

SINC™ Technology User's Guide

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SINC Technology Overview

(S)imultaneous **(I)**mage and **(N)**umeric Data **(C)**apture

SINC™ Technology (SINC) was developed to allow the user to simultaneously record motion data (with an EduForce Module) along with video capture (with a Bluetooth enabled device) of the motion, then automatically merge the two files into a singular graphic output so the user can see and analyze both the data and the motion. SINC is the patented process by which this is accomplished.

In the classroom, students will now “see” the physics they are conducting. They will learn the properties of physics through experimentation, but also be able to see the data represented in a way never before achievable in a classroom due to the limitations of sonic rangers and photogates. The purpose of this guide is to show the steps necessary for preparing the Module and Device, recording the data, and using the SINC Graph to see and analyze the data.

The advantage of using SINC Technology is the user can watch the experiment while the corresponding motion data is displayed. SINC adds a new layer of understanding to the motion data, providing visual clues to variances or unexpected results in data. Also, in the education environment students all too often only encounter or study “ideal” situations (the “massless” string, “perfect” harmonic motion, no outside effects during a collision, etc.) In reality, there are often small nuances that occur during an experiment which impact the final results. With the EduForce Module, operating with SINC, students and other users can now actually see and analyze the motion along with the corresponding data, *at the same time*.

As an example, when studying conservation of angular momentum, the effect of a student “tucking their head” while rotating changes their Momentum of Inertia. This appears in the graph as a “blip” or “hiccup” in the data. When the student reviews the graphed motion data, they will actually see the corresponding motion in the video. The value is in observing what actions during the motion caused unexpected variations in motion data and, in being able to relate “real world” circumstances to the “ideal” physics classroom.

Using SINC Technology

To use SINC you will need: A Module(s), Device, Remote.

Please note, you can use more than one Module when conducting your experiment. Though it is possible to pair more than one Remote with one or more Modules and Devices, we do not recommend this action. Use only one (1) Remote for pairing /operation.

We recommend, when possible, to use a tripod for mounting the Device to reduce vibration/blur/etc. Once the Device is mounted, the Module(s) configured for the experiment, and the experiment is set-up, simply press the Button on the Remote (iOS or Android as appropriate) to begin recording, run the experiment, and press the Button on the Remote to stop recording.

Step 1 Prepare Device

- Pair the Device with the Remote using the device's "settings" feature
 - The Remote's Bluetooth identifier is AB Shutter 3
- Test the Device's compatibility with the Remote (Some smartphones require a separate app download to function with the Remote)
 - Start a video recording by pressing the appropriate button (iOS or Android)
 - If the Device starts recording video- they are compatible move to Step 2
 - If the Device does not start recording video (or only takes a still photo) – download a video recording app, like "Open Camera". Retest for compatibility.

Step 2 Prepare Module

- Connect the Module and open the Dashboard you wish to use (Education or Advanced)
 - Bulk Erase the Module(s) (refer to Dashboard User's Guide for specific instructions)
 - Pair the Module(s) with the Remote

Step 3 Calibration

- Complete the Calibration Process (covered below)
 - Complete the steps for the Dashboard selected (Education / Advanced)
 - Apply the Offsets
 - Bulk Erase the Module(s)

Step 4 Experiment

- Set-up & run the experiment
 - Configure the Module for the selected experiment (refer to Dashboard User's Guide)
 - Mount the Device
 - Set-up & run the experiment (i.e. Inclined Plane, Pendulum, Conservation of Momentum, etc.)

Step 5 Download & Analysis

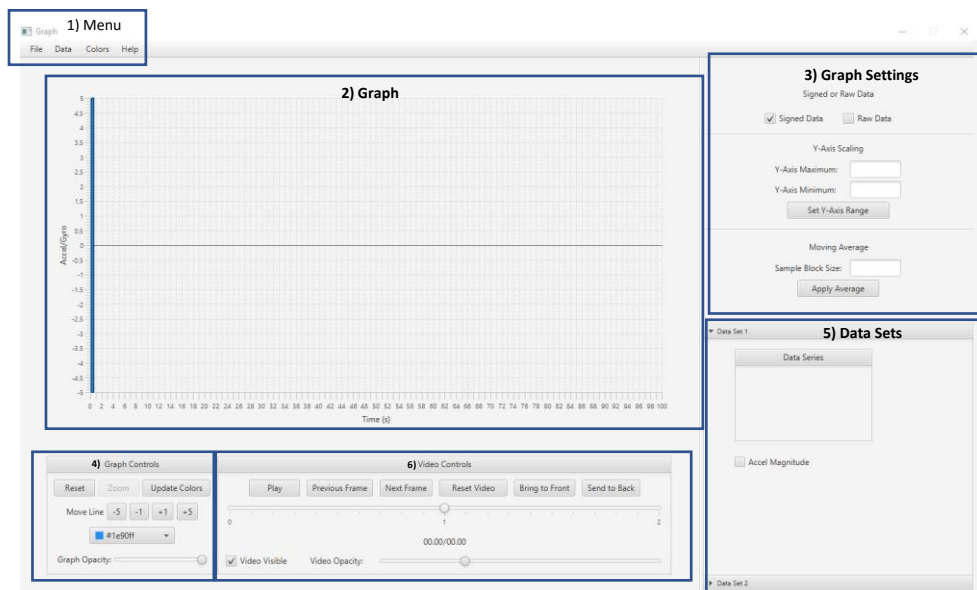
- Download the video file onto the computer, noting the location where the file is saved
- Reconnect the Module to the Dashboard and "Read Data"
- Launch "SINC Technology" (refer to Dashboard User's Guide)
- Review & Analyze Data through the SINC Graph

The SINC Graph Overview

The SINC Graph is a Java-Based proprietary graphing application designed to automatically and seamlessly merge and display the video and motion data captured during the experiment. The user can control how the motion data is displayed including: color of the Time Marker crosshair, Sensor Axes color, Y-Axis Range, Moving Average- Sample Block Size, and manual adjustment of the starting point of the Time Marker. Video Controls include; Pause/Play, Frame-by-Frame movement, Replay Speed, Video Forward/Back, Video On/Off, and Video Opacity percentage. The SINC Graph can also be used to display motion data only.

The Graph can be launched on the Education Dashboard from the: 1) SINC Technology Tab on the main display, 2) Experiment Tab> Step 3 (Choose SINC Technology) or >Step 4 Launch SINC Technology. It can be launched on the Advanced Dashboard from the : 1) Stored Tests tab, or 2) Graph tab.

The Graph sections are indicated below, with detailed information for each section following:



- 1) Menu Bar
- 2) Graph
- 3) Graph Settings
- 4) Graph Controls
- 5) Data Sets
- 6) Video Controls

1) Menu Bar

- File
 - Import CSV
 - The default location is your Documents Folder; however, users can choose to save their files in any location
 - Any previous file can be opened from this menu
 - Import Video
 - Video files are saved in a folder of the user's choosing, there is no default location

- Import Conservation of Momentum (CoM)
 - Because of the nature of CoM, a specific graph format is used. When using the CoM parameters (Education Dashboard>Experiment/Step 1) select this graph to properly display motion data
- Data
 - Use the dropdown menu to clear data (All/ Data Set1 only/ Data Set 2 only) from the current graph and import a new data file
- Colors
 - Use this dropdown menu to customize the color of the *sensor data*
 - Locate the sensor/axis you want to change and click the drop-down menu
 - Select preset colors from the palette or, use the Custom Color option
 - Click “Save”, then click “Update Colors” in the Graph Controls section
 - Use “Reset” to change back to the default color scheme

2) Graph

- Y-Axis displays Sensor Data
 - Default Scale ± 5.0
 - Scale is adjusted in Graph Settings section
 - X-Axis Accelerometer data is the default display
 - Change displayed data in the Data Series section of the graph
- X-Axis displays Time in seconds

3) Graph Settings

- Signed & Raw Data
 - The Default Setting is Signed Data (Raw data which has been mathematically treated to apply a “positive” or “negative” direction). Raw data is an absolute value of the original data as read directly from the module. ***These functions should only be used in limited applications through the Advanced Dashboard.***
- Y-Axis Scaling (Acceleration/Gyro Data)
 - The Default Maximum and Minimum settings are ± 5
 - They can be reset by the user to increase or decrease the scaling factor of the Y-Axis
- Moving Avg
 - Sample Block Size- In order to “smooth” the graph a rolling block average is used to plot data
 - The default setting is 50 Blocks; however, the user can increase or decrease the Sample Block Size and see the resulting changes
 - Changes in the Sample Block Size do not influence the video playback rate
 - Changes in the Sample Block Size **are cumulative**, they are not applied to the original data
 - The changes remain in place even if new CSV files are imported. To clear changes made to the Sample Block Size you will need to:
 - Clear the Sample Block Size field
 - Clear the Data (located under the Data Tab)
 - Then import a data file (located under the File Tab)

4) Graph Controls

- Reset
 - Resets the Y-Axis Max/ Min back to the default ± 5
- Update Colors
 - Click this button to update the sensor data color selected from the “Colors” menu
- Move Line
 - These buttons allow the user to increment the Time Marker by ± 1 or 5 units if a manual adjustment is desired
- Graph Opacity
 - Allows the user to increase/decrease the Opacity of the *graph* to improve the contrast between the graph and the video

5) Data Sets

- Select which Sensor's / Axis data to display.
 - All three Sensors / Axes and Accelerometer Magnitude can be displayed once
- Accel Magnitude can be toggled on or off as needed, shows the overall force of the Module's motion
- Data Set 1 = Module 1; Data Set 2 = Module 2 (if used)

6) Video Settings

- Play/Pause
 - Start and pause the video playback
- Previous / Next Frame
 - Moves the video forward/back one frame at a time
- Reset Video
 - Restarts video from original start time
- Bring to Front/ Send to Back
 - Moves video display in front of or behind the graph. Use this in conjunction with the Graph Opacity function to get the best resolution for examining the experiment data with the video
- Video Opacity
 - Increase / Decrease the Opacity of the video to improve visual quality of the playback
- 0 / 1 / 2 Scale
 - This scale increases/ decreases the playback speed. “1” is normal speed, “2” is twice the normal playback speed
- Video Visible
 - Allows the user to toggle the video display on and off

SINC Calibration (Preparing the Video Recorder & Module)

In order to synchronize the starting point of both the motion data (as captured by the Module) and the video (as captured by the Device) both devices must be paired to the same Remote. Once paired, and the experiment set-up, the Remote will start/stop both the Device and the Module data capture.

Due to the inherent latency of wireless communication, the amount of delay from the pressing of the remote's button and the receiving equipment starting to record data must be calculated and accounted for. This delay is referred to as the "offset". The offset is automatically calculated, recorded and processed by the Dashboard through the SINC software.

Calibration between a Device and Module only needs to be completed once. However, if you use a different Module and/or Device, you will need to calibrate them prior to operating any experiments. Take the following steps to properly calibrate your Module/Device/Remote combination and record the offset.

Step 1 Pairing the Device with the Remote

- Device
 - Ensure it is powered on and has sufficient charge
 - If your video function allows you to change the frame rate, ***you must select 30 frames per second (fps)***
- Turn on the Remote
- Pair the Device with the Remote using the device's "Settings" feature
 - The Remote's Bluetooth identifier is AB Shutter 3
- Test the Device's compatibility with the Remote
 - Start a video recording by pressing the appropriate button (iOS or Android)
 - If the Device starts recording video- they are compatible, move to Step 2
 - If the Device does not start recording video (or only takes a still photo) – download a video recording app, like "Open Camera". Retest for compatibility.

Step 2 Pairing the Module with the Remote

Refer to Dashboard User's Guide for details. Ensure the Module is successfully connected to the Dashboard (via the USB Cable) before launching the Dashboard (users will see a message display on the Dashboard that the "Module is Connected". SINC Technology can be used with either the Education or Advanced Dashboard.

- **Education Dashboard**
 - Click "Erase" Tab
 - Erase Module (refer to Dashboard User's Guide for details)
 - Click "Pair/Unpair Remotes" Tab
 - Pair the Remote with the Module
 - Click "SINC Module Calibration" Tab on the main menu
 - Click "Configure Module for SINC Calibration"
 - Disconnect Module

- **Advanced Dashboard**
 - Click “Erase” Tab
 - Click “Bulk Erase”
 - Click “Remote Control” Tab
 - Pair the Remote with the Module
 - Click “SINC Calibration” Tab
 - Click “Configure Module for SINC Calibration”
 - Disconnect Module

Step 3 Performing the SINC Calibration

- Place the Module inside the SINC Calibration box where indicated, close the box
 - Module’s Board LEDs will be flashing
- Turn on the remote
- Set your Device to record video
- Center the Device’s camera over the hole in the box
 - You should see flashing red lights in the camera’s viewfinder.
- Press Remote button which corresponds to your device (iOS/Android)
 - Your Device’s camera will start recording, and the lights of the module will turn a solid red
- Wait approximately 2 (two) minutes until the Module’s lights start flashing again (*no longer solid red*)
- **Manually stop the Device’s video (*do not use the remote*).**
- Connect your Device to the computer
 - Transfer the video to your computer, noting the location of the file
 - Disconnect your phone from the computer
- Reconnect the Module to the Dashboard

Step 4 Downloading Files and Applying Offsets

- **Education Dashboard** (*you should still be on the SINC Module Calibration tab*)
 - Click “Browse” select video file from the location noted in previous step
 - Click “Apply SINC Configurations to Module”

Your Module now has the proper offsets applied for using with SINC Technology. Navigate to the “Erase Module” tab, Bulk Erase the data and proceed with configuring your Module for the experiment. You will not need to repeat this process if you use the same Module(s), Remote, and Device.

- **Advanced Dashboard** (*you should still be on the SINC Calibration tab*)
 - Click “Browse” select video file from the location noted in previous step
 - Click “Import Calibration Data and Calculate Offset”
 - Timer0Calibration Offset & Delay After Start fields populate
 - Click Apply Offset to Module

Your Module now has the proper offsets applied for using with SINC Technology. Navigate to the “Erase” tab, Bulk Erase the data and proceed with configuring your Module for the experiment. You will not need to repeat this process if you use the same Module(s), Remote, and Device.