



Documentation

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INSTALLATION

At the time of writing, the software can be obtained at <http://cabrillo.edu/~dbrown/tracker/>.

There are two options for running the video analyzing software: (1) a web-based application, WebStart Tracker 4.0, (2) a desktop application, Tracker 4.0.

WEBSTART TRACKER 4.0

The WebStart Tracker is a web-based version of the program. That is, it doesn't need to be installed on the computer to run. This may be useful if the software is not installed on one of the lab station computers or if DeepFreeze prevents keeping the software on the lab station computer. However, if the website is down, this option is unavailable. Also, since this program works with video, it is best to install the software on the computer for performance reasons.

This application can be started by navigating to the link above and clicking the "WebStart Tracker 4.0" link near the top of the page.

TRACKER 4.0

This is the desktop software package (must be installed on the computer, unlike the WebStart tracker option). To install this, first navigate to the link above. Click the link "Download Tracker 4.0 Windows Installer". The software will be downloaded. When the download has completed, run the software to start the installer.

During the installation, you'll be asked to accept a license agreement. To use the software, accept the license agreement.

When prompted to specify the directory where Tracker will be installed, make sure that you install the software to a location on the D:\ Drive (at the time of writing, the D:\ drive is not affected by DeepFreeze so all files placed on this drive should still exist after the computer restarts). For example, install the software to D:\Tracker

When asked to select the components to install, select *Tracker* and *Xuggle* (*Xuggle* allows the software to work with a variety of different video formats). *Sample Videos and Experiments* are not necessary but can be installed if desired.

When asked to specify where to install Xuggle, again choose a location on the D:\ drive. For example, D:\Tracker\Xuggle

Note that Xuggle does not seem to install correctly on the lab station computers. It is not necessary to use the software, though, because currently we are capturing video in .mov files (Tracker supports .mov files *without* Xuggle). It is recommended that Xuggle be used, though.

Note that the installer seems to have trouble installing Xuggle in a custom directory. If you choose to attempt to install Xuggle, after the installation (before you restart the computer), check the directory you specified for the Xuggle installation. If it is empty, the installer probably installed Xuggle in the default location. Usually, that is C:\Program Files\Xuggle

Copy the contents of the Xuggle folder into the specified Xuggle directory (for example, if you specified Xuggle to install to D:\Tracker\Xuggle and it *did not install there*, copy the content from where it *did* install [again, most likely C:\Program Files\Xuggle] into D:\Tracker\Xuggle).

When the installation completes (you do not have to view the readme file), you will need to restart the computer. Restart the computer.

At the time of writing, the installer does not create a desktop icon. After restarting the computer, to run the software, navigate to where the software was installed (our example location would be D:\Tracker). Find "Tracker.exe" (you may not see the ".exe" part of the filename). If you want to create a shortcut on the desktop (note that DeepFreeze will remove the shortcut upon a restart), right-click Tracker.exe and select *Send to* → *Desktop (create shortcut)*.

Click Tracker.exe or the shortcut to run the software.

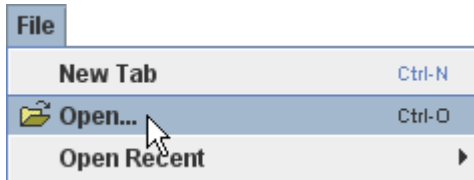
OPENING A VIDEO FILE

To open a video file in a new tab (multiple video files can be opened in one tab where a tab represents something like a project):



click the open file button

or



go to *File* → *Open...*

Using either option, an open-file-dialogue window will prompt you to select a file. Select the video file to open (if you are not using Xuggle, the video file must be of file type .mov, .avi, or .mp4).

This is a quick overview of opening a video. For more advanced options and for working with tabs, see the full documentation: <http://cabrillo.edu/~dbrown/tracker/help/frameset.html>

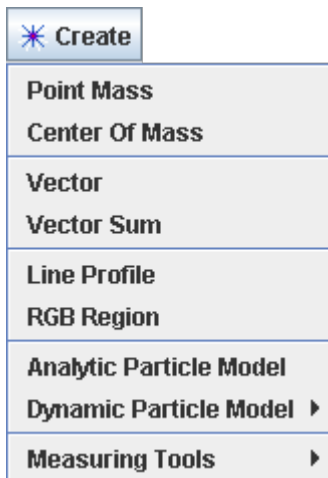
TRACKING

This software features two types of trackers: (1) manual tracking and (2) auto-tracking. Below is a brief overview of the tracking methods and should be sufficient to accomplish the labs performed. For a more detailed discussion and tutorials on tracking, see the full documentation at <http://cabrillo.edu/~dbrown/tracker/help/frameset.html>.

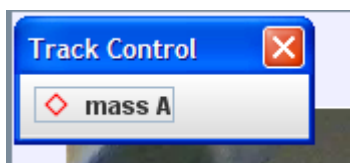
MANUAL TRACKING

This is the most precise method of tracking and is recommended over auto-tracking when precision is a concern.

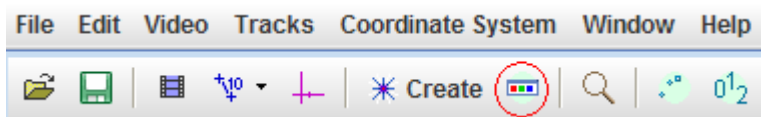
Tracks must be created for each object to be tracked. For our purposes, to create a track, select the “Create” button:



Then select “Point Mass”. The Track Control window should appear.



If the track control window did not appear, you can open it manually by clicking the track control icon in the toolbar.

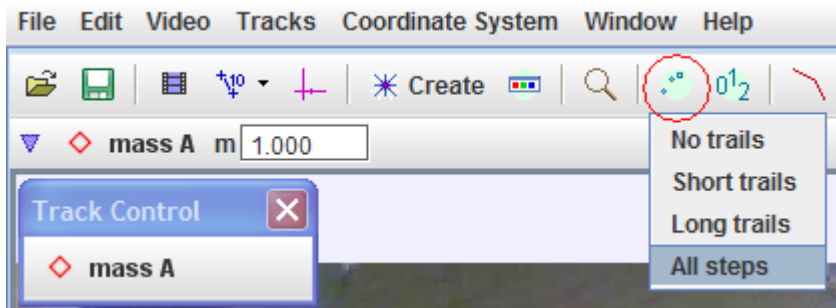


In the track control window, select “mass A” (the default name given to the first point mass track created). This will expand a menu of options available for the mass A track. When manually tracking an object, Tracker will advance each frame after a point is selected on the current frame. This behavior is recommended, however, to disable the auto-advance to the next frame, deselect the “Autostep” check box in the “mass A” dropdown menu.

To plot points for tracking an object, hold down SHIFT and left-click on the current frame to place a point. If “Autostep” is enabled, Tracker will automatically advance to the next frame to allow you to continue manually tracking.

Note that you can start tracking on any frame that you'd like. However, it is advised not to skip frames between tracks (do not leave one frame unmarked between two "marked" frames) if you plan on using Tracker's analysis tools (velocity, acceleration, etc.) as this will skew the analysis.

If a mistake was made in tracking an object, simply click the problematic marker and drag it to relocate it. All analysis tools will update to reflect the change. (Note: to view all traces made on a particular track, click the trail length button and select "All steps". This will show all markers placed on the current track.

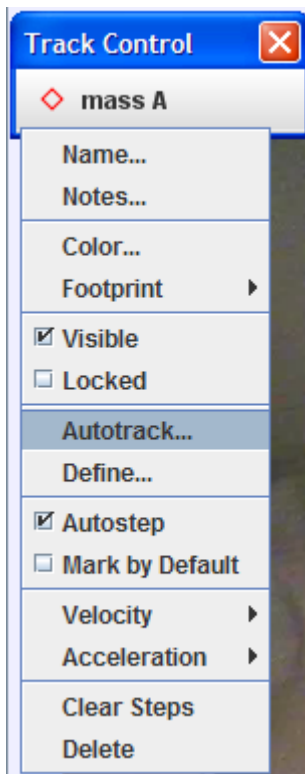


AUTO-TRACKING

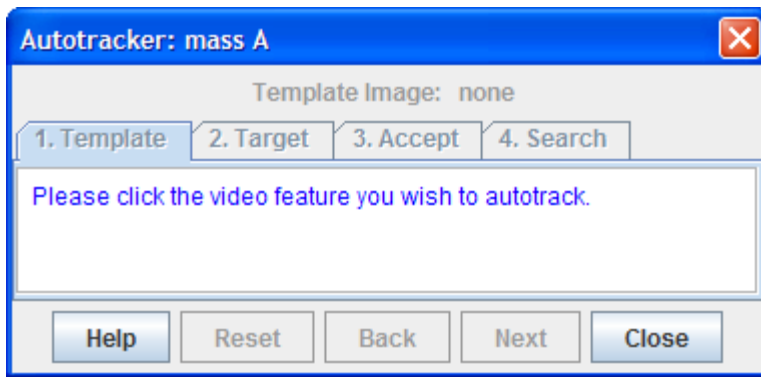
For distinct shapes or colors (images with high contrast with their environment), auto-tracking is a quick and easy option to trace the position of a moving object. On the other hand, if the object to be tracked is hard to distinguish in the video (if it blends with its environment), manual tracking is most likely a better option. Also note that for the best precision, manual tracking should be used.

To auto-track, create a new track by clicking the "Create" button (the same one used for manual tracking).

Select "mass A" in the Track Control window. If you do not see the Track Control window, see "Manual Tracking" for how to manually show the Track Control window. Select "Autotrack..."



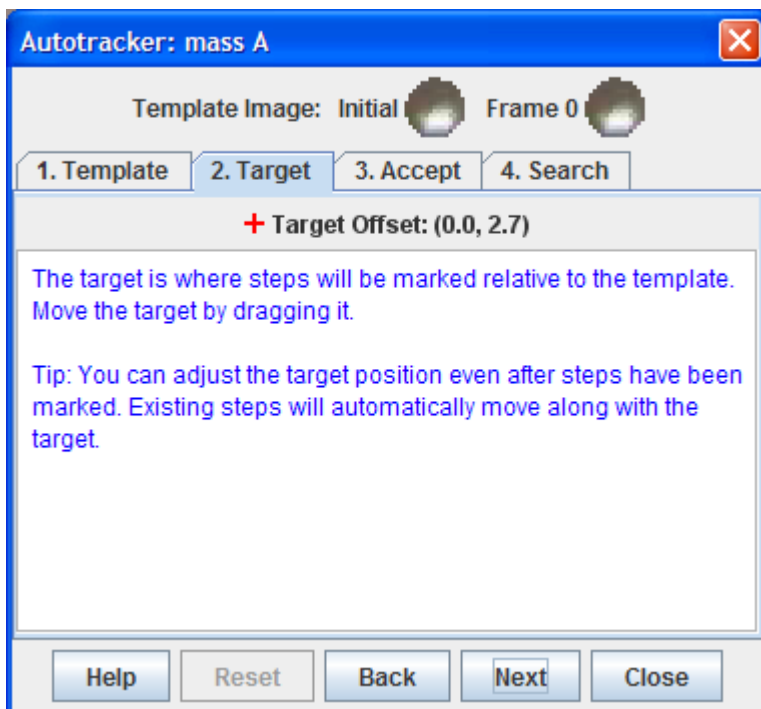
The Autotracker window will appear.



On the video frame itself, select the item to be tracked. By doing so, Tracker will create a template representing the object. It will use this template to track the object through each frame. Note that it is important that the template represent the object (or at least a portion of it) as accurately as possible. If someone's hand is in part of the template, this will confuse Tracker. Select a portion of the item to be tracked *only*.

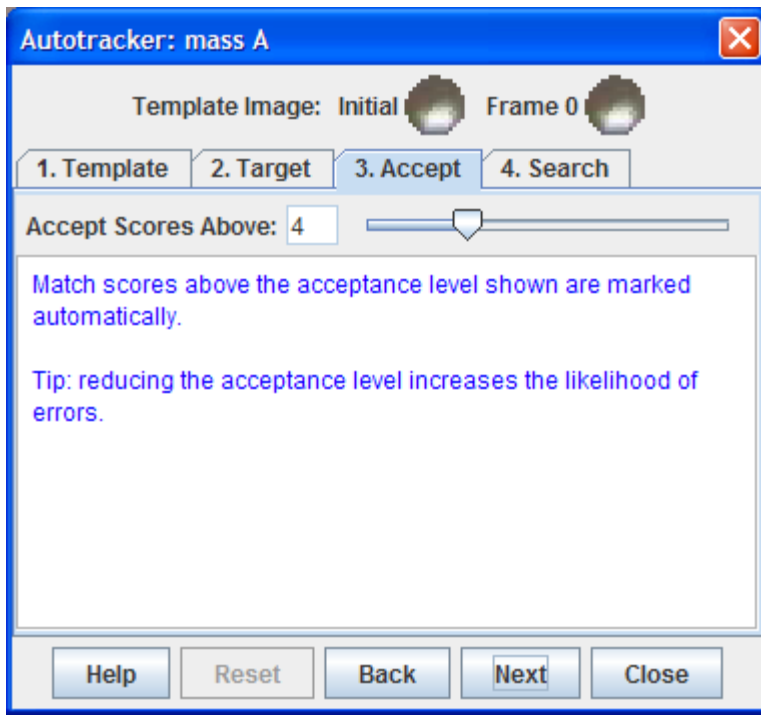
After selecting the template, you will have an option to select the "evolution rate". This is the rate at which the object will change shape or color throughout the frames. Since we are not expecting a shape change nor a significant color change, we can leave this at its default (10%). Click "Next".

Next, you will be presented with the "Target" tab.

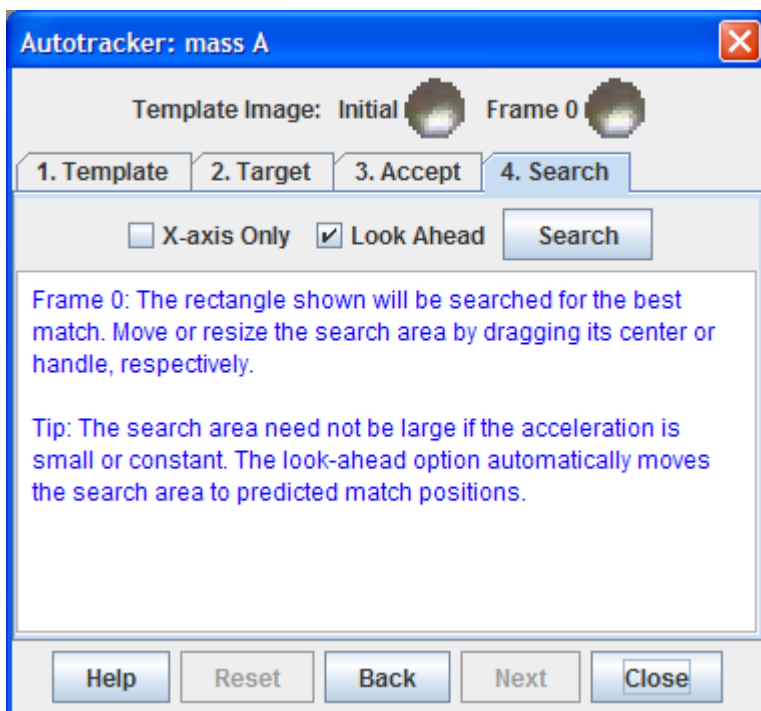


The target is the point on the tracked object that will be marked in each frame. It is best to place the target as close to the point of interest as possible. For example, if we are concerned with the center of mass of a moving puck, we should place the target on the estimated center of mass. Click "Next".

Now you will see the "Accept" tab. This tab allows you to adjust the "Accept scores above:" slider. This slider adjusts the sensitivity of the tracking algorithm. Note that reducing the acceptance level means that the tracker will be less picky about its tracking point. While this may introduce more errors in the auto-tracking, this may also compensate for glare on a shiny puck or ball. For now, we'll leave this at its default (4). Click "Next".



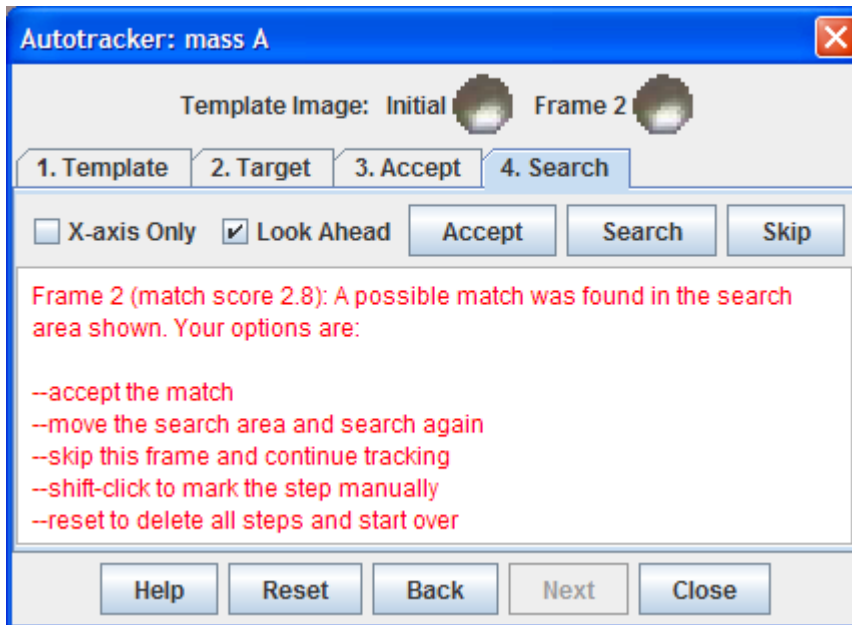
Now we arrive at our last tab (“Search”). Before clicking “Search”, note the two check boxes. “X-axis only” will limit the tracker to looking for the object on a horizontal linear path. Since we don’t necessarily want this, leave it unchecked. “Look ahead” tells the auto-tracker to move the search box (the box in which the tracking algorithm looks for the object in the next frame) to the next estimated position. This will allow us to track a moving object, so check this box.



Click “Search” and watch the Autotracker step through each frame and track the specified object.

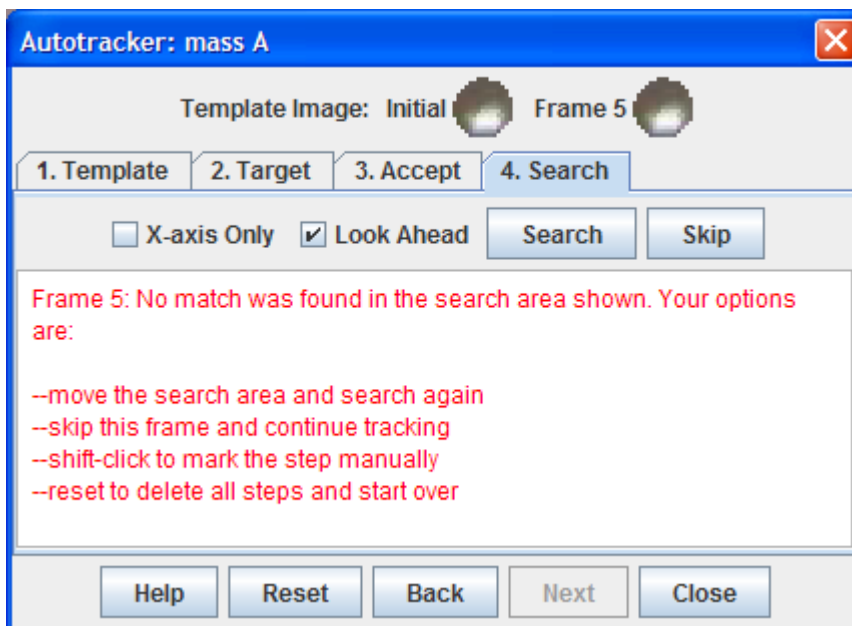
AUTO-TRACKING ERRORS

If you see an error such as



then the searching algorithm has not found any certain matches to the object being tracked, but it has found one or more probable matches. If the "Accept" button is available, and if you are satisfied with the auto-tracker's selection, click "Accept" to accept the auto-tracker's best guess. Otherwise, manually select the point by holding down SHIFT and left-clicking on the object in the frame.

If you see an error such as



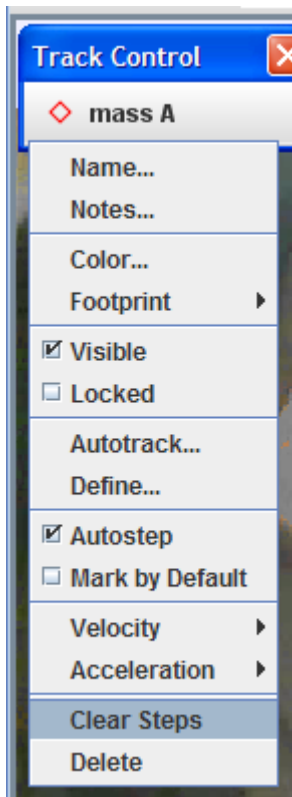
then the searching algorithm cannot confidently estimate any points in the search box that match the object to be tracked. In this case, you must manually select a point for this frame by holding down SHIFT and left-clicking the object in the frame.

If you receive many of these errors, to the point where auto-tracking has practically become manual tracking, the template must be revised and improved. This can be accomplished by selecting a relatively small portion of the object to be tracked. If possible, select a distinguishing characteristic of the object such as a high-contrast colored

area, a mark on the object, or a sticker. Revising the template and also decreasing the accept threshold on the “Accept” tab are the only ways to improve auto-tracking results (given that the footage of the object to be tracked is clear and that the object is not difficult to distinguish).

CLEARING A TRACK

To clear a track of all marks created on the track, select the respective track in the Track Control window. For example, for “mass A”, select mass A to show its drop-down menu.



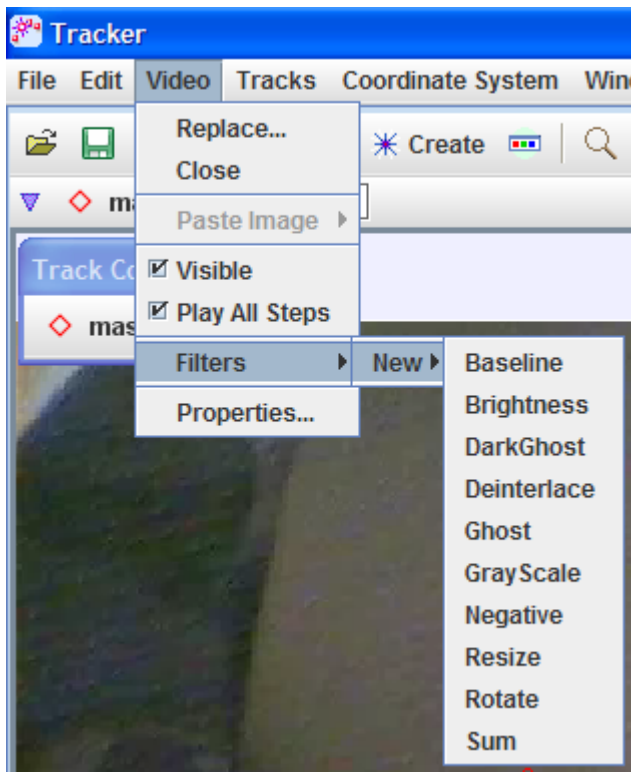
Select “Clear Steps” to remove all marks on the respective track. If you no longer want the track to exist, “Delete” will delete *the track itself*.

FILTERS

Filters allow the user to add special effects to the footages that can alter the color scheme, enhance image tracing, change frame orientation (rotate), etc. The ones of potential use for labs are outlined below. (This is only a brief overview. For a full discussion and tutorials, see the full documentation at <http://cabrillo.edu/~dbrown/tracker/help/frameset.html>.)

ADDING FILTERS

To add filters, click the “Video” tab on the toolbar. Select “Filters” → “New” → *desired filter*



BRIGHTNESS

This filter controls the brightness of each frame in the footage. It can be used to make the background completely black or white (possibly for printing purposes). However, marks from traces on tracks will still be visible. This is an option if the dimensions of the tracked image are not important (if only the path of motion is important).

To achieve an all-white frame set, increase the “Brightness” and “Contrast” to their maximum values. To achieve an all-black frame set, decrease the “Brightness” and “Contrast” to their minimum values.

DARKGHOST

“DarkGhost” will average each frame to determine changes in color (interpreted as motion) between the frames. It will leave a “ghost image” of a moving object in previous frames. As the name implies, DarkGhost leaves a dark ghost image of anything that moves. This filter is well-suited for light backgrounds.

To increase the lifespan of each ghost image (upon experimentation, you’ll notice that each ghost image fades out after a certain number of frames has passed), decrease the “Fade” slider.

GHOST

Similar to DarkGhost, “Ghost” leaves ghost images of moving objects. Ghost images created by Ghost, however, are much lighter than those created by DarkGhost. This filter is best suited for objects moving over a dark background. Again, to increase the lifespan of the ghost images, decrease the “Fade” slider.

NEGATIVE

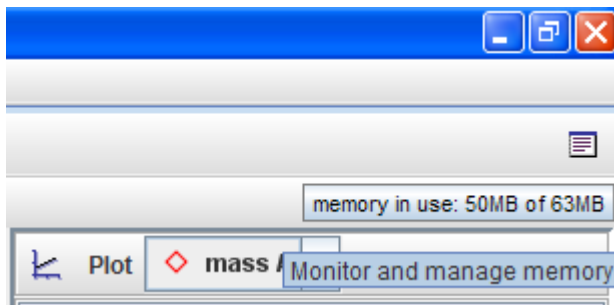
This filter is similar to “Invert Colors” in Microsoft™ Paint. This can be used to invert the footage colors to make the dark lab tables bright while bright objects are shaded into dark objects. This may save ink for printing.

TRACKER ISSUES

Below is a discussion of possible issues that may affect the usability of Tracker. For a full discussion of known issues, bugs, or for more help, consult the official website or a forum (<http://cabrillo.edu/~dbrown/tracker/>).

MEMORY ISSUES

When Tracker runs, it is allocated a fixed portion of the computers main memory. It is possible that Tracker may use all of its allotted memory. This could cause Tracker to crash or to become slow to respond/unresponsive. To allocate more memory to Tracker, click the “memory in use: xxMB of xxMB” label (pictured below).



This will open up the memory monitor and manager (this can also be found under “Edit” → “Preferences” → Runtime (tab).

Deselect “Use default”. The textbox for memory allocation is now unlocked and able to be changed. Pick a new memory allocation size greater than the previous maximum. At the time of this writing, the lab computers have approximately 4GB of main memory available. Tracker should not need more than a couple of hundred of MB of allocated memory. Do not allocate a disproportionate amount of main memory to Tracker as this will starve other background processes and cause them to possibly become unresponsive.

