UZH-CH

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Platform: Linux

Prerequisites: MATLAB R2014b (x64)

UZH-CH: SUMMARY

Our cell tracking algorithm consists of two traditional steps: Segmentation and tracking. In segmentation, we combine watershed segmentation with Otsu thresholding. Later, the identified objects are tracked in a frame-by-frame fashion. There, two consecutive frames are taken into account and the objects are matched to each other via a modified nearest-neighbor algorithm. No post-processing step is executed.

UZH-CH: PREPROCESSING

To increase the signal-to-noise ratio (SNR), we first adjust the contrast of the image by mapping the intensity values in the input image frame to new values in the modified image such that 1% of data is saturated at low and high intensities. Following that, we blur the resulting image with a Gaussian filter of width w. Lastly, we compute the mean intensity and subtract that from the image. Where negative intensities occur, we take their absolute values.

UZH-CH: SEGMENTATION

Our segmentation is based on seeded watershed segmentation. To find the seed locations, the image is first complemented and its negative distance transform is calculated. Using this, we compute a seed mask by applying an extended-minima transform with the depth level of h. This gives us regional minima, which are connected components of pixels that have constant intensity. These minima are used as seed points for individual watershed basins. We use this mask to start the watershed transform and obtain the segmented image. After that, we apply a downscaled Otsu thresholding with the downscaling factor of d. To clean up artifacts, we neglect objects that are smaller than 10 pixels and fill segmented objects to avoid holes in them.

UZH-CH: TRACKING

Our tracking is based on a nearest-neighbor search algorithm where the nearest neighbors are chosen in a spatiotemporal manner (i.e., closest objects in the next time frame). We compute all-to-all distances between the objects in frame t and t+1. A maximum distance (*maxDist*) thresholding of 50 pixels is applied and for each object O_t found in t, we get a first set of possible candidates in t+1. Here, we limit the maximum number of neighbors (*maxNeigh*) to five in 2D. Depending on the number of candidates and their relative sizes compared to the object, we formulate three main scenarios: (i) disappearing, (ii) self-tracking, and (iii) division. If no spatiotemporal neighbors are found or if a single candidate is found, but it is more than twice the size of O_t, then the object is disappearing. If only a single candidate with an acceptable size (i.e., less than 2*object size), is linked to O_t, we call this case self-tracking. Whenever we are left with more than two possible candidates, we create all possible two-pairings and check which pair's mean centroid is closest to the O_t. If this closest pair's total size is not larger than twice the size of O_t, we accept this cell division.

UZH-CH: POST-PROCESSING

No post-processing is carried out after tracking.