

Autotracker tips & tricks

Jens Biele, March 2021

1 Purpose

Howto tracker short version; Tips and tricks for autotracker, including comments by Doug Brown

Tracker version 5.1.5, Feb 2020

1.1 Autotracking a long video - short version

Start tracker, check settings (language; number format; unit; RAM as high as possible, 986 Mbyte on my machine; angles in deg, short trails, hide numbering, show path, use view/notes, enable autofill

Load .trk file if existing, else video-file. Set clip in Video, i.e, start frame, step size (if not 1), end frame, actual fps = 1/frame dt, metadata if you want, filter if you want.

Turn off auto-refresh (important for long videos!)

Click the Calibration button and select the calibration stick or calibration points. N.B.: You can always adjust a marked position by dragging it with the mouse or selecting it and nudging with the arrow keys. Right click the video to zoom in for sub-pixel accuracy. Zoom box e.g. with right mouse-click

Click the Axes button to show the coordinate axes. Drag the origin and/or x-axis to set the reference frame origin and angle

Click the Create button and choose Point Mass

1. Shift-control-click the video feature of interest to create a key frame. This will display autotracker if it is not already visible.
Adjust target, template circle – not ellipse if your target rotates, search area – few times bigger than template circle
2. Change the default settings if desired: evolution rate (as low as possible but not 0, normally) and min score (4 is ok).
3. Click the Search button, RUN. Check if target does not drift out of template area.

When done, click “refresh” to see the track data; save your work! Export track data to a spreadsheet or a text file*. Do NOT change filenames of videos (!) a posteriori! (The TRK file is a text file that has the path to the video but does not contain the video itself). A better way to save your work is in a TRZ file, which is a zip file containing the TRK and video along with automatically generated documentation. Changing the name of the TRZ is fine

since it's self-contained. Usually I save a TRK while working on a project, then save a TRZ when I'm done.

*Tracker's *Datatable View* displays track data in a table. To change the variables included in the table, click the Data button and select from the list displayed.

Data can be easily exported from the datatable by copying to the clipboard and pasting into a spreadsheet or other application.

1.2 Choice of target marker, if possible

Best is to use artificial target markers on the object, Rings in 2 colours or at least black and white, examples below. **Cross-hair targets are really bad, if the target is rotating!**



I usually have long videos with objects that often have no markers stuck on them. Tracker usually finds a feature that autotracker can track, but over time, evolution of the template may cause a drift that can be significant. Then all the fine sub-pixel accuracy is lost, obviously. In some cases, the target is changing ever so slowly, but steadily could probably be near 0. But only 0 and 5% can be set in the present version; upcoming versions, Doug promised, will have a finer scale and maybe a mechanism to “tether” the template to the original one.

The template can be a circle or an ellipse. However, the ellipse cannot be rotated (at defining it), and it does not rotate in sync if the template pattern rotates over time, which can be bad.

1.3 Choice of templates

Note: search area centers on template, but target can be anywhere relative to both!

Make search area a few times bigger than template, else template too easily drifts out!

1.4 If Autotracker stops (score too low..)

Skip (if autofill is activated) helps to get over just a few frames with the cat in front of the object or things like that. Else, you have to define a new template and re-start with that. An “autoskip” option may appear in future.

After autotracker is finished, you can adjust the track points in each frame at will (mouse)

Shift-click auf Autotracker “Search“ button opens Options menu: Search fixed area (see manual) and: Copy match data, interesting to check how the score evolves.

2 Some collected Q&A

Video timescales: Inhowfar can we trust the timescales given in videos ? There is only a framerate in the file, sometimes even wrong if you know you used slow motion like 1 fps and it still says 30 fps. And it could be 30 fps although actually it is 29.97 fps (NTSC TV legacy) The timestamps in MPEG4 are not really “measured stamps” but calculated from number of frame and framerate.

I made a video with 1fps of a digital stopwatch (IPhone, displays 0.01 s) and that showed a little variation of the last digits, rms about 0.03 ms or less, and a drift less than $2E-6$ over several hours.

DB: The time codes and time base for videos is definitely an issue at times. Especially when a video has been converted or edited. And of course there is the 29.97 fps standard inherited from TV versus the 30/60/120 fps now used som commonly. When Tracker could use both QuickTime and Xuggle engines they would sometimes report different frame rates and even frame counts for the same video. So if I were serious about data I would determine the frame rate of the camera (specs) and then in Tracker set the frame rate to the correct value in the clip settings.

Trackcontrol/mass/Autostep: what is Autostep? DB: Autostep means that when you mark a position of a point mass with the mouse then the video will automatically step to the next frame. I'm not sure why anyone would want that off, but it's in there as an option anyway...

Radial distortion filter, nomenclature: it's not a correction for lens distortion (i.e., effects of a *real* lens, or system of lenses, deviations from pinhole model, different for each real lens) but change from/to various projections. The pinhole camera has obviously what you call orthographic projection, $r \sim \sin \theta$. I would call that perspective projection (pinhole camera!), and orthographic only if object is at infinity. But a matter of terminology.

Autotracker's "look-ahead", seems to struggle if the timestep is so small that the target hardly moves from frame to frame. Then, the template does not move, and the object drifts out of the search frame eventually.. I could prevent this, however, with setting evolution rate =0 (luckily, circular target marker, and 2D-motion, so it really did not evolve, to a good approximation).

DB: That's interesting about the lookahead not working well with very slow motion. Must be that the noise from one frame to another swamps the actual movement. Did you try setting the step size to some large number like 50? That would still give you 200 data points in a 10000 frame video. Another thing to do is just turn off the lookahead, since that way the search area in each frame is centered on the match of the previous frame.

3 Infos from Doug Brown:

Evolution of the template works like this: for each step, the new template image is a composite of the previous template and the match to the previous template. The alpha values for this composite are defined by the evolution rate, so that when set at 20%, for example, each pixel in the new template is 80% of the pixel in the old template plus 20% of the corresponding pixel in the match. Note that "the match" is the single best match (1 pixel resolution), not a combination of it and the neighbors that were used to find the subpixel best position for the match.

Yes, you can autotrack the calibration points so the coordinate system changes with time. Before doing this, uncheck the fixed origin, fixed angle and fixed scale items in the Coordinate System menu. Fixed means the same in all frames, so when you change something in one frame it changes in all, whereas Locked means you can't change them at all. To autotrack a calibration point select the calibration track and either point in the autotracker dialog.

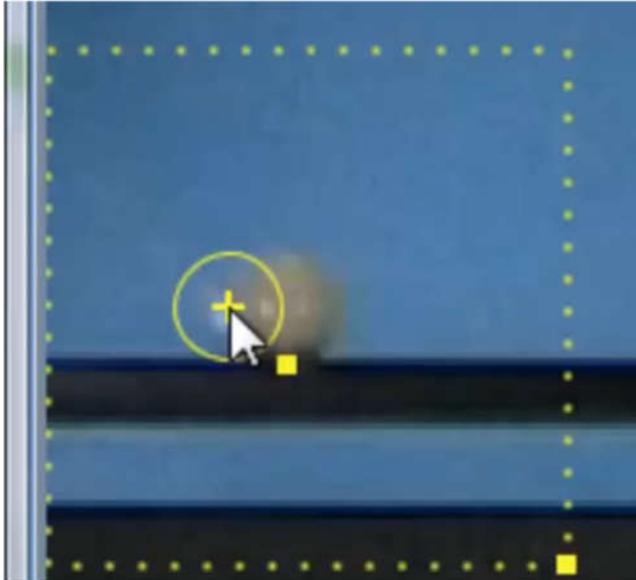
With the circle fitter, too, you must uncheck the "fixed" box in order that it change from frame to frame (if you attach it to one or more point masses, I think it will be automatically unfixed). An important thing to realize is that when a track is unfixed each time you make a change in a frame then that frame becomes a "position keyframe" (not the same as an autotracker keyframe). The changes to a keyframe apply to it and to all frames following it up

to the next keyframe (if any). So in a video with frames 0-5 and an unfixed calibration track, first changing 0 applies to all (there are no other keyframes), then changing 3 would apply to frames 3-5, then changing 5 would apply to 5, then changing 0 again would apply to frames 0-2 (since 3 is now a keyframe), changing 2 would apply only to 2 and changing 3 would apply to 3-4. Do you see how that works? Normally you (or the autotracker) would step through the video and change every frame, so going back to an earlier frame for another change would apply only to that frame.

- The 'look ahead' feature in autotracker, does it use both velocity and acceleration? How many "good" steps does it need? I think that if acceleration were used, rotatory motions could be tracked better if the target moves a lot from frame to frame. But not sure..

4 Clarifications from the autotracker tutorial

The keyframe:



Rectangle: search area. Ellipse: template area. +: target.

How the autotracker works

$$\text{RGB difference} = \sum_i [(\Delta R_i)^2 + (\Delta G_i)^2 + (\Delta B_i)^2]$$

where i iterates over all pixels,

$$\Delta R_i = \text{Red}_i(\text{test image}) - \text{Red}_i(\text{template})$$

$$\Delta G_i = \text{Green}_i(\text{test image}) - \text{Green}_i(\text{template})$$

$$\Delta B_i = \text{Blue}_i(\text{test image}) - \text{Blue}_i(\text{template})$$

How the autotracker works

$$\text{Match score} = (\text{mean RGB diff} / \text{match RGB diff}) - 1$$

perfect match: RGB diff = 0, score = infinity

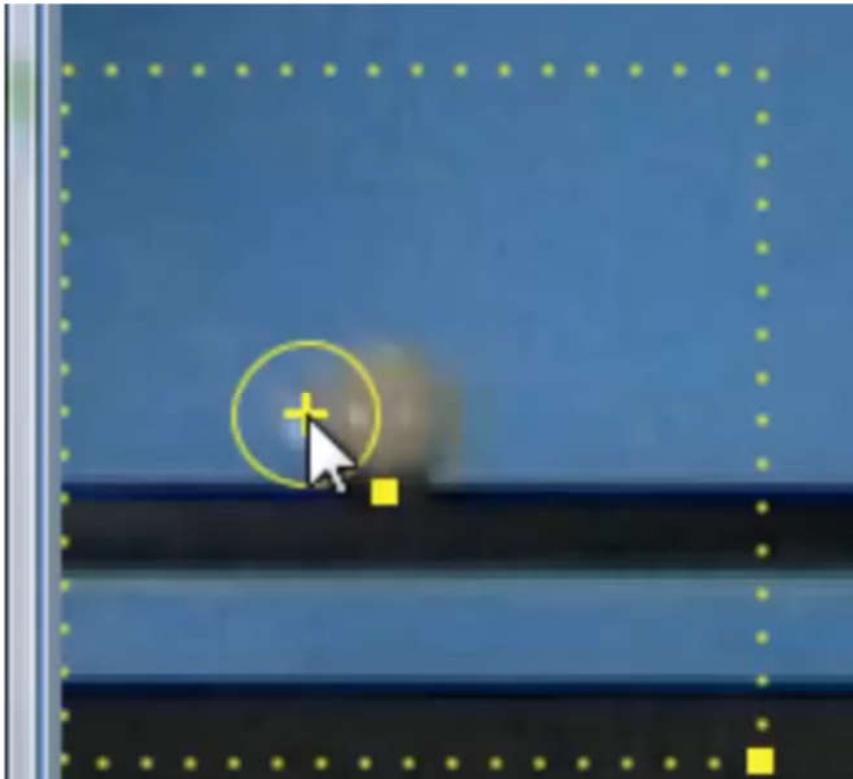
average match: RGB diff = mean, score = 0

good match: RGB diff < mean/5, score > 4

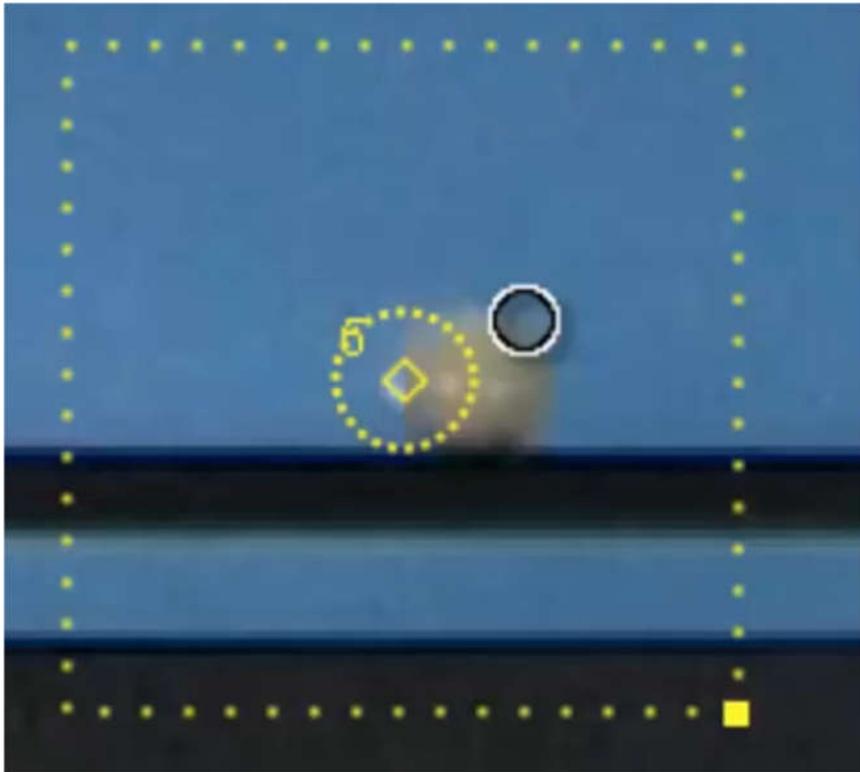
Recommendations: video

1. *Uniform contrasting background*
2. *Uniform illumination*
3. *Fast shutter speed*
4. *Motion perpendicular to line of sight*

If a fresh new keyframe is created, is with crosshair = target:



If on the way you create a new keyframe, no new target, looks like this:



Rectangle: search area. Ellipse: template area. +: target.

Recommendations: template

1. Smaller is better
2. Track curved or corner edges
3. Track a circular feature if rotating
4. Increase evolution rate if needed, but watch out for drift

Recommendations: searching

1. Smaller search areas are faster
2. Use Look-ahead unless accel changes rapidly
3. Use X-axis-only when tracking 1-dim edge