GeigerCount
Installation and Operation
1.1

Installation:

The program is distributed in two forms; source and a binary library. Both are in .zip files on the project website. Most users will be best served by downloading the binary. Those who want to tinker with the code may download the source files. The instructions below apply to installing the library file.

You will need to have a Java Run-time Environment (jre) installed on your computer to run this program. Please make sure you have a very recent version. The latest version can be downloaded for free, from http://java.com. (Oracle/Sun). Follow the installation instructions supplied there.

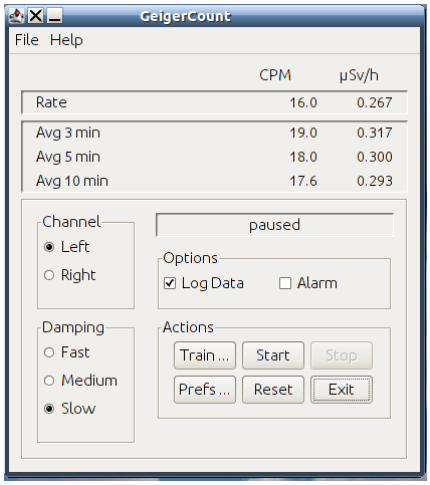
To acquire and install the GeigerCount program, go to the GeigerCount website, http://sourceforge.net/projects/geigercount, and find the latest release of the binary program. Download the zip file to pretty much anywhere. Extract the .zip file to a place where you store executable code. For Windows users a good choice is your Documents and Settings/username folder. For Linux users, a good choice would be your '\home\username' directory. When you extract the contents of the zip file DO NOT disturb the directory structure within the extracted folder. The top level in the directory you extracted will have file GeigerCount.jar. Linux users should manually set the permissions for that file to executable. The program may now be run by opening the GeigerCount.jar file with the virtual machine in your jre. If file associations are properly set in your system then double-clicking on the file should launch it. You will probably find it useful to create a link (alias, favorite, …) or two to put where you like; on your desktop or in your applications launcher menu. (Directions for that vary considerably by OS.)

Operation:

The program requires a connection from the audio output connector of the Geiger counter to an audio input port on your PC. (See later on for details on making a patch cord). You need a wired connection. Holding a microphone up to the Geiger counter speaker or headphones won't be reliable.

Launching the program will take you immediately to the main screen. At the top are fields where the current rate and averages are displayed. Below that, toward the left, are options to select the input channel, damping rate, data logging enable, and alarm enable. Toward the lower right is a group of six buttons that are the available actions to be performed. Below the displays and controls are described, controls first, with some theory of operation thrown in for those interested.

The states of the controls on the main screen are saved between runs, along with the rest of the settings that are set by means of the 'Preferences' dialog. They are saved in a file in your home directory called '.GeigerCount.prefs'. (Linux users, note the leading '.', making it a 'hidden' file.) The file, in harmony with inherent sanity, is human-readable-editable with a plain text editor.



Damping Rate

A conventional analog Geiger counter displays a rate of Clicks Per Minute (CPM) or Röntgens per hour or other values based on current flow through a meter. When a 'click' occurs, a bundle of charge is put on a capacitor in the meter circuit. The current through the meter comes from charge stored in the capacitor which is drawn off through a series resistor. The value of the resistor-capacitor combination determines the damping rate. It's what is known as an exponential decay Infinite Impulse Response (IIR) filter. Often the value of the series resistor is selectable from the control panel of the device, thereby changing the damping rate of the meter.

The GeigerCount program uses a workable approximation of the above. It uses a linear Finite Impulse Response (FIR) filter instead. The click count of the most recent second is weighted by the number of seconds in the filter, down to the last second in the series of seconds which has a weight of 1. 'Fast' response filters over 5 seconds; 'Medium' response over 10 seconds; and 'Slow' response over 20 seconds. (This may change in future releases.)

Channel

The channel selection is simply the choosing of either the right or left channel on the stereo input of your PC. In most cases it will make no difference. However, someone might leave one channel disconnected; or an enterprising individual might elect to hook up two Geiger Counters, one to each channel, and select between them.

Log Data

This control enables or disables data logging. If data logging is enabled, a file named 'GeigerCountLog.csv' is created in your home directory. If if doesn't exist, a new file is created. If it does exist, it is appended to. Comma Separated Value (.csv) format is chosen because the file can be directly opened with most text editors, spreadsheet programs (Excel, etc.), and database manager engines (MYSQL, etc.).

A new entry is appended to the file every one minute that the GeigerCount program is in the 'running' mode. The first field of each line is the time in GMT, formatted YYYYMMDDhhmmss. The second field is the CPM for that minute; and the third field is the equivalent of that CPM in micro Sieverts per hour (µSv/h). For your data collection purposes, feel free to rename/move this file as you need to. If it's

not where expect it's recreated.

Alarm

This control enables or disables the alarm feature. If the current CPM rate, as determined by the 'Damping Rate' control, exceeds a threshold that's settable in the Preferences dialog, a warning window and audio alarm are triggered. Alarm triggering is disabled for the first four seconds of 'running' mode (first use of Start button) to reduce false alarms.

Status

A small status display appears toward right-center, above the action controls. This display shows the current mode of the software. The program operates as a state-machine, in one of four possible states. Those are:

- cleared: Counters and accumulators are all reset to startup conditions. This can also be approximated by the use of the 'Reset' control.
- training The training thread is in operation. More further down under description of the 'Train...' button. Displays countdown until training is completed.
- running Busy counting clicks, reporting rates and averages, logging data, and monitoring for alarm. Displays total seconds of time in this state.
- paused An interim state where the software has been running but has been stopped, and is awaiting another action. Counters and accumulators remain at their last 'running' values.

Train

Make sure all connections between the Geiger counter and your PC are in place, the counter is turned on, and then use your system input control to adjust the volume from the Geiger counter to be about 80% of available amplitude. Then, on first use only, you will need to select your audio input mixer in the Preferences dialog (more later).

Clicking this button starts a training cycle. The program needs to listen to your Geiger counter for 20 seconds to determine the minimum and maximum values of the clicks in the incoming signal. This is necessary before the very first 'Start', and after any change to the input mixer volume controls. Values are stored along with other preferences and Train does NOT need to be invoked between sessions unless the input volume controls have been changed. Train looks for minima and maxima that are between 10% of available amplitude and 99%, with no clipping. Errors will be reported.

Training also looks for what is suspected to be an inverted input signal; that is, a signal in which a click creates a positive-going spike. If this is detected the “Invert Signal” preference is set (see preferences dialog).

Start

Clicking the 'Start' button initiates the 'running' mode. This fires another thread in the software that is largely independent of the main thread that controls settings and displays. Changes to the controls on the main screen (Log Data, Alarm, Damping Rate, Channel) will be honored by this thread to the next second-worth of data.

In the 'running' mode program is listening to the input stream from the audio input channel. It acquires buffers of data one second at a time at 44100 samples per second. It processes the data one second at a time, processing each second as the next second is being recorded, so it misses no data. It looks for waveforms that indicate a 'click'; that is, the Geiger-Müller tube has had a hit and gone into conductance. A waveform that is counted as a 'click' is one in which the input value goes below a threshold. The threshold is determined by the minimum and maximum values acquired during the training process, along with the threshold percentage value from the 'Preferences' dialog (more on the threshold in the discussion of Preferences).

GeigerCount maintains a ten-minute record of click-counts by second in a shift register. With each new second-worth of data, the oldest value is shifted out, the register is shifted, and the newest second-worth is inserted. It's this shift register that maintains all the data for the rates and averages computations.

One second at a time, the program updates the rates display, averages display, saves the data for later logging, and checks for alarm conditions. A record is maintained of the longest number of samples that the tube appeared to stay in conductance.

Stop

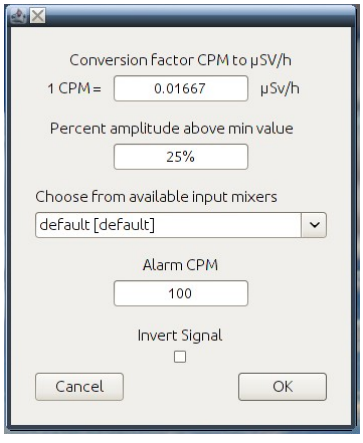
The 'Stop' button pauses the current 'running' condition and sets it to 'paused'. In this condition the program is awaiting another action to be performed. Counters and accumulators remain intact.

The count of maximum samples in continuous conduction is checked and if more than 5 contiguous samples showed conduction, a warning is displayed.

Reset

The reset button is pretty simple. It just sets all the counters and accumulators back to zero, awaiting another 'Start' or other operation. Status is set to 'cleared'.

Prefs



The 'Prefs' button invokes the Preferences dialog.

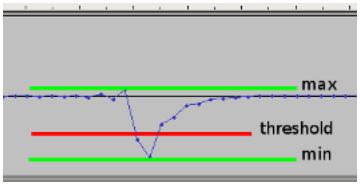
Prefs: Conversion Factor

This number is used to convert clicks per minute, the natural measure of the Geiger counter and this software, to µSv/h for display. If you set it to zero, you will get displays of CPM at the real number and µSv/h of zero. It depends on the model of Geiger-Müller tube used in your Geiger counter. If the counter uses a '6993' tube, like most CDV-700's, the value should be 0.01667. Many more modern counters are more sensitive, and a value of 0.0100 would be more appropriate. See the documentation for your particular Geiger counter for the right value.

Prefs: Percent Amplitude

Back in the discussion of the Training and Start functions we discussed the method of determining what constitutes a 'click'. Training determines peaks and valleys of the input signal. A threshold is determined, above the minimum input signal value, at which the Geiger-Müller tube has gone into conduction mode. (See waveform below.) The number in this field is the percentage of (max - min value) that should be added to the (min value) to determine that threshold. A value around 25% is generally good. The detection algorithm is not particularly sensitive to it. When the signal has gone below the threshold for the first time during a click, a click is acknowledged and counted.

If the Invert Signal checkbox is selected then the above is just reversed. The Percent Amplitude becomes percentage of the total amplitude that's subtracted from the maximum amplitude to determine the threshold. A signal higher than that threshold indicates tube conductance.



Prefs: Mixers

The purpose of this control is to select the audio input channel to monitor from those available on your PC. Unfortunately, Java has no method that I've found to automatically determine the best input channel to use. On the first launch of the program it will look at all available devices and make a wild guess about the best one, However, the choice is left to the user. It's trial-and-error. The list will show you available input channels. Try them until you find the one that works. There are usually only a few. Your choice will be recorded in the preferences so you don't have to select a channel more than once.

Prefs: Alarm

This control sets the CPM rate at which the program will trigger a new thread with a new window with an audible alarm. I'm not going to recommend a starting value as that's a matter of personal preference and intuition. My advice is to convert whatever level of absorption in µSv/h is intolerable to you to CPM (based on the conversion for your Geiger counter) and enter that as the alarm limit.

Once triggered the alarm will display and sound until you manually dismiss it. Yes, it could be automatically reset when the CPM rate drops below the trigger point, but then you might never know it had gone off.

Prefs: Invert Signal

Manual override of inverted signal detection during Training. (See discussion under Start and Stop).

When it doesn't work

1. Is the Geiger counter on?
2. Is the patch cord connection from the Geiger counter to your PC solid?
3. Are you connecting to the Line Input (not Microphone) input of your PC? If using the Microphone input you will probably need a manual volume control. (See below).
4. Is the input volume set through the system 'control panel' to show 80% deflection, without peak clipping?
5. Is the correct input port selected in the GeigerCount preferences dialog?
6. Has the Training procedure been run and has it reported success?

Making a patch cord

This applies to connection from a CDV-700 Geiger counter. Other models will be similar.

I here describe what I did with complete success. You may choose to do otherwise. Your choice.

The idea is to create a female pigtail on the Geiger counter's audio connector, in parallel to the headphones. Then a male-to-male patch cord can be used to connect to the audio input of the PC. I accomplished this by obtaining two parts from Radio Shack. One was a female-to-male patch cord with ⅛-inch stereo connectors (part # 420-2492) and the other was a male ⅛” stereo connector (part # 274-284)(beware of bad connection between this part's' tip connector and corresponding solder lug).

Cut the cable of the male-to-female cable about 6 inches from the female end. That little female section will become a pigtail from the Geiger counter's headphone connector. Solder both the right-channel and left-channel wires together with the 'hot' side of the headphones to the center connection on the headphone connector. Solder the ground lead to the body of the connector.

The other longer length from the newly-cut cable, with the male connector, will become the patch cord to your PC. Solder one of the connectors (part# 274-284) with channels separated (right-to-right, left-to-left) to the cable. Now you have a nice long stereo patch cable.

The patch cable you just made plugs into the female pigtail on the Geiger-counter connector and then into the audio input jack on your PC.

You may find that one other part is needed; a manual volume control to lower the signal level from the Geiger counter to a level that's acceptable to the input of your PC. If you find that you can't adjust the volume control on your external sound input to a low-enough level with just the software controls, try a simple in-line control. (Radio Shack 42-2559). If you're plugging into a microphone input instead of a line input port you will almost certainly need the in-line volume control.

I'll make some diagrams and pictures if somebody asks for them.