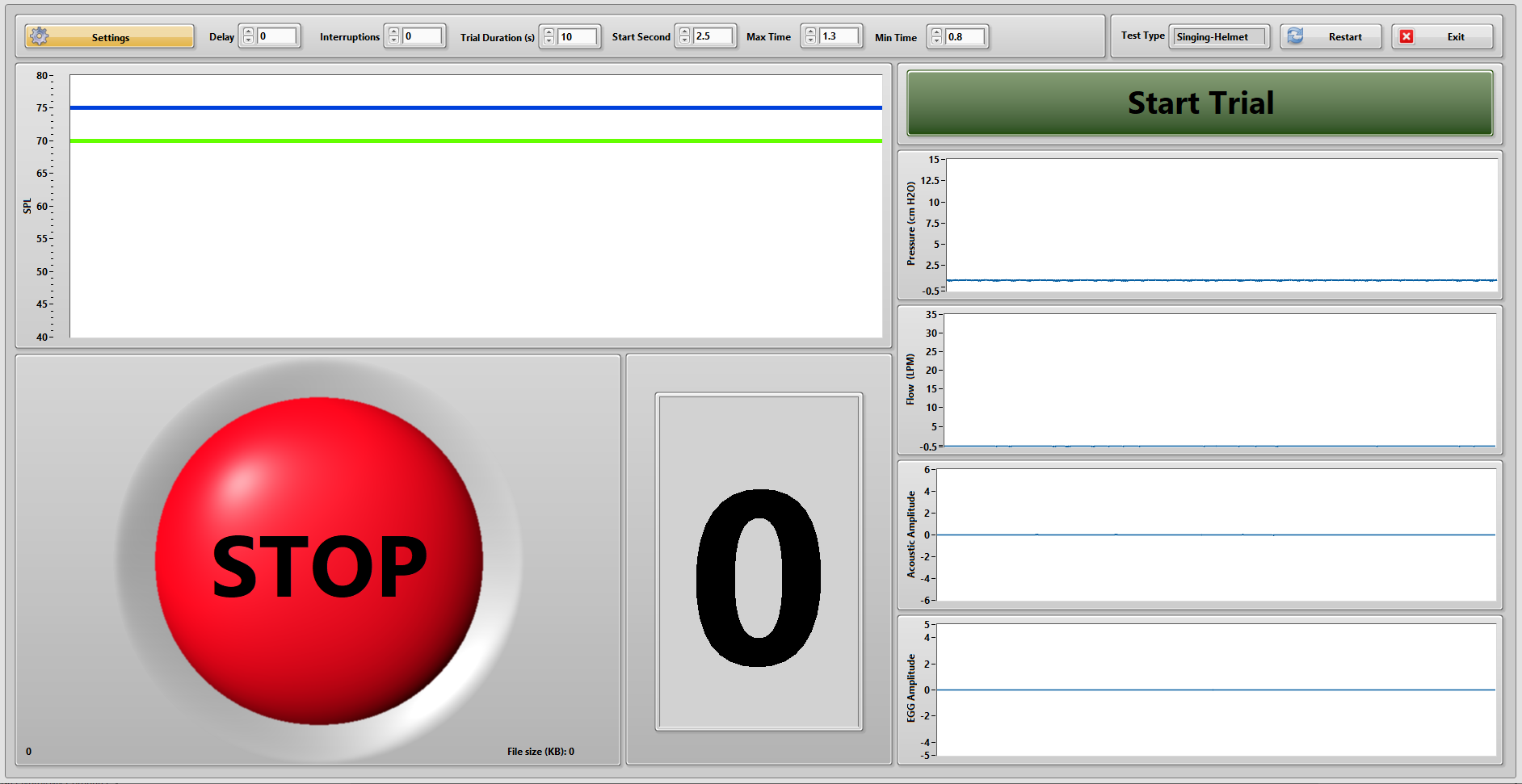
The user will then be prompted with the Test Type Selection VI. Here, they select what type of test you will be conducting. They should also enter the subject code, their age, select their sex, and then click **Okay**.

The settings and calibration data used during collection will depend on the type of test selected at this step.

The user will then be prompted to confirm the save location and file name.

Once the save file location is confirmed, signals will start being read from the NI DAQ board. Signals include:

* Sound Pressure Level (SPL) in dB – Upper Left
* Pressure in cm H2O – Upper Right
* Airflow in LPM – Below Pressure
* Acoustic Amplitude – Below Airflow
* EGG Amplitude – Bottom Right

All of these data will be saved whether or not you have sensors hooked up.

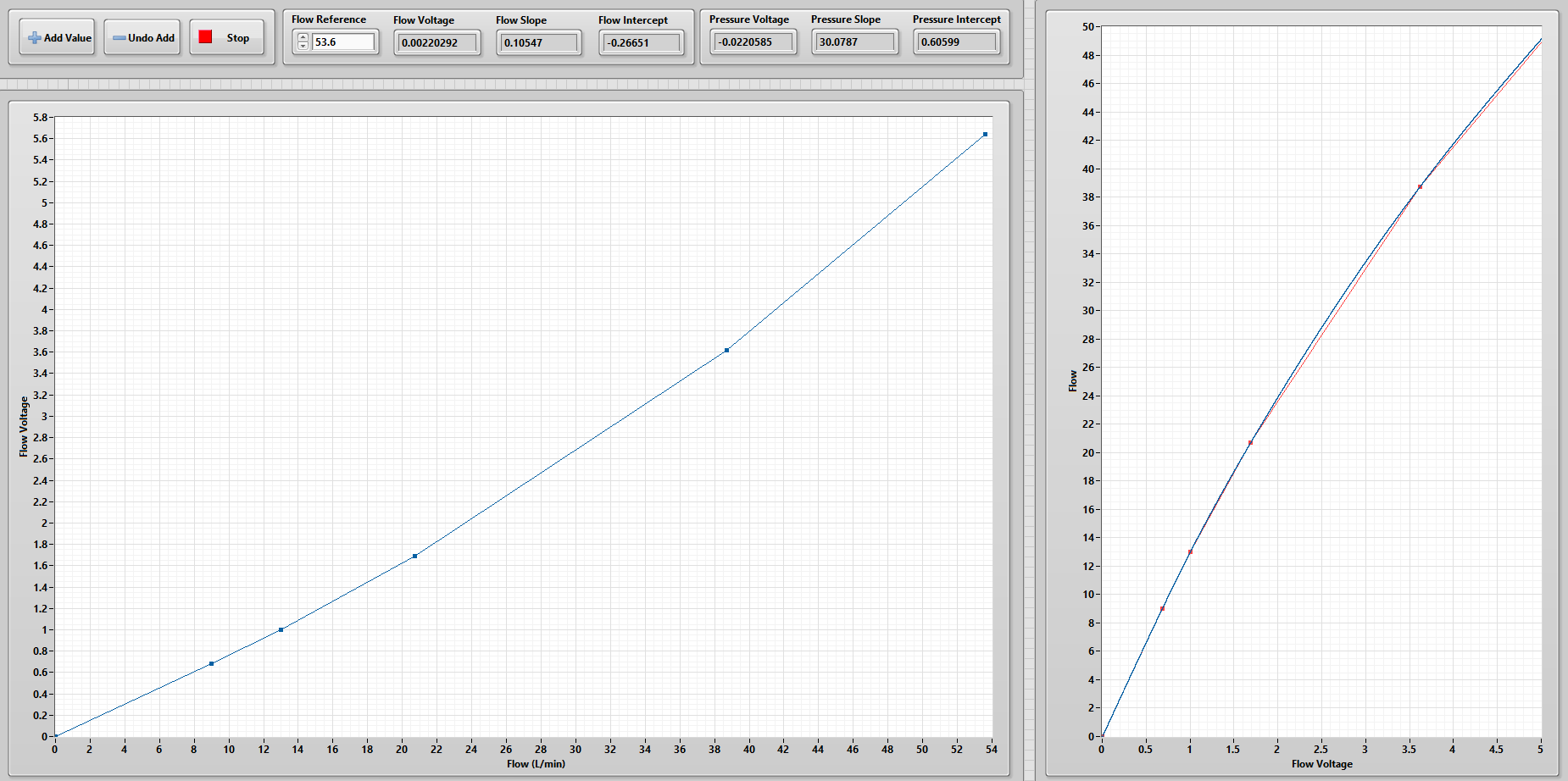
Clicking the **Settings** button will allow the user to alter the following:

* Delay – How long the balloon will be inflated
* Interruptions – How many interruptions there will be during a trial
* Trial Duration – How long until a trial will stop automatically
* Start Second – The earliest second of recording when the balloon can be triggered
* Max Time – The longest time between balloon triggers
* Min Time – The shortest time between balloon triggers

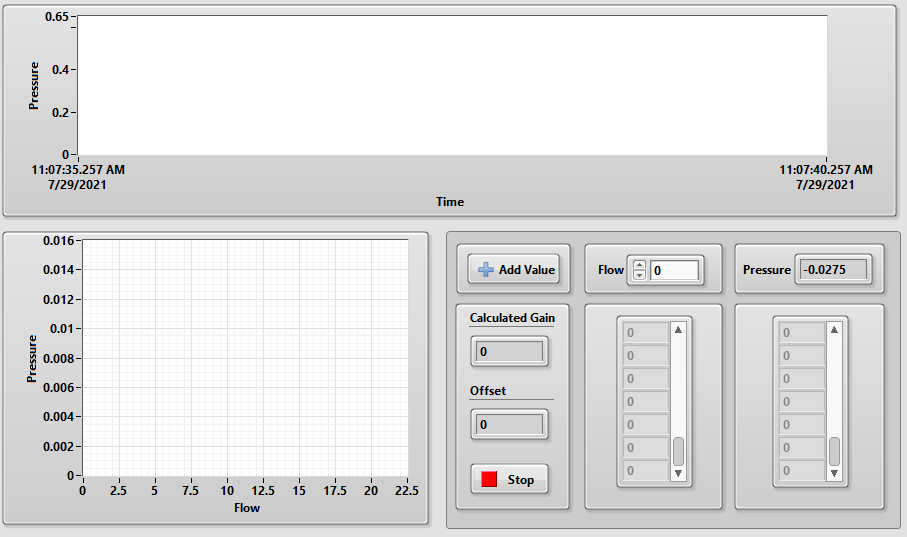
Other notes:

* The **Restart** button allows the user to change the test type without returning to the main menu. Default file names will adjust accordingly.
* The program is only recording when the stoplight shows a green **GO.**
* The small number in the bottom right indicates how many recordings the user has started.
* The size of the recording file is indicated to the bottom right of the stoplight. Use this to make sure that your data is being saved.
* When recording with the singing helmet, the flow data is saved as pressure.

### Calibrate Pneumotach

To calibrate the pneumotach, the user just needs to provide a reference flow value (i.e., tell the program the flow readout from the Omega flow meter) and add values. After adding at least 5 data points, you should end up with a plot similar to the one below. Do not worry, it is not supposed to be perfectly linear. Since only the flow portion of the pneumotach needs to be calibrated, **the P+ port should be disconnected from the interruption device during this process**.

### Calibrate Helmet

This program is used to define the relationship between the voltage read from a pressure transducer and the flow through the singing helmet.

The user just needs to provide the flow input while the transducer is connected to the pressure port on the helmet.

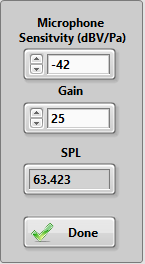
A *very* sensitive pressure transducer is needed to get a good calibration curve.

Note: when collecting data, the flow data is saved as pressure.

### Randomize Tasks

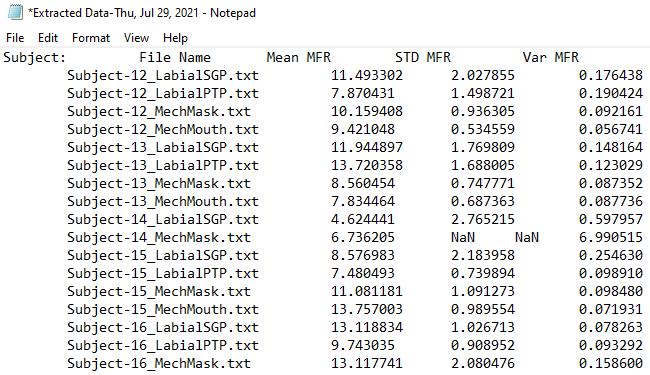
This simply displays a randomized order of tasks to be carried out while testing the complete interrupter. This is typically only used when you are comparing labial interruption to mechanical or complete interruptions.

### Calibrate SPL

To calibrate the SPL read from a microphone, you will need the microphone sensitivity in decibel-volts per Pascal (dBV/Pa). For the microphone currently in the complete interrupter, this value is -42. You will also need a calibrated SPL meter and a source of sound.

Set the sound source equidistant to the opening of the interrupter and the SPL meter. Then, adjust the gain on the program until the SPL readout matches the one seen on the SPL meter. This is not especially precise, but it gets the job done. Come up with a better way if you want.

### Extract Data from Text Files

**This program is used to get the means, standard deviations, and coefficients of variation from all the analysis text files in a folder. Note that the front panel for this program will not appear to the user.

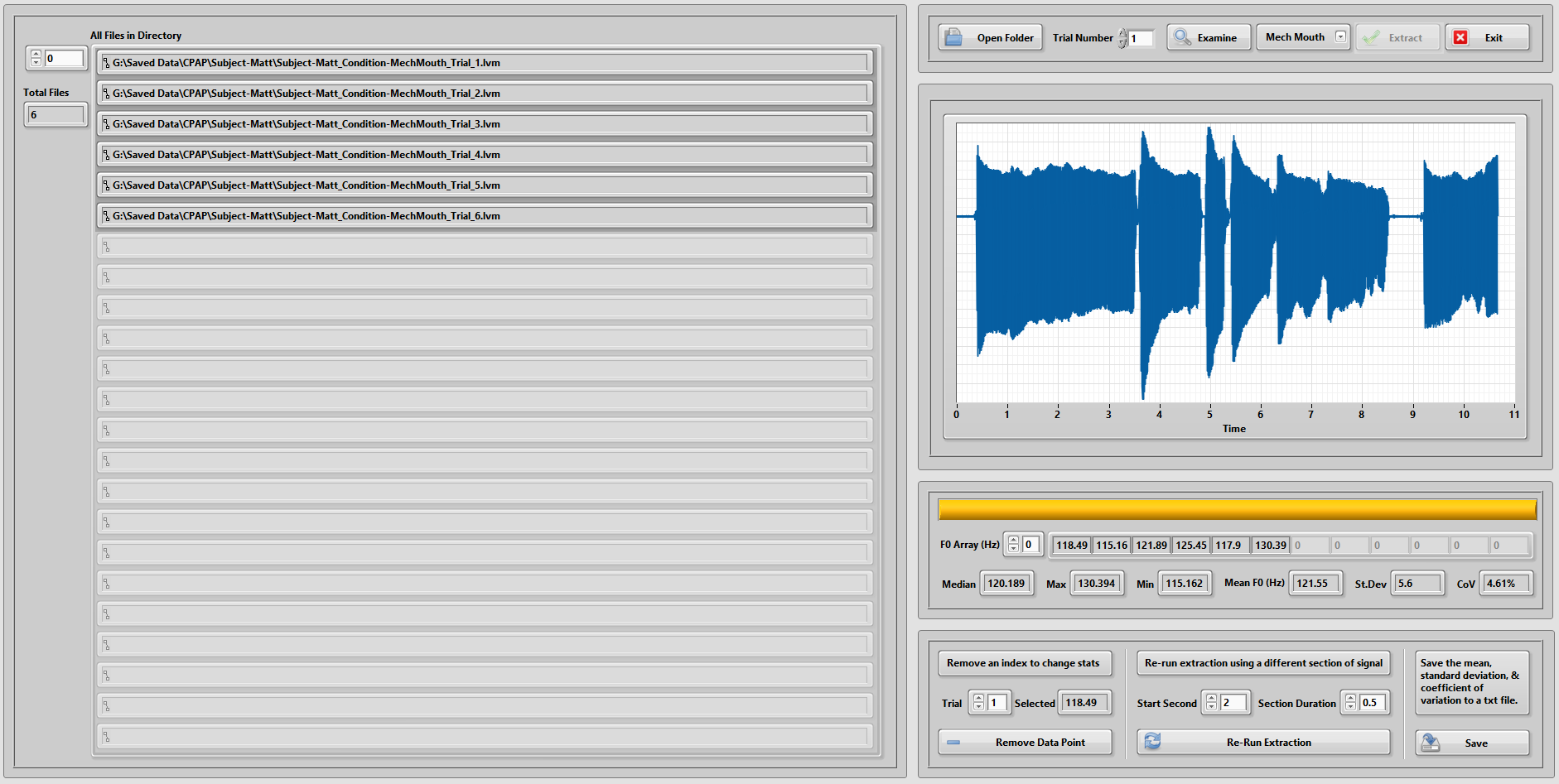
When opened from the main menu, the user will be prompted to select a folder of data. The program will then find all of the analysis results files in that folder and its subfolders and runs some basic statistics. The results of this are output in new text file with the default name of *Extracted Data-Day, Month, DD, YYYY.txt* For example: *Extracted Data-Thu, Jul 29, 2021*

Note: If and *NaN* appears in the extracted data, that means the program could not find any trials with that data. If the *NaN* is just in the standard deviation and variance columns, that means only one trial was found but stats could not be computed.

### Extract Fundamental Frequency

You should not need to use this program unless you are reanalyzing data collected before 2018. It is used to calculate the fundamental frequency on data files where F0 was not recorded, but acoustic data was recorded. Steps to complete this are below.

1. Click **Open Folder** and select a folder of LVM files.
2. Select the type of trial (e.g, mechanical mouthpiece) you need to extract data from using the dropdown menu.
3. View each trial by setting the **Trial Number** and clicking **Examine.**
4. In the bottom right, set the **Start Second** and **Section Duration** to be where there is phonation in all of the trials (2 second start and 0.5 second duration usually work).
5. Click **Extract** and wait for F0 data to be calculated for each trial.
6. If one of the trials shows an impossibly low or high F0, you will want to remove it. Do this by selecting that trial and clicking **Remove Data Point** in the section labeled “Remove an index to change stats”.
7. There is also an option to re-run the extraction.
8. Once you are satisfied with the results displayed in the **F0 Array**, click **Save.**

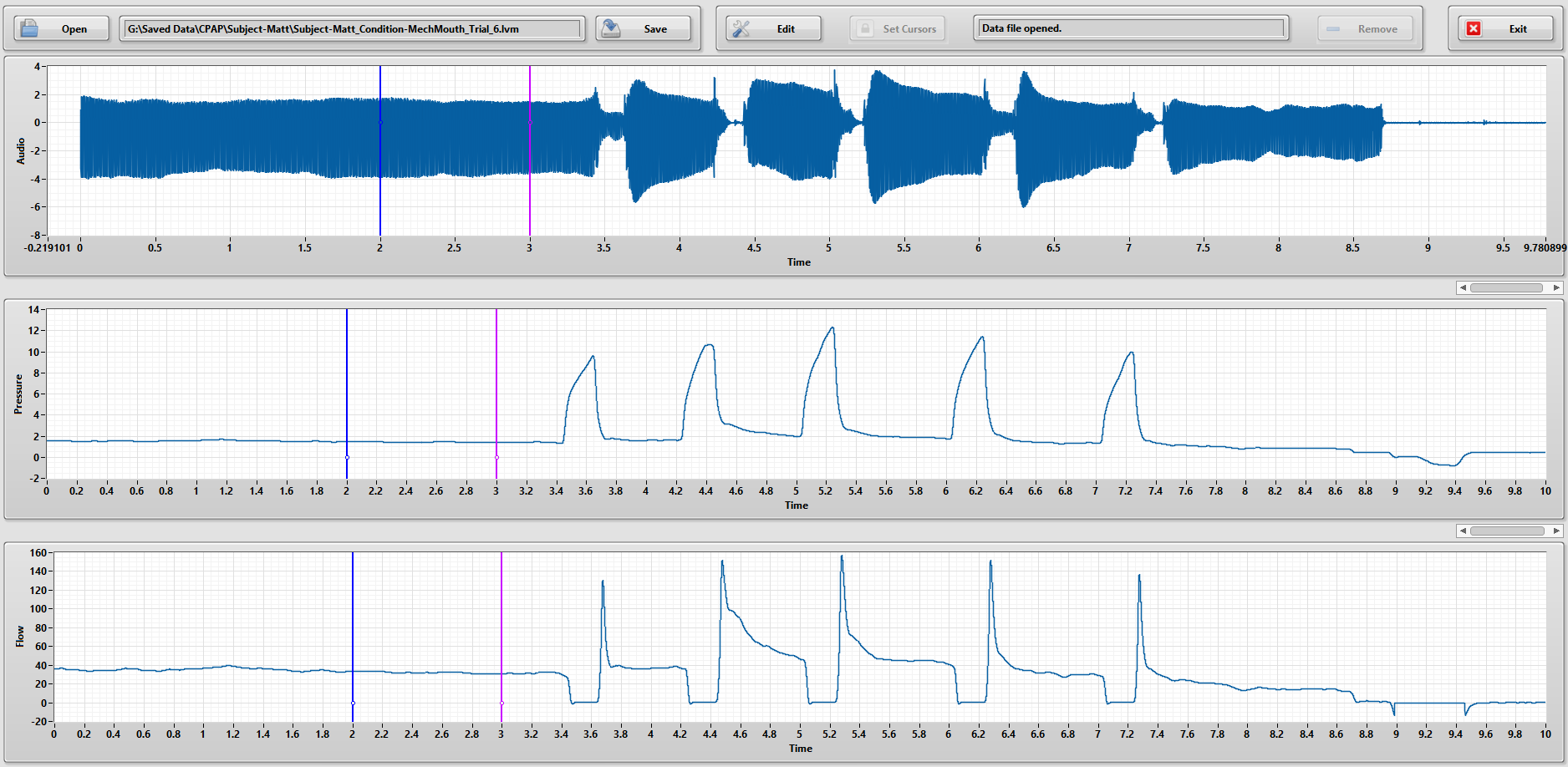


### Analyze Data

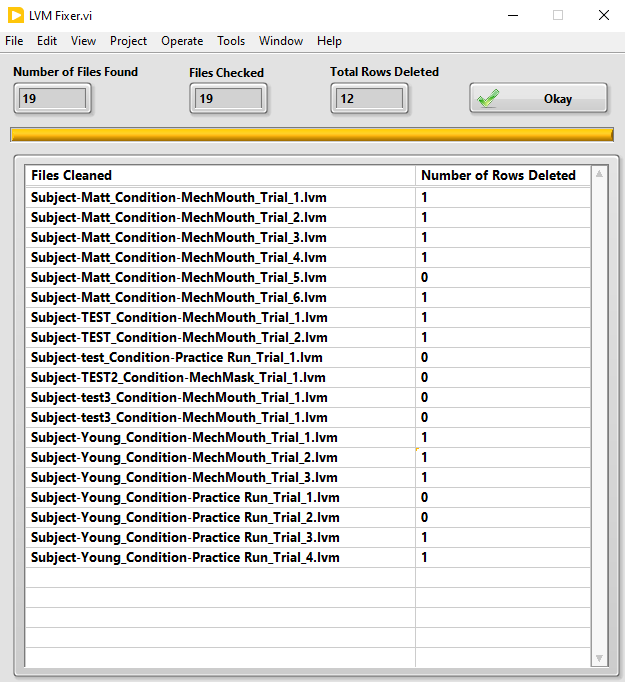
More information on the data analysis portion of this program can be found in a later section of this user guide.

### Data Clipper

This program is used to remove sections of data from an LVM file. This is primarily used for the singing helmet project.

1. Click **Open** and select an LVM file you would like to edit.
2. Click **Edit** to unlock the cursors.
3. Move the cursors to a section of data you want to remove.
4. Click **Set Cursors** to lock them in place.
5. Click **Remove** to delete the select section of data.
6. Click **Save** to save the edited data file.

### Fix LVMs

*NaNs*can appear for a myriad of reasons, but they usually are not a problem. However, they can cause problems if there are a lot of them. If an LVM data file has a lot rows that show *NaN*, use this program to delete those rows.

The user will be prompted to select a folder of data files. The program will then search through all of the LVM files in that folder and delete the rows of data that contain one or more *NaNs.*

Once completed, it will display the files that were found in the selected folder and how many rows of data were deleted from each.

### Submit Error/Request

Clicking this button will open up a Google Form in your default internet browser. From there, you can report errors that you run into, request edits be made on a program, or request a completely new program. All submission on this form will notif y Austin and he will respond whenever he can.

## Block Diagram

In the following sections, we will go over the block diagrams for all of the important VIs and SubVIs found in the Master Aero Program. Details for the Master Analysis Program will be covered later in this user guide.

### Main Menu

Event Structure Cases

* Collection
* Randomize
* Calibration
* Calibrate Helmet
* SPL
* Extract Button
* Extract F0
* Analysis
* Clipper
* Fix LVM Button
* Report Error or Request Change
* Timeout
* Application Instance Close
* Panel Close?

### Aerodyanmics Collection

##### Test Type Selection

##### Get Calibration Data

#### Parallel Loops

### Randomize Tasks

### Calibrate Pneumotach

### Calibrate Helmet

### Gain Estimator (SPL Calibration)

### Extract Data

### Extract F0

### Analysis Master

### Clipper

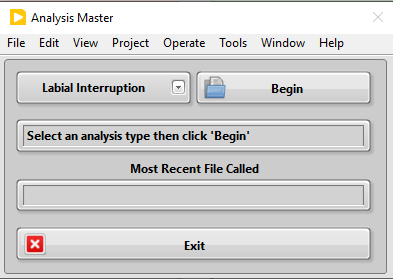
### LVM Fixer

### Timeout Check

# Master Analysis Program

## Front Panel Guide

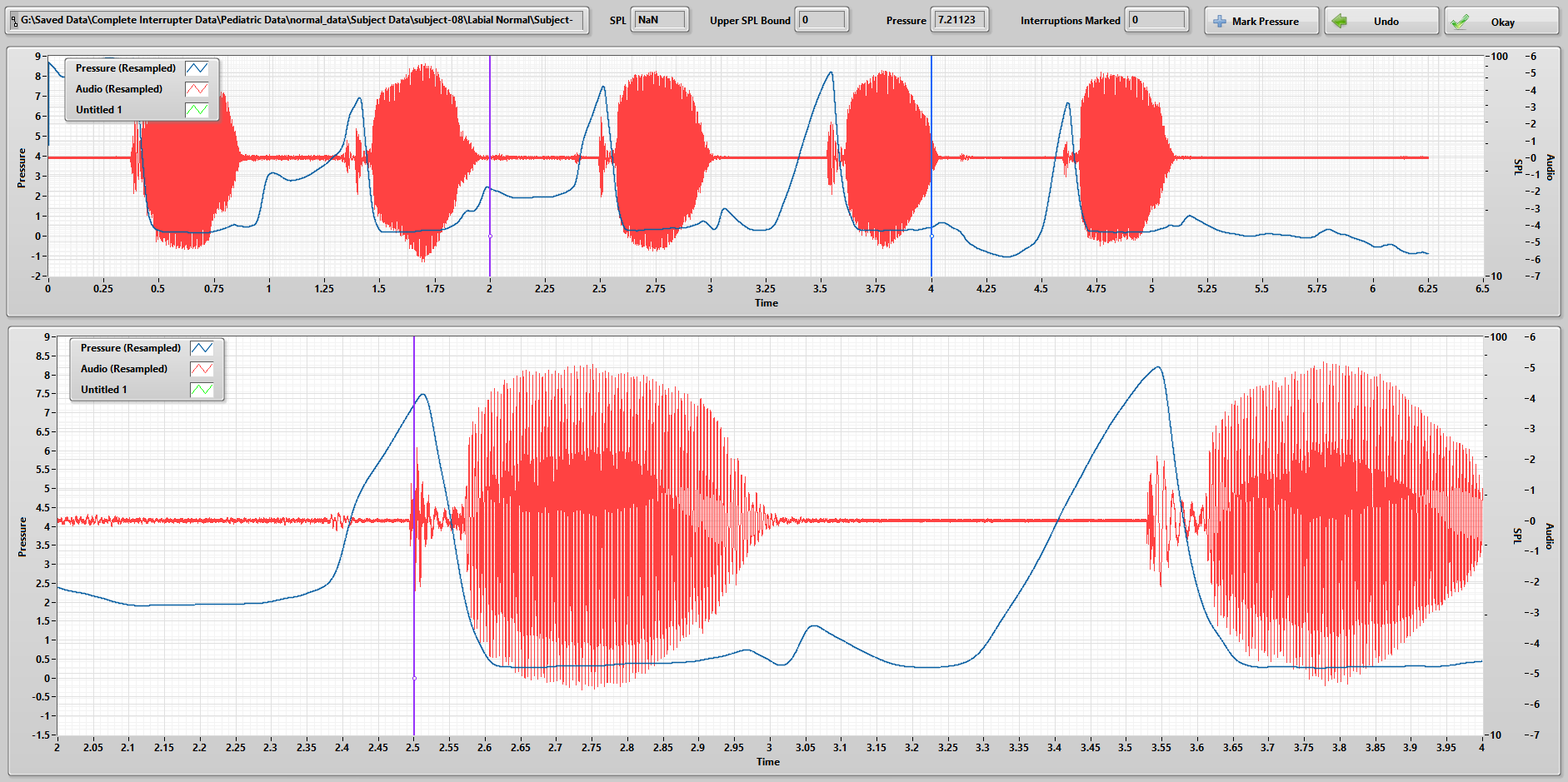
### Main Menu

The main menu is fairly simple. The user just needs to select the type of data they want to analyze and click **Begin**. No matter which test type is selected, the user will always be prompted to select an LVM file before anything else occurs.

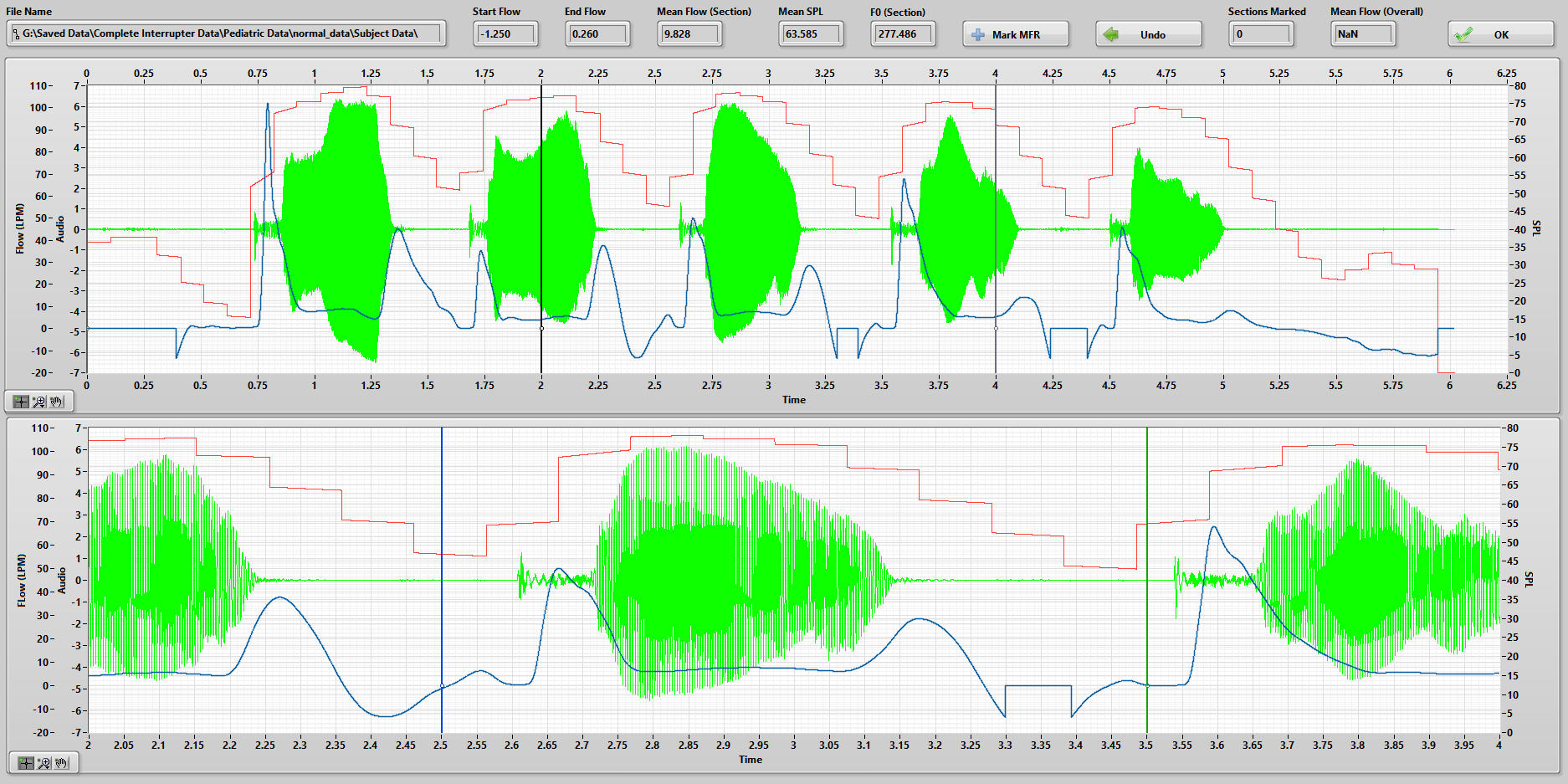
The display for most recent file called is to help the user remember where they are in analysis and avoid reanalyzing the same file multiple times.

Note: there is no analysis option for the signing helmet data. Analysis for this was done with a MATLAB program.

### Labial Interruption

The first interface that appears when analyzing labial interruptions is call Labial Pressure Marker. Here, the user moves the cursors on the upper graph to control zoom in on the each interruption, seen in the lower graph.

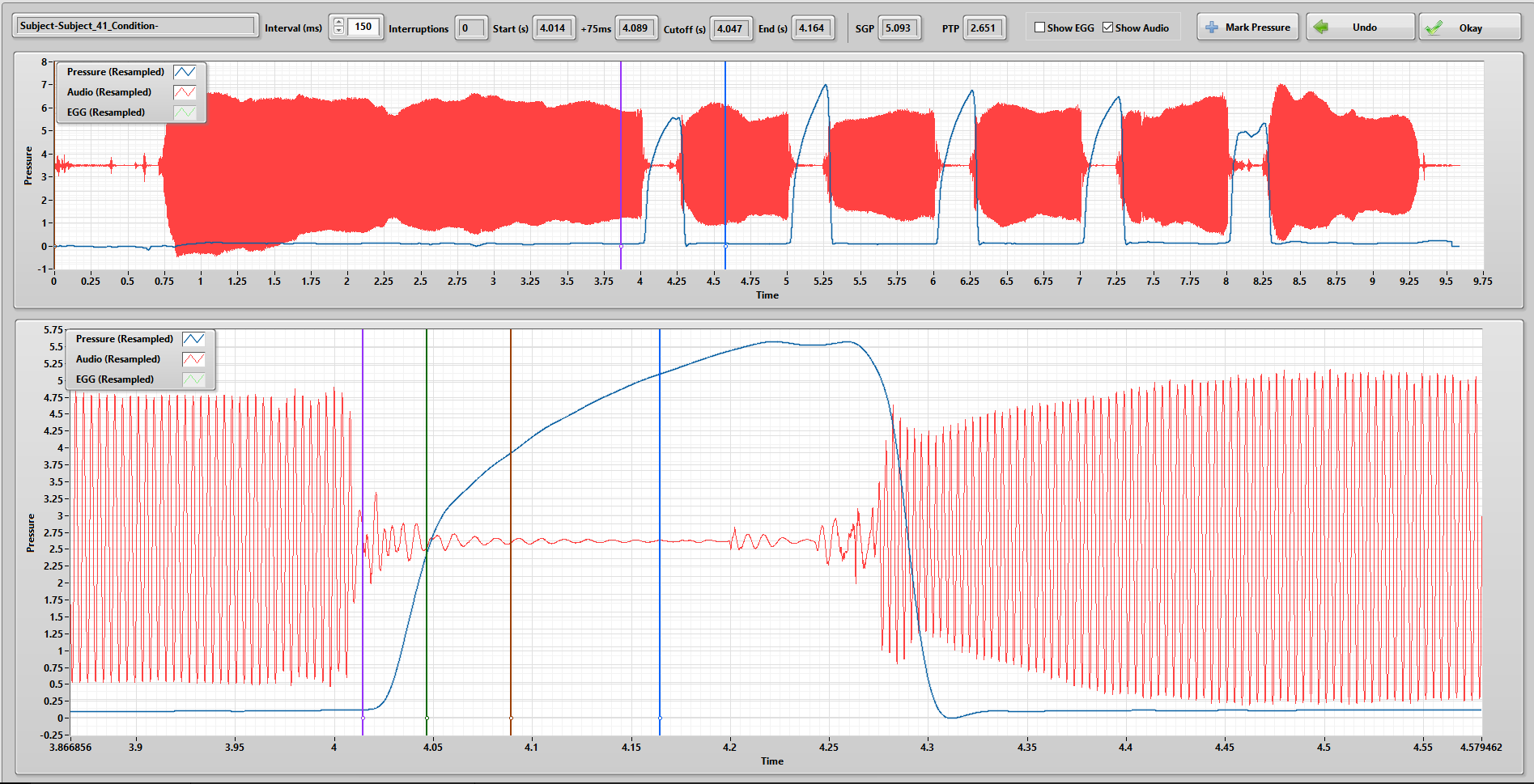
1. Move the cursor in the lower graph to the peak pressure that occurs immediately before phonation.
2. Once the peak is located, click **Mark Pressure.**
3. If you accidentally mark the wrong spot, you can click **Undo.**
4. Repeat steps 1 and 2 for all of the peaks found in the data file.
5. Click **Okay.**

The next interface is simply called MFR. Similar to the Labial Pressure Marker, the user moves the cursors on the upper graph to control zoom in on the each interruption, seen in the lower graph.

1. Move the cursors in the lower graph to a section where there is phonation.
2. Click **Mark MFR.**
3. If you accidentally mark the wrong spot, you can click **Undo**.
4. Repeat steps 1 and 2 for at least 3 phonation segments.
5. Click **OK**.

You can now save these data (MFR, SGP, SPL, and F0) to a new or existing text file.

### Mechanical Interruption

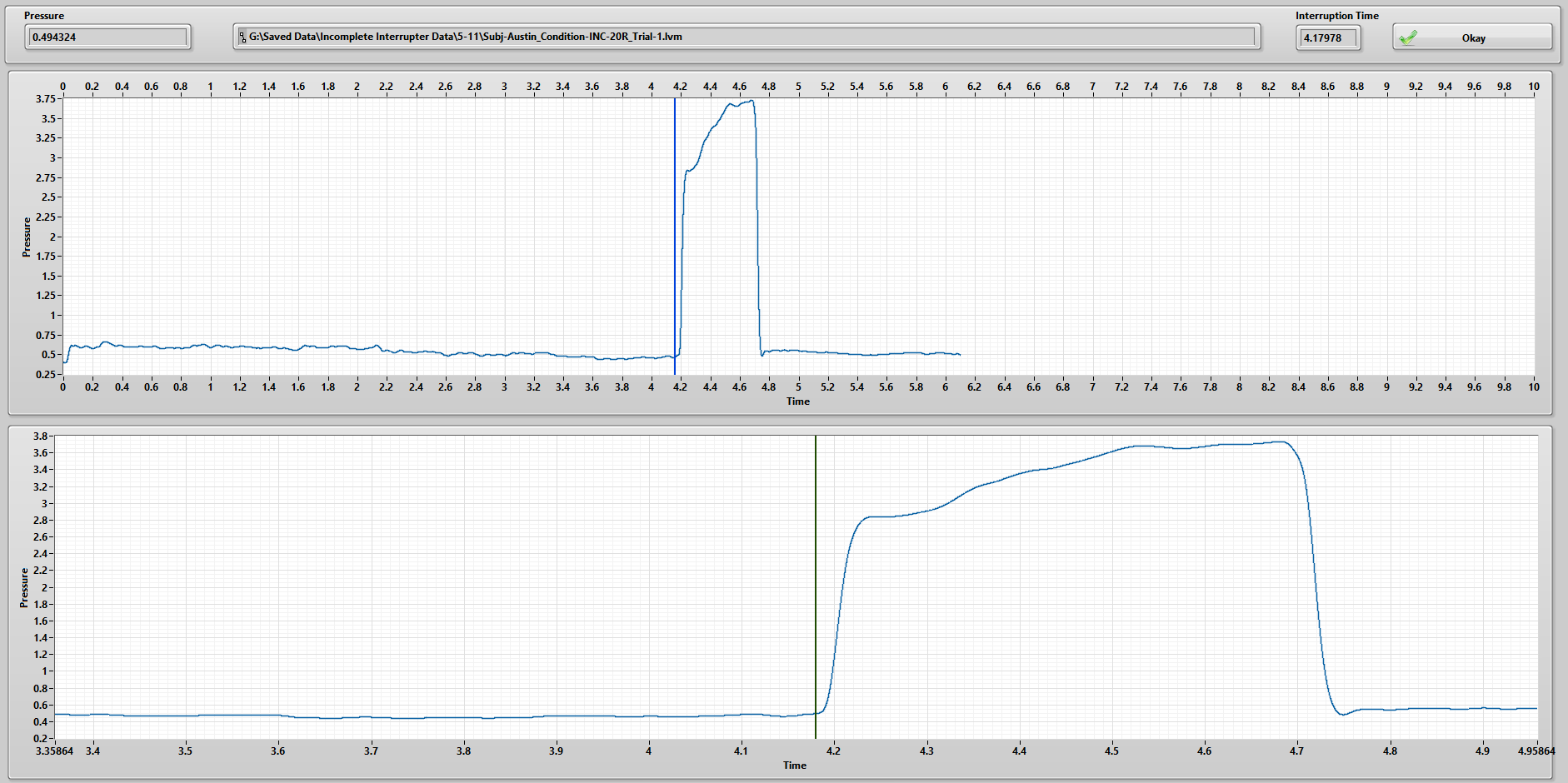
The first interface for analyzing mechanical interruptions is called Find SGP and PTP.

1. Move the cursors on the upper graph to zoom in on an interruption.
2. In the bottom graph, move the farthest left cursor (purple) to the spot right before where the pressure trace starts increasing
   1. The brown and blue cursors move with the purple one.
   2. The brown cursor shows is 75 ms after the purple one.
   3. The blue cursor is after the purple at whatever the interval is set to (this is usually 150 ms).
3. Use the check boxes in the top bar to show acoustic and/or EGG data.
4. Using either the acoustic or EGG data, move the green cursor to where phonation is cut off (this can be tricky, refer to JJ’s analysis guide in the Aero Protocols binder)
5. Click **Mark Pressure**.
6. Repeat steps 2 through 4 for all the interruptions in the data file.

The next interface is the MFR analysis program. This is the same one used when analyzing labial interruptions. Please refer to that section.

You can now save these data (MFR, SGP, PTP, SPL, and F0) to a new or existing text file.

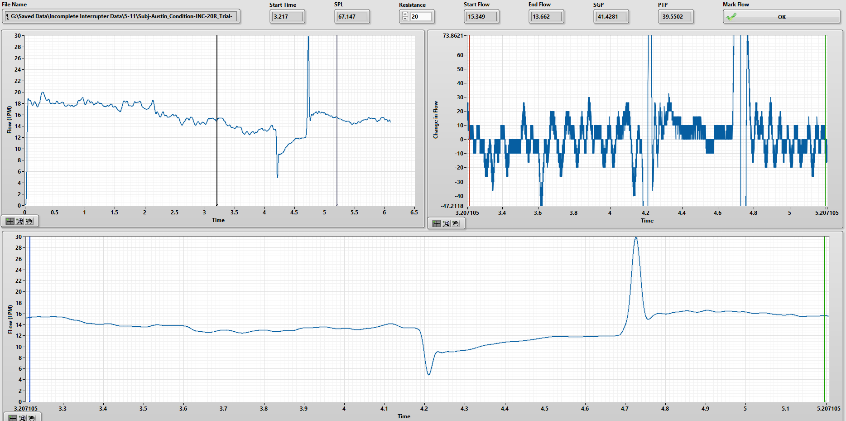
### Incomplete Interruption

This program was originally written back in 2016 and has not seen many updates since. Its purpose is to analyze a single long (500 ms) interruption. During the interruption, the subject will be phonating through a set resistance instead of completely blocking airflow. The user will be prompted to choose PTP or Not PTP.

If Not PTP is chosen, the above will appear. Here the user should

1. Move the cursor on the upper graph to change the bounds on the lower graph.
2. Use the lower cursor to mark where the interruption begins.
3. Click **Okay** when ready to move on.

In the following interface,

1. Set the resistance to be whatever was used during collection.
2. Use the cursors in the upper left graph to zoom in on the interruption.
3. Use the cursors in the upper right graph to mark a section of minimal changes in airflow.
4. Use the blue cursor in the bottom graph to mark a spot of steady flow just before the interruption and click **OK.**

If PTP is chosen at the beginning, the first interface will be similar to marking cutoffs for mechanical interruptions.

### Airflow Redirector

In this program, the user simply needs to move the cursors to mark where the max pressure of the trial is. This will be where the pressure in the tank equilibrates with subglottal pressure (read the redirector paper for more information).

After the pressure is marked, the MFR program will come up again. See the labial interruption analysis section for more details.

## Block Diagram

In the following sections, we will go over the block diagrams for all of the important VIs and SubVIs found in the Master Analysis Program.

### Main Menu

#### Initialize

#### Wait to Start

#### Analyze

#### Save