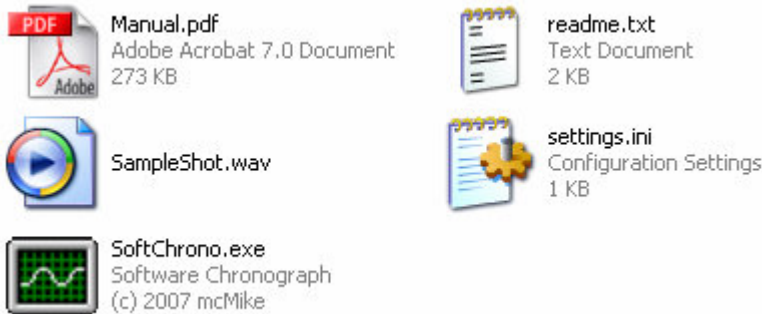# SoftChrono

Software Chronograph version 1.0
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1) Software Install

SoftChrono does not include or need installer nor additional DLLs. It is meant to be just a standalone executable. You can even put it on the memory stick and use directly from there. After unpacking you should find:

- Quickstart manual in Adobe PDF-format (manual.pdf)
- latest changes (readme.txt)
- example waveform of detectable shot (sampleshot.wav)
- settings file (settings.ini)
- The main executable (softchrono.exe)

To start the program just double click the **SoftChrono.exe** program-icon.

2) Shooting Setup

The idea with software chronograph is to measure the velocity of a projectile with the sound. This requires two detectable sound spikes. One from muzzle exhaust and another from target hit (the impact).

Setup a target (preferably wood) or anything that makes loud clear sound when it is hit. Good range is approximately 10 meters but longer and shorter distances works too. The longer the distance the more accurate the velocity measuring is.

Measure the distance accurately (sub inch or sub cm) and place the microphone (or laptop) precisely between this distance. The idea is to have microphone in the middle so that the distance from muzzle and from target are same. This will calibrate the speed of sound out of equation and measuring.

3) Microphone Setup

First you need to make sure microphone is selected as recording source unless you plan to use some special Line In - level hardware for measuring.
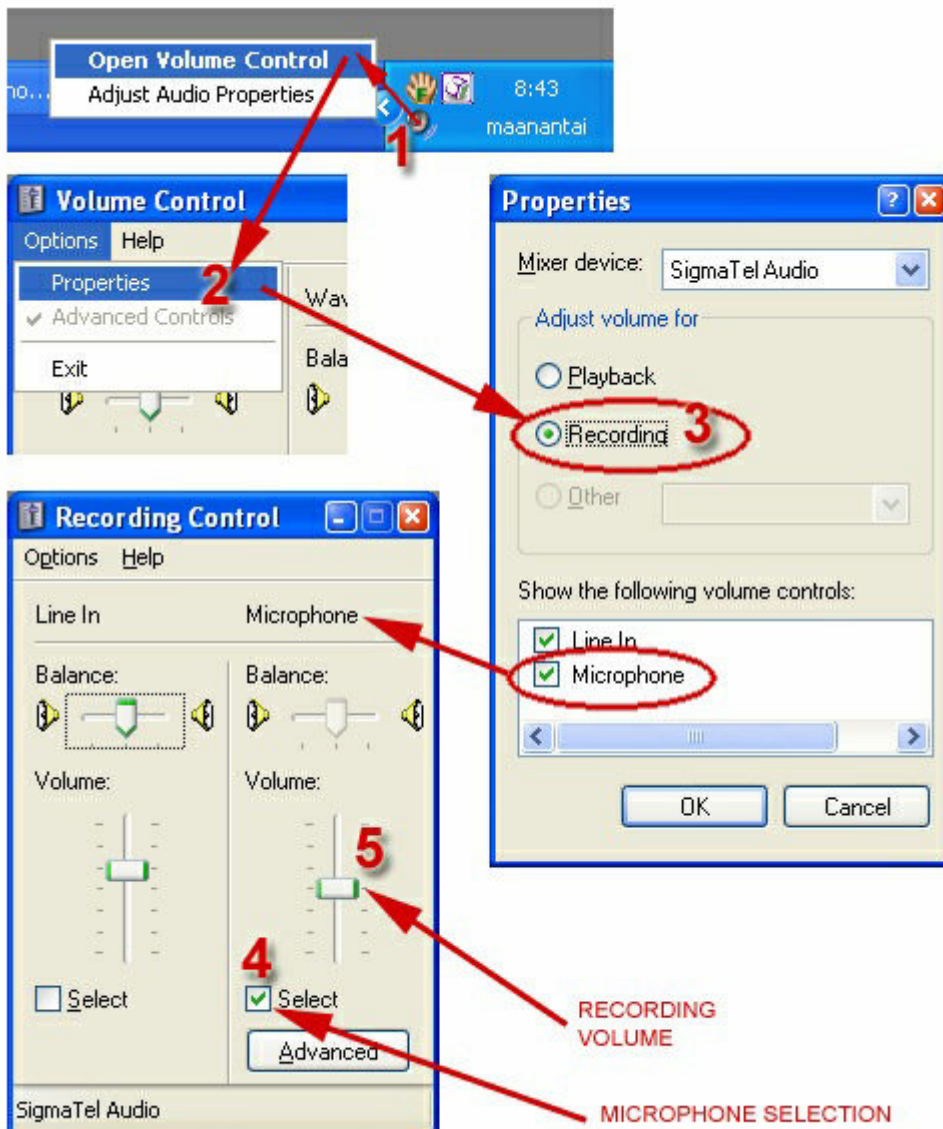
(1) From lower right of your desktop right mouse click the speaker-icon and *open volume control*.

(2) From Volume Control dialog open *Options->Properties*.

(3) From Properties select "*adjust volume for"* **Recording** and make sure microphone is selected in the lower list and click **ok**.

(4) Make sure microphone is still the active recording device

(5) Adjust the recording volume to approximately in the middle at start if you shoot outside. For inside use 1 or 2. Later you very likely need to fine tune the volume to get best possible waveform for measuring.

Program Setup

Start the program and click **_Settings_**. The main window will expand and settings are displayed along with _RealTime Waveform_ (once start is pressed).

Main window expanded for settings

1) select the _units_ you wish to use (metric / imperial)

2) enter _target distance_ in selected units (in imperial only feet are used)

3) enter _pellet mass_ (if you wish to get muzzle energy)

4) enter _min_ and _max velocity_. These will guide the program and set limits for tracking window. Think it as window in X-axis for waveform analysing from where to look trigger levels. The max velocity will help to step over initial muzzle exhaust echoes and decoying sound. Min velocity is like timeout for impact to happen.

5) enter _muzzle_ and _impact volume_. Start with something like 30/60. You will later need to fine tune these.

6) enter _retained velocity_. This you can grab from Chairgun2. If you don't know it just

use 100% for average velocity over range. Retained velocity will transform the average velocity to real muzzle velocity. It is calculated by adding half of velocity loss over the measured velocity.

7) from *Auto Analyze* select all checkmarks. If any of these conditions are met during shooting the recording will stop and *analyzing window* pops up with latest shot's waveform.

   -*if shot detected* will open analyzing window every time successful shot is detected

   -*if no impact* will do the same only when muzzle trigger is detected but no impact

   -*if max velocity exceeded* opens the analyzing window if measured velocity is same than maximum. This usually means that the echo or decaying sound from muzzle triggered the impact and false measuring happened.

8) You can have program to automatically save shot data. The data is saved to ASCII txt-file placed in the directory where you started the program. You can change the location from *settings.ini* –file manually.

   -*autosave after detected shot* will save the velocity and date/time

   -*save extended data* also includes some internal measuring data

   -*save shot waveform* will save the audio file (96KHz 8-bit mono PCM-encoded .wav) for each shot so you can later reload it and analyze or even open to another audio-program

9) If you have access to real commercial chronograph you compare it's results to SoftChrono and calibrate the readings for better absolute velocity accuracy. Enter the difference of those readings to *calibration offset*. Positive value if real chronos number isbigger and negative otherwise.

10) *Realtime Waveform* window displays the ongoing recording once **Start** is pressed. If the muzzle trigger is detected it is marked with blue vertical line and impact trigger with red line.

The sound is recorded in 1500ms looping buffer by sound card device driver and waveform is displayed with background timer 300ms behind recording. So the RealTime waveform is not actually true "real time". Don't get fooled about the small delay in drawing of the waveform – the recording is still done as accurately as hardware permits.

Now you can just click **Start** to begin the recording and make test shot. If the analyzing window didn't popup your microphone recording volume is too low or muzzle/impact trigger volumes are too high. Adjust them until you get the analysing window. If nothing seems to help you can also perform **calibration shot** from corresponding button.

When you finally get the analyzing window you need to fine tune the volumes. You should see a waveform that is first flat and then raises rapidly for muzzle sound. Then continues with relatively loud and diminishes slowly. At the end there is another spike for impact. Unless you can't spot the muzzle and impact spikes visually the program can't do it either. So pay extra attention to fine tune microphone volume levels and environment.

Analyzing

Analyzing window is divided into two separate views. The upper view displays total waveform and the lower displays zoomed area which is indicated with cyan in upper window.

You can move and resize the zoom window with mouse and W/A/S/D-keys. The yellow box in upper window indicates max and min velocities after detected muzzle trigger.

Relatively good wave form of shot which can be measured.
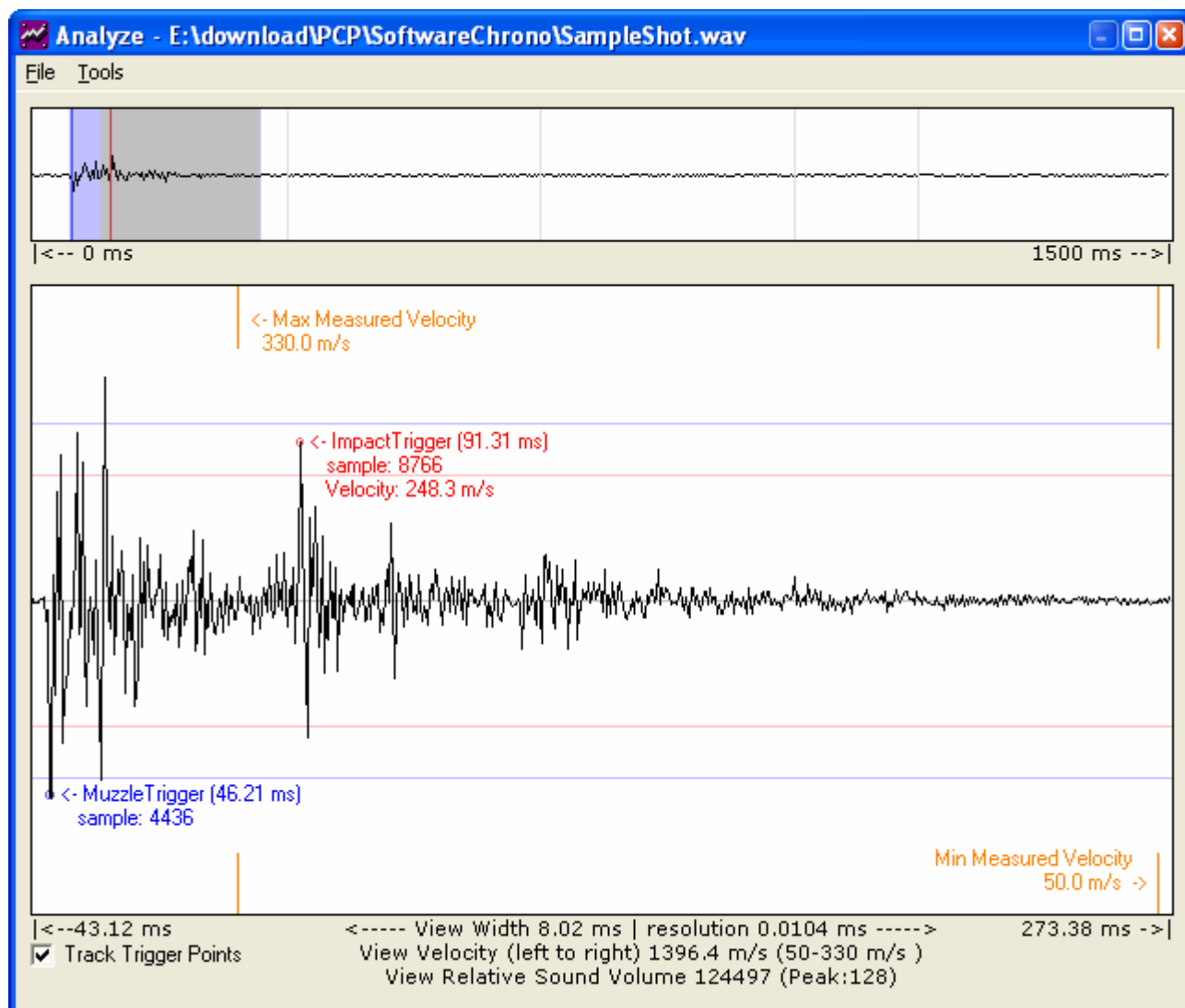
Above you see quite good waveform of shot. At the left the (blue) muzzle trigger is clearly visible and just exceeded the set volume for muzzle exhaust trigger . This is where the time starts to count. Impact trigger (red) is reached little after maximum velocity. You can zoom the muzzle and impact points all the way to individual sample level to analyse more precisely what happened. The velocity is measured only between predefined max-min velocities. If the impact happened before max velocity line was reached or after min velocity line was crossed it is not counted.

So make sure you set them correctly depending of application. For airgun 150-330 m/s is good. For air-soft and paintball you need to use different and smaller values. Also for ice-hockey, floor-ball, golf and baseball.

On the bottom of page you can also see *Relative Sound Volume* (124497). That is an *experimental number* of view's total volumes summed up. You can use that number to check the efficiency of your silencer. It is not directly comparable to other people setups but gives a reference for your progress. Just zoom the muzzle exhaust to fill the view. Write down the number. Make your adjustments to silencer and compare.
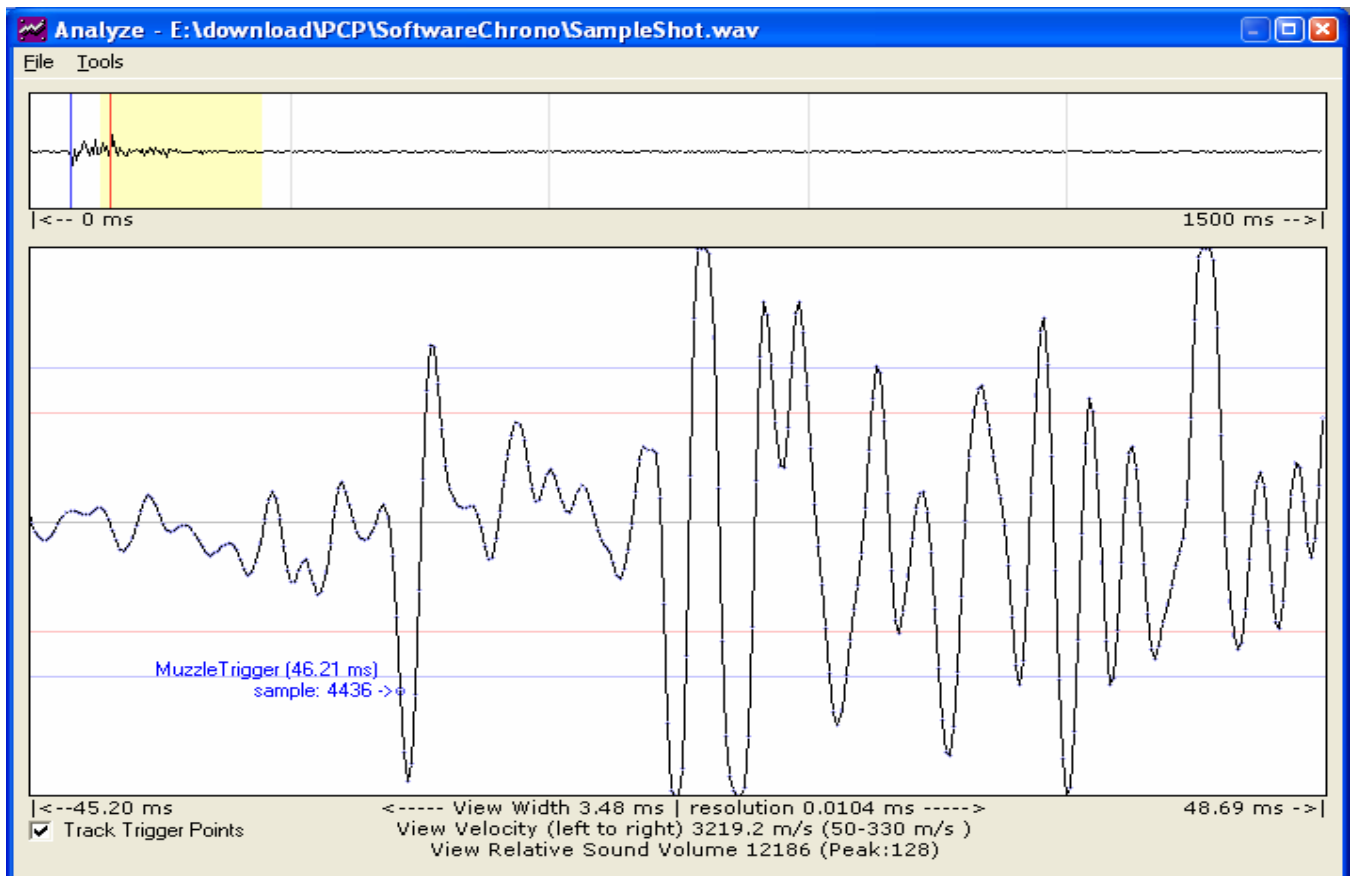
Sample level zoomed view of Muzzle trigger. The waveform peak exceeds defined volume level at crossing of blue line.
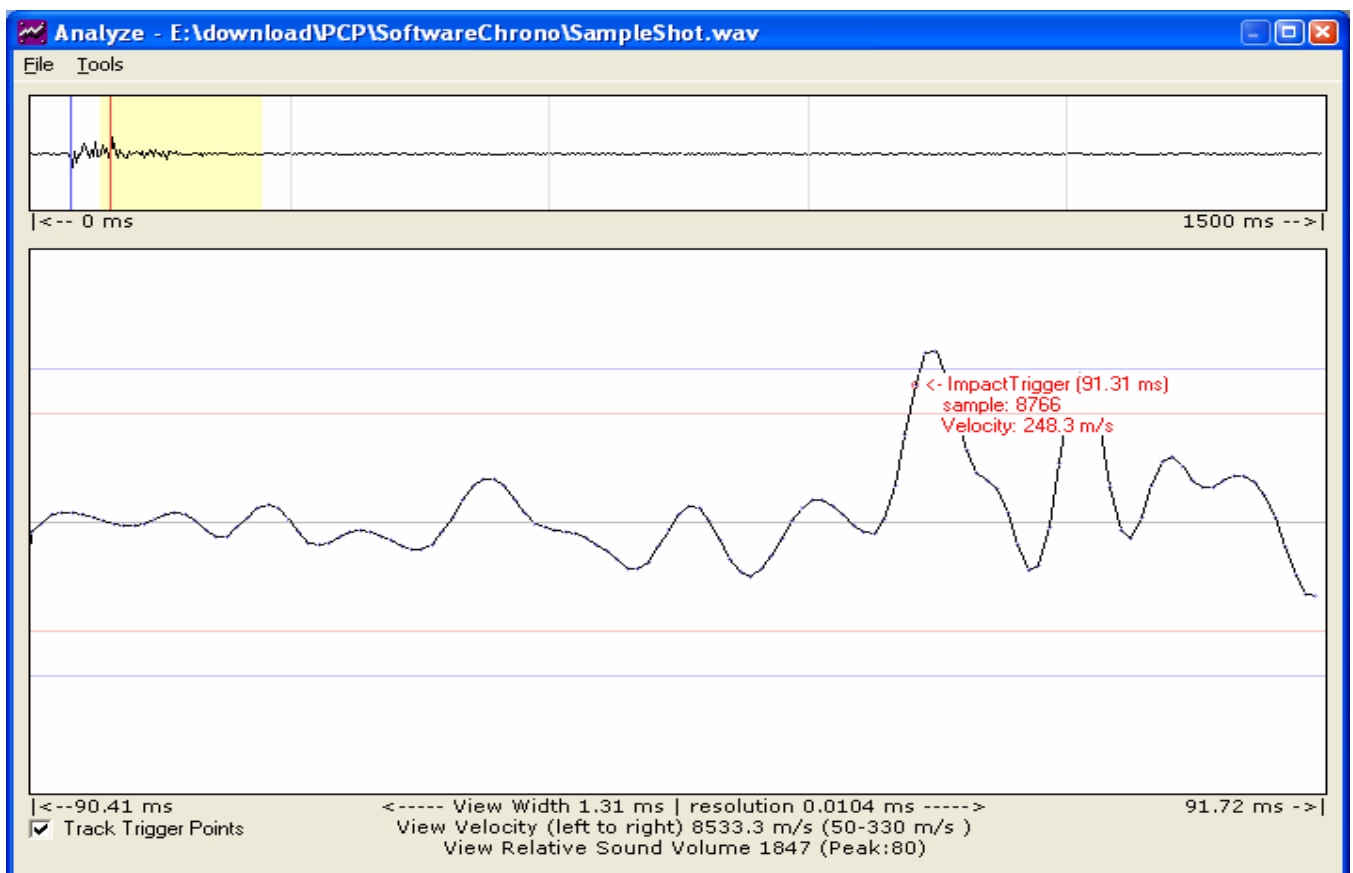
Sample level zoomed view of Impact trigger. The waveform peak exceeds defined volume level at crossing of red line.

You can adjust the horizontal volume levels by dragging them with mouse so that they cross the muzzle trigger peak and impact trigger peak accordingly.

Shooting

Once you get over setup and detection starts to work in your environment you can start shooting the strings. By clicking the *Start*-button the shooting-window opens and displays basic statistical information of shooting session.

Typically you maximize this window and leave it topmost. The user interface is simple with extra large fonts since the laptop is very likely in the middle of shooting distance and many meters away from you.

Information is self explaining and at the bottom there is the shot string displaying graphical representation of your current session's velocity history.

To **reset** the stats and shot counter just double click **Shot Num**-label.

Normal shooting view with statistics

Saved data

SoftChrono saves each shot to external ASCII-file which you can import to excel or any other program to analyse and review later. The file is comma-separated one shot per each line.

Example of results with standard output
```
Date        Time        Shotnum  velocity
12.10.2007  16:12:02  , 1  ,  243.86482
12.10.2007  16:12:02  , 2  ,  242.61396
12.10.2007  16:26:54  , 1  ,  285.81727
```

Example of results with extended data
```
Date        Time        Shotnum  velocity    distance  Pell.weight  volumes  deltasamples Freq
12.10.2007  16:12:02  , 1  ,  243.86482 , 11.20 , 1.0360 , 52 , 63 , 4409 , 96000
12.10.2007  16:12:02  , 2  ,  242.61396 , 11.20 , 1.0360 , 52 , 63 , 4431 , 96000
12.10.2007  16:14:54  , 3  ,  241.81727 , 11.20 , 1.0360 , 52 , 63 , 4493 , 96000
```

Disclaimer

SoftChrono is not meant to replace real commercial light gate chronographs but to provide a free alternative for those who don't own or don't want to purchase such. With SoftChrono you should be able to get decent information about your shooting velocities quite easily.

If you setup everything correctly and enter distances precisely and have a good acoustic environment and microphone the accuracy and repeatability is as good as with cheaper commercial light gate chronos.

Happy shooting and enjoy the software !

Remember to send feedback by visiting www.talonairgun.com-forums in SoftChrono-section.

Finland October 2007

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