Tracking

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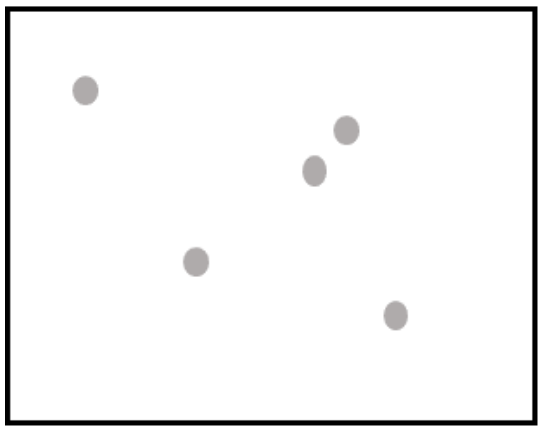
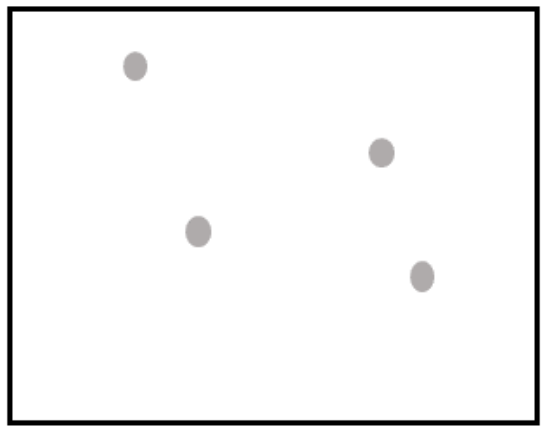
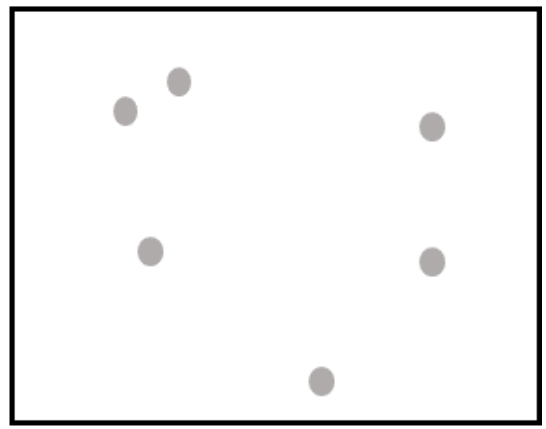
Tracking main steps



Frame #1

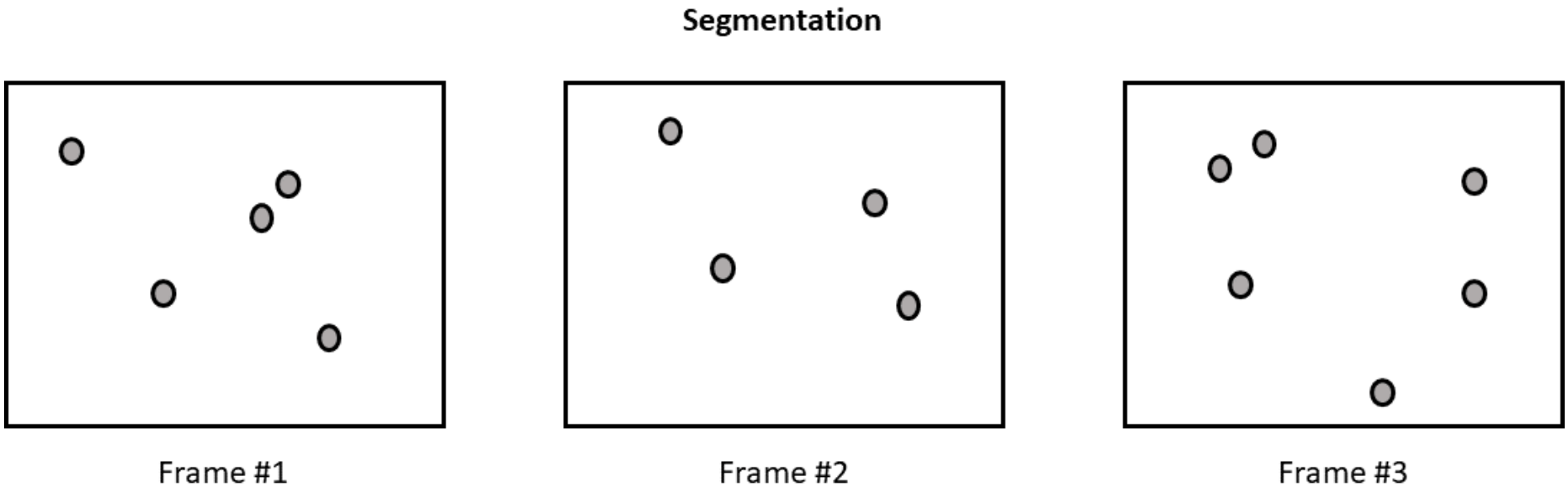


Frame #2

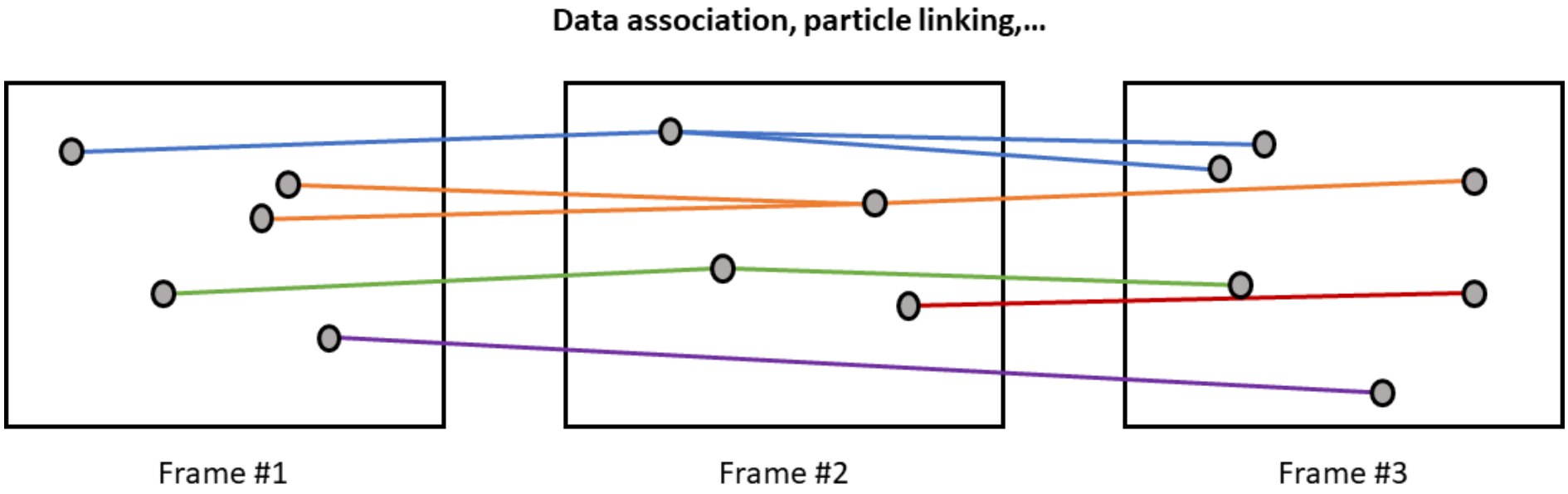


Frame #3

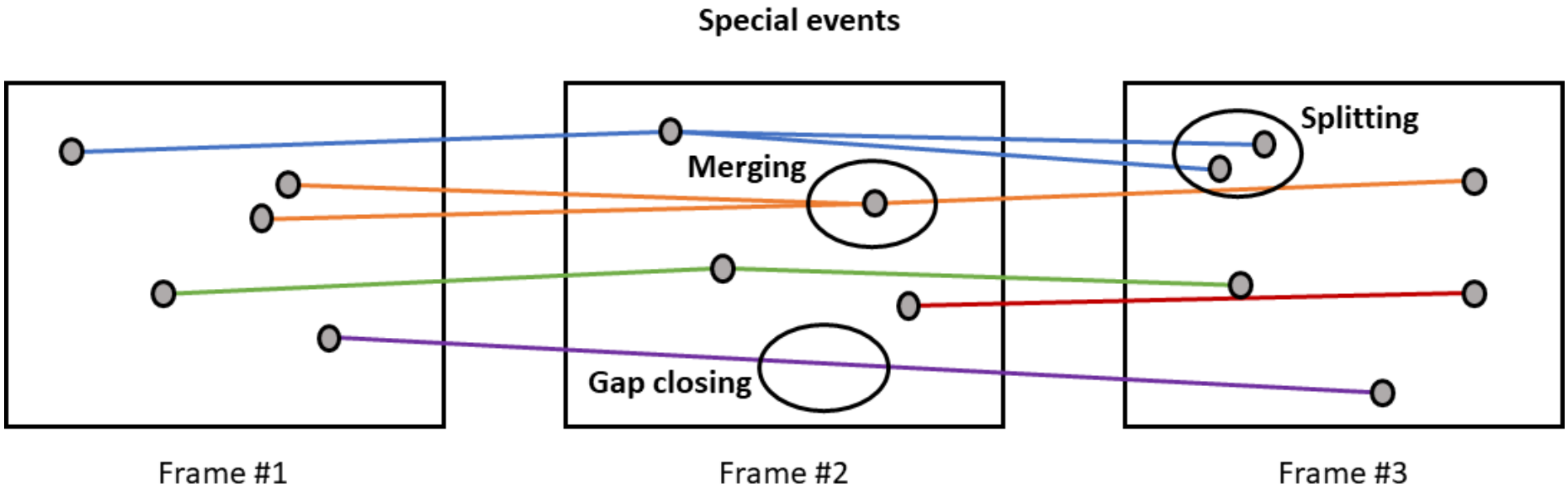
Tracking main steps



Tracking main steps



Tracking main steps



TrackMate

Methods
Volume 115, 15 February 2017, Pages 80-90

TrackMate: An open and extensible platform for single-particle tracking

Jean-Yves Tinevez [a], Nick Perry [a, 1], Johannes Schindelin [b, 2], Genevieve M. Hoopes [c], Gregory D. Reynolds [c], Emmanuel Laplantine [d], Sebastian Y. Bednarek [c], Spencer L. Shorte [a], Kevin W. Eliceiri [b, e]

Bringing TrackMate into the era of machine-learning and deep-learning

Dmitry Ershov, Minh-Son Phan, Joanna W. Pylvänäinen, Stéphane U. Rigaud, Laure Le Blanc, Arthur Charles-Orszag, James R. W. Conway, Romain F. Laine, Nathan H. Roy, Daria Bonazzi, Guillaume Duménil, Guillaume Jacquemet, Jean-Yves Tinevez

doi: https://doi.org/10.1101/2021.09.03.458852

nature methods

Published: 20 July 2008

Robust single-particle tracking in live-cell time-lapse sequences

Khuloud Jaqaman, Dinah Loerke, Marcel Mettlen, Hirotaka Kuwata, Sergio Grinstein, Sandra L Schmid & Gaudenz Danuser

TrackMate

1 - SEGMENTATION

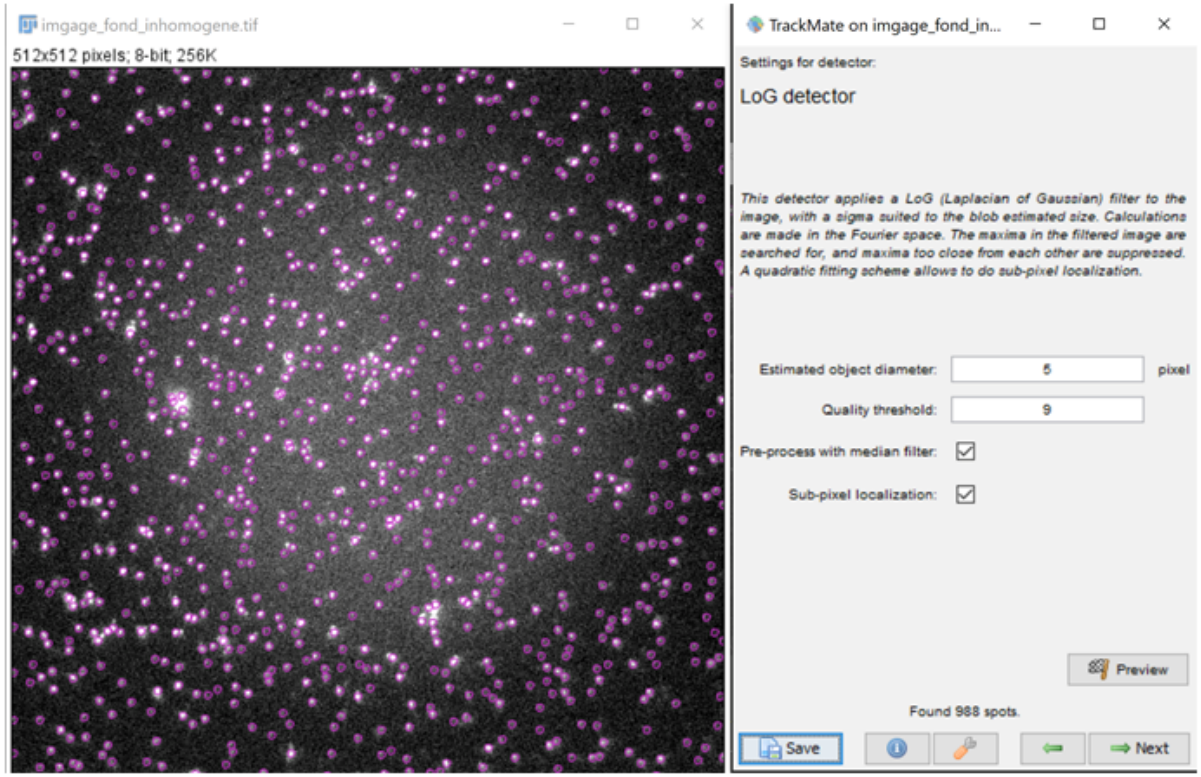
Classic detectors:

- **Manual annotation**
- **Threshold detector**
- **DoG/LoG detector**

TrackMate

1 - SEGMENTATION

LoG detector: scale-based detector, powerful with **objects of the same size** such as intracellular particles



TrackMate

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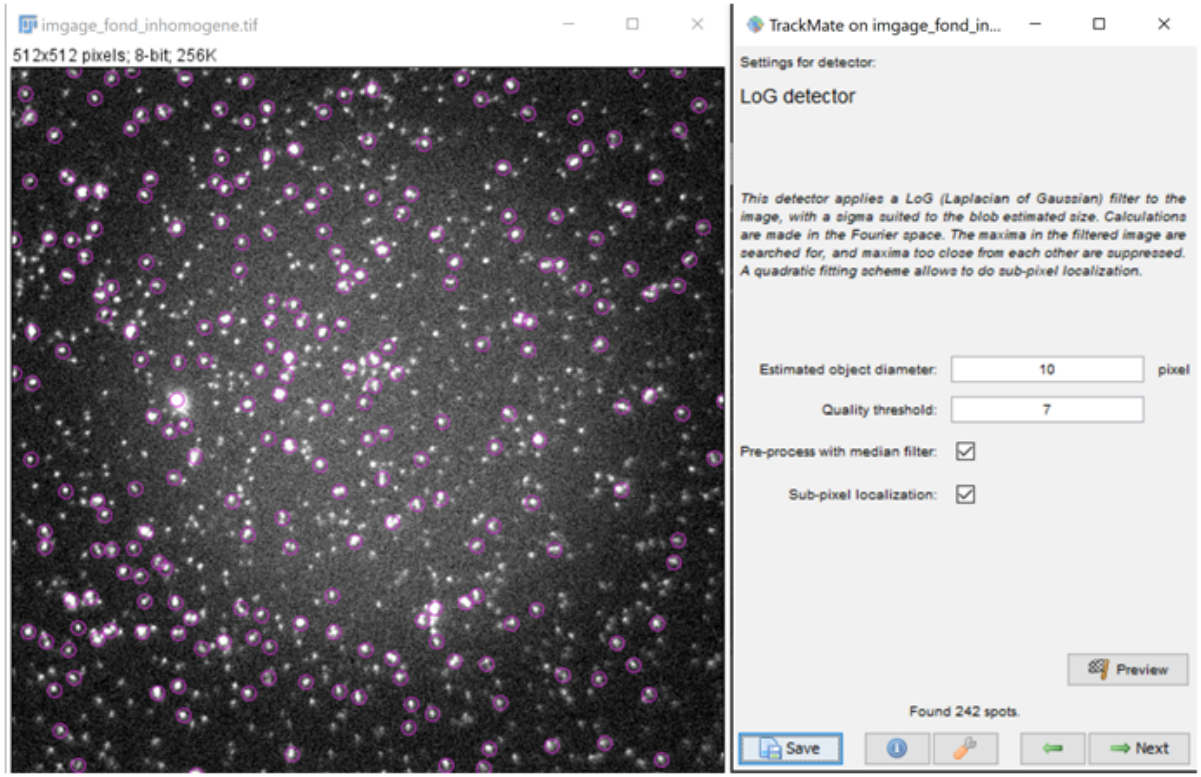

TrackMate

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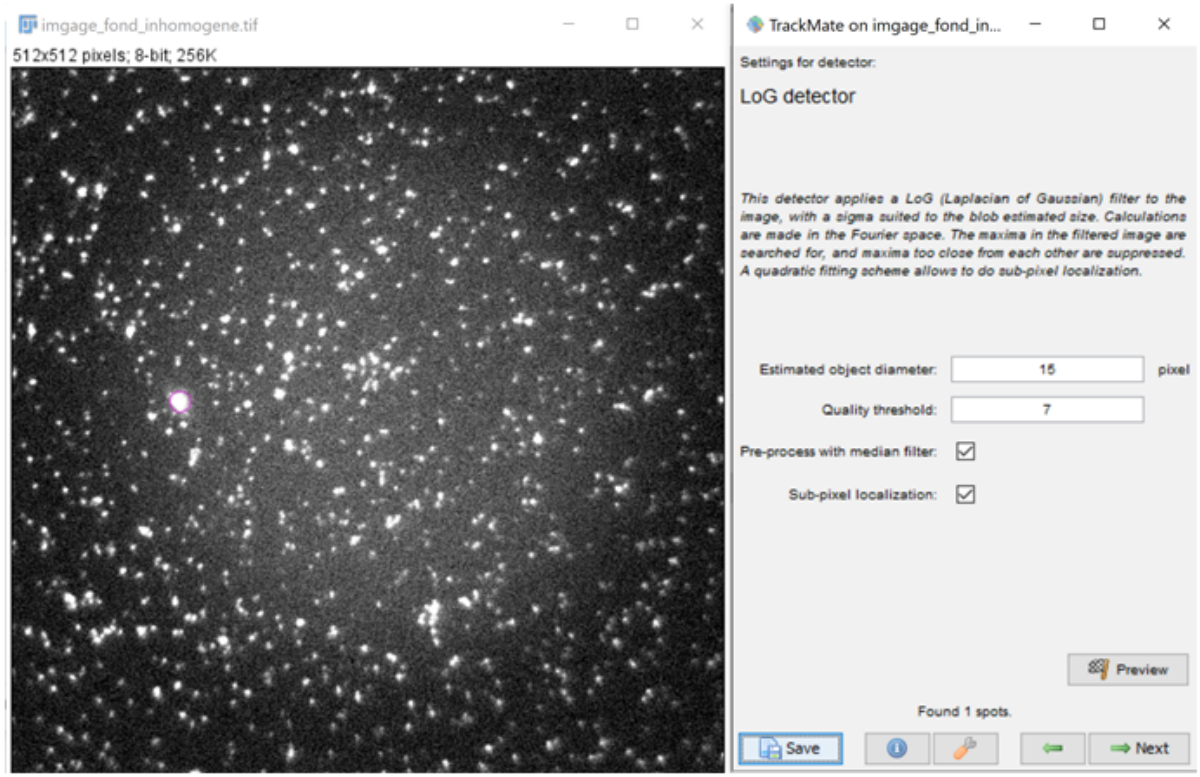
LoG detector: scale-based detector, powerful with **objects of the same size** such as intracellular particles



TrackMate

1 - SEGMENTATION

Classic detectors:

- **Manual annotation**
- **Threshold detector**
- **DoG/LoG detector**

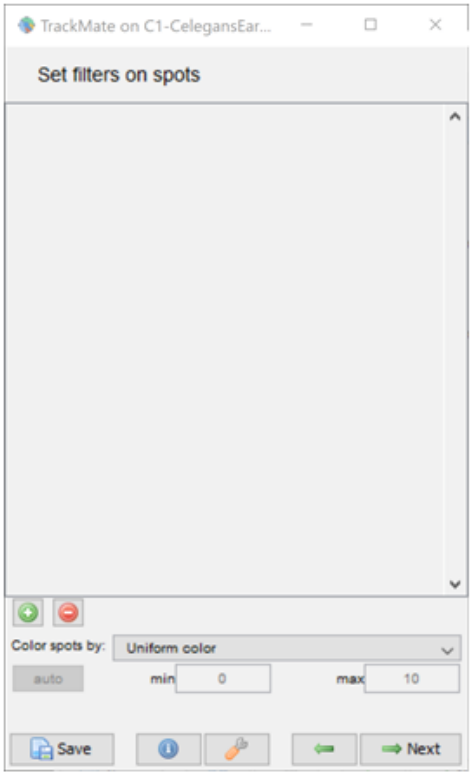
New generation detectors:

- **Stardist**
- **Cellpose**
- **Weka**
- **Ilastik**
- **MorpholibJ**
- **Custom segmentation via label images**

TrackMate

2 - Spot Filtering

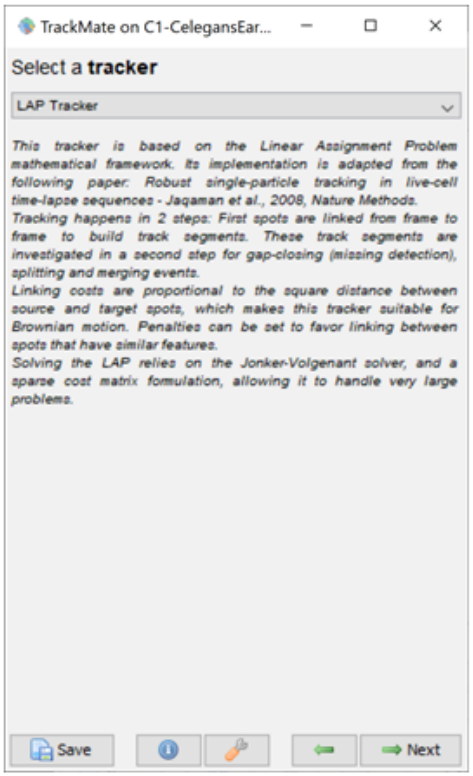
Filter out spots based on **spot features** such as size, average intensity, ...



Possibility to **visualize spot features** with heat maps.

TrackMate

3 - Data Association



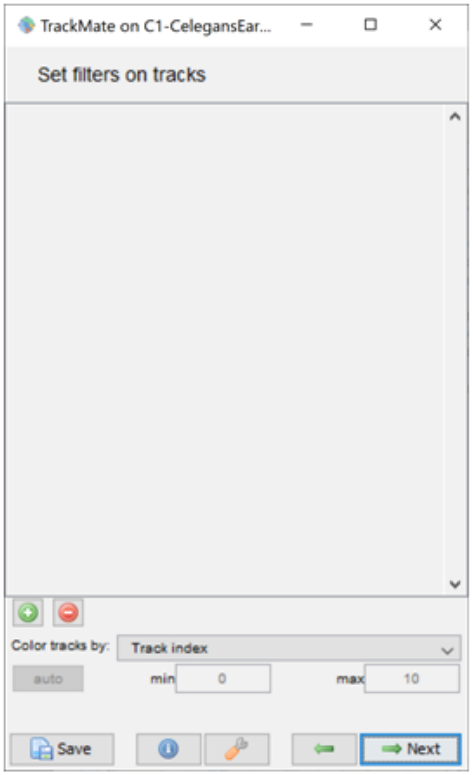
Trackers:

- **Manual tracking**
- **Overlap tracker:** based on intersection over union between two consective frames – only 2D
- **Nearest-neighbor tracker:** associate closest particles between two consecutive frames
- **Kalman tracker:** based on Kalman filtering, suited for objects with directed and constant motion, allows gap closing
- **Lap tracker:** implementation of utrack (Jaqaman *et al.*), based on the Minear Assignment Problem mathematical framework, allows to change linking cost between particles by penalizing features and to perform splitting, merging and gap closing
- **Simple LAP tracker:** same as LAP tracker, without cost penalties, splitting and merging

TrackMate

4 - Track Filtering

Filter out tracks based on **track features** such as number of spots, duration, ...

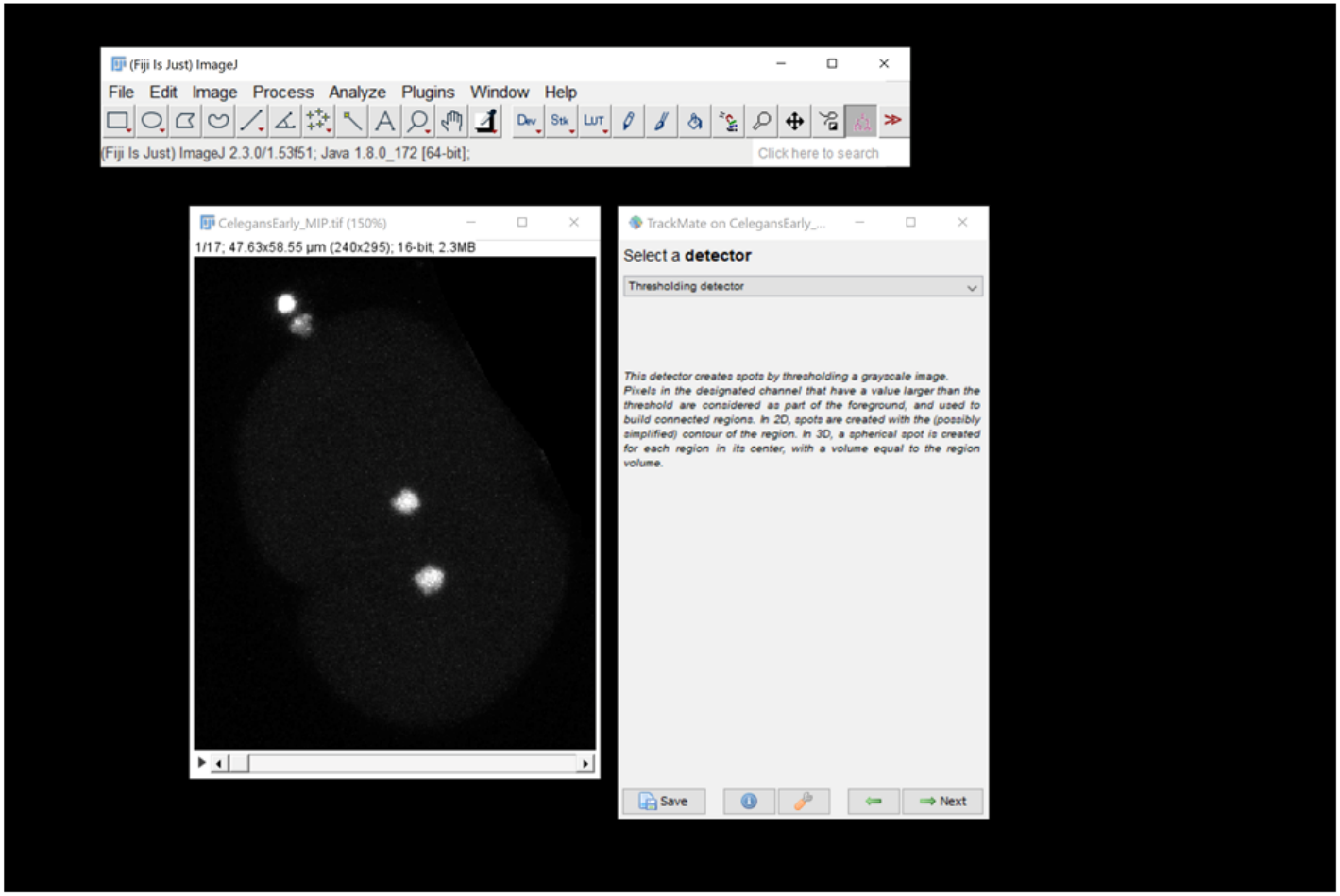


Possibility to **visualize track features** with heat maps.

Hands on TrackMate

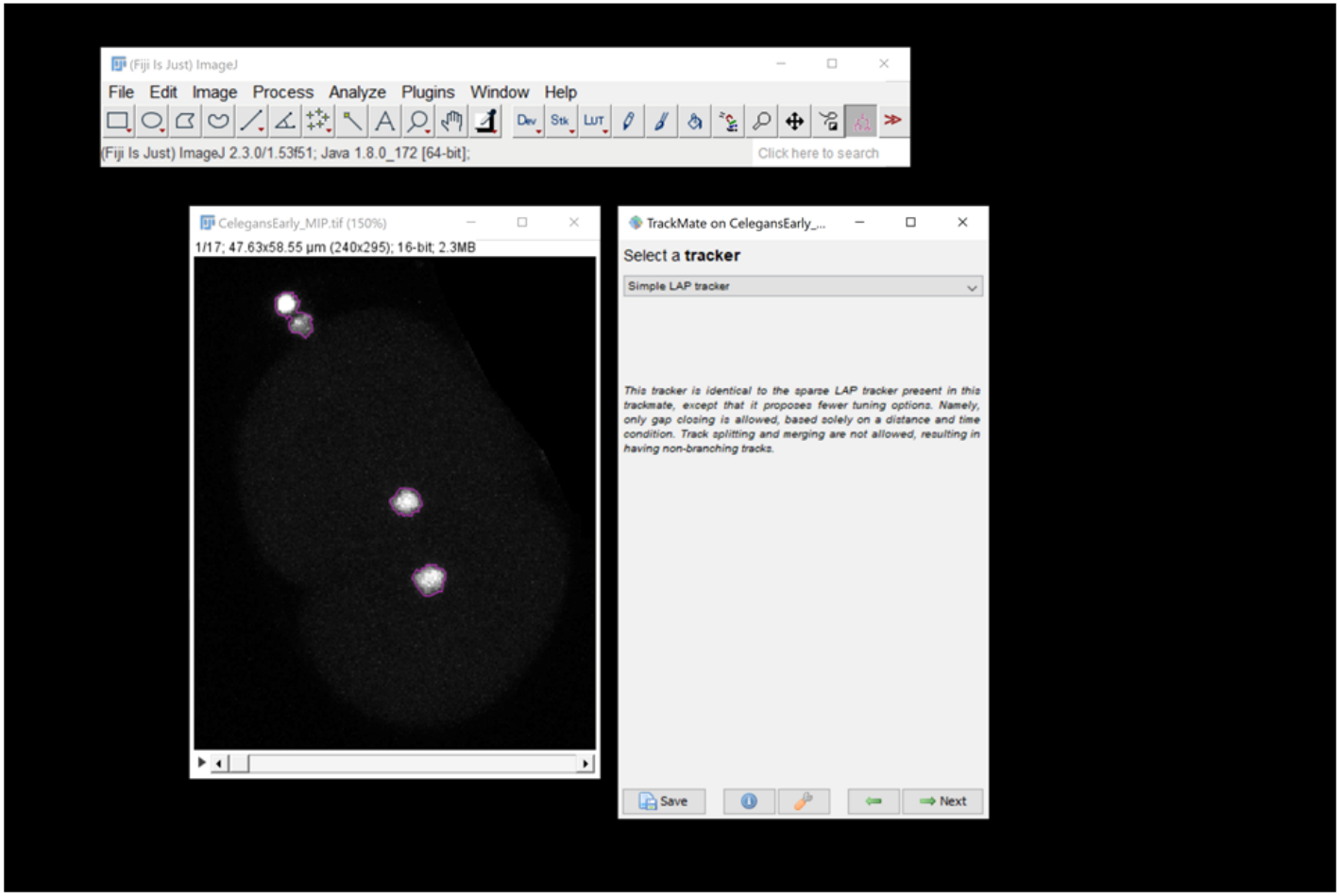
Open CelegansEarly_MIP with **TrackMate** and segment cells with **Thresholding detector**

Filter out as many as possible **non-cell objects** but keep **all cells** detected



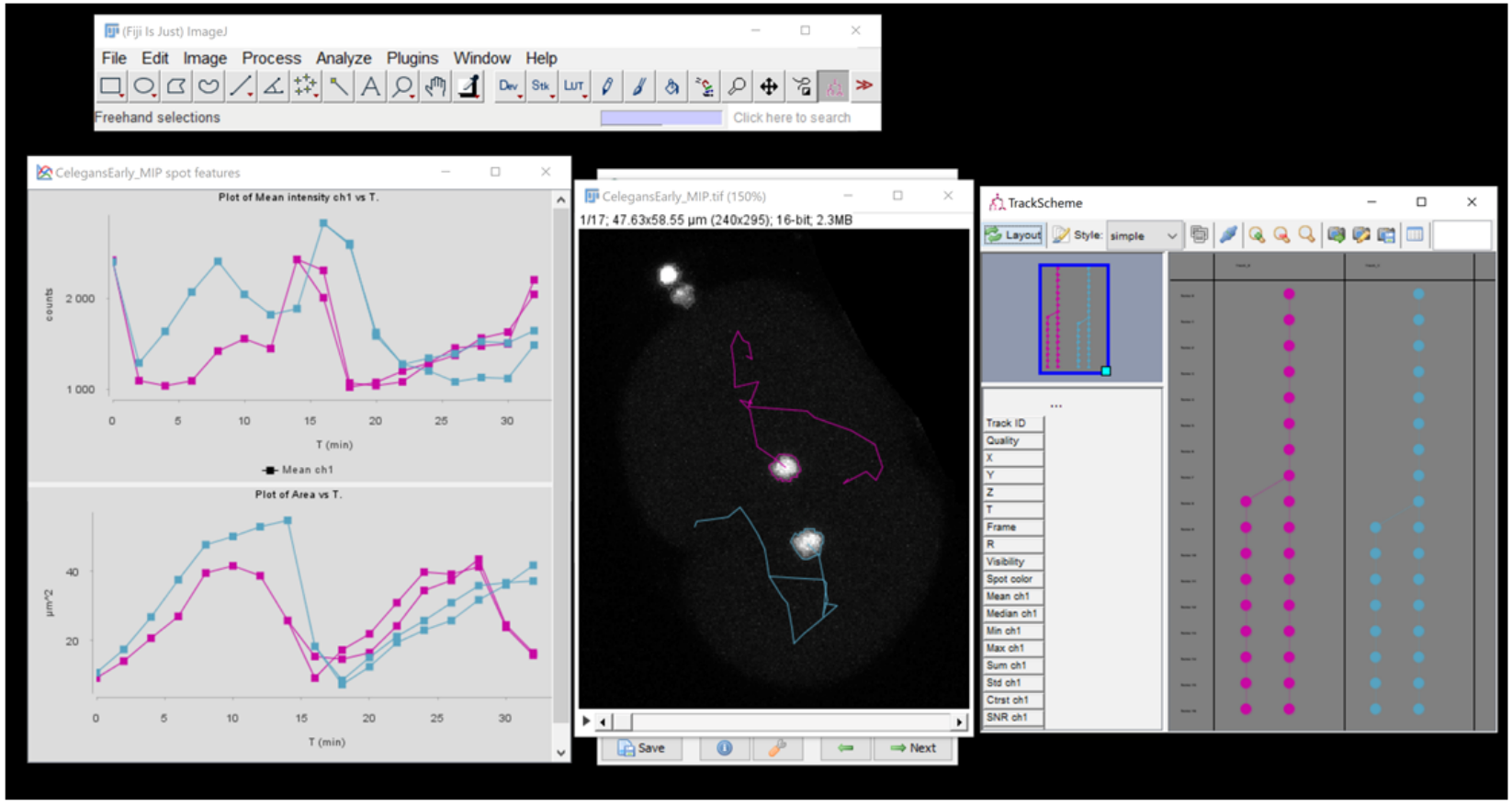
Hands on TrackMate

Use **Simple LAP tracker**, **filter out track(s)** corresponding to non-cell objects and **manually split** the tracks when **cells divide** with TrackScheme



Hands on TrackMate

Plot features, save results...



Hands on TrackMate

Use **LAP tracker** with **splitting** and **filter out track(s)** to directly obtain the **2 tracks** for cells