Manual Addendum to the ParticleTracker_ Manual for the

ParticleTracker_3D - ImageJ PlugIn

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1 Introduction

The ImageJ plugin `ParticleTracker_` version 1.2 is a straight forward extension to three space dimensions of the ImageJ Plugin ParticleTracker_ written by Guy Levy. **This version handles both, 2D movies and 3D movies. Also, the plugin might be used for feature point detection only in 2D and 3D.** Both versions can be downloaded from the Mosaic[1] web-page.

This document complements the user manual of the `ParticleTracker_` plugin. Generally, the extensions to the plugin are designed such that it does not affect the handling of the plugin. Currently there is no visualization of the z-coordinate. Only z-projected trajectories can be displayed.

2 Extensions and Changes

2.1 Installation

Please note that the plugin needs a Java Runtime Environment (JRE) version 5 or higher and ImageJ in version 1.36b or newer. To install the plugin, copy the `mosaic_plugins.jar` archive to ImageJ's plugin folder and restart ImageJ. After restarting ImageJ, the plugin should appear in the `plugins`→`Mosaic` submenu.

2.2 Load movie and start

Open a image or an image stack. **In the image properties dialog (shortcut `Ctrl-p`) check if the number of slices and frames is set correctly**. From this information, the software will detect if it is a 2D image, 2D movie, 3D image, or 3D movie.

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[1]http://www.mosaic.ethz.ch/Downloads/index

2.3 Visualization

2.3.1 Detection

If you like to only detect particles (not link them), click on the `Save Detected` button. The detected particle positions are drawn on the image. Use the sliding bar on the parameter window to watch at the result for other frames.

2.3.2 Tracking

Note that, while visualizing the trajectories, a frame consists of n slices. If you would like to export movies, select a trajectory or an area and focus on your selection using the appropriate button in the result window. This generates a RGB image that you may z-project using the Image5D framework for ImageJ.

2.4 Batchprocessing

The plugin supports batch processing using standard ImageJ macros. If the plugin detects that a macro is running, data are written to disk (if the user has the appropriate permissions) instead of visualized in a new window. A directory `ParticleTracker3DResults/` is created in the directory of the image. The result file has the same name as the file name of the image, concatenated with the suffix `PT3D.txt`. If there are any problems while writing the data to the disk, the macro is aborted.

2.5 Results

Trajectory information format This format is written to disk if you saved a report or if the report was printed to the text panel. The output only slightly differs from the 2D version. In this version, the z-coordinate, the first, third, and fourth intensity momentum are added to the outuoput. The z-coordinate starts from the first slice with value 1 and ends with the number of slices per frame of your movie. If the image to process is in 2D, the z-coordinate is set to 0.0. The resulting text format is then:

```
%Trajectory n
f     x     y     z     I_0    I_1    I_2    I_3    I_4    s
```

with

- `x` The x coordinate of the particle in pixel from left to right
- `y` The y coordinate of the particle in pixel from top to down
- `z` The z coordinate of the particle in slices from the first to the last slice of the frame

- I_k The intensity momentum of order k
- s The particles score evaluated during the non particle discrimination step

Particles information format   This format is written to disk if when clicking the button "Save detected" in the parameter dialog. It is also the format that can be read by the plugin when starting without having an image open. The format does not contain any information about trajectories. Using the same shortcuts as in the paragraph above, the frame format is:

```
frame f
x   y   z   I₀  I₁  I₂  I₃  I₄
```

The numbers are separated by the white-space character.

Full report format   The header is supplemented by the line (the right arrow $\rightarrow$ stands for a tab character):

```
%Frames information
%→   Depth:  s slices
```

with s being the amount of slices per frame. The following information are in the same format as in the 2D version except that for the particles the z coordinate is appended:

```
%Frame f:
%→   n particles found
%→   Detected particle positions:
%→   →   x→  y→   z
```

Export to ImageJ Table   Particles and trajectory information can be exported to a ImageJ-compatible format using ImageJs tables. In the result window, you can export particle or trajectory information using the appropriate button:

- Table content when exporting particles to ImageJ tables:
  ```
  row_nb   frame  x   y   z   I₀  I₁  I₂  I₃  I₄  s
  ```

- Table content when exporting trajectories to a ImageJ table:
  ```
  row_nb   trajectory_nb  frame  x   y   z   I₀  I₁  I₂  I₃  I₄  s
  ```

3 Acknowledgments

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