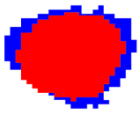
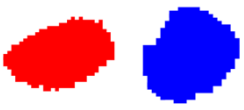
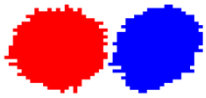
Cost Function Parameters

The cell tracker uses a cost function to create a tracking decision between cells in consecutive frames. The cost function that relates two Cellular objects between consecutive frames is computed using the following normalized weighted 3 time-lapse cell characteristics:

1. **Weight of Cell Overlap**
   If cells tend to move slowly and have big overlapping areas between consecutive frames, then this value should be the highest among all other cost function weights.
2. **Weight of Centroids Distance**
   In the event when cells don't overlap as much and/or amount of overlap is almost similar, the distance of their centroids movement will make the difference in the tracking decision.
3. **Weight of Cell Size**
   If cells retain their size between consecutive frames then this weight value should be high. However, if cells go into mitosis and their respective size changes rapidly then this value should be low.

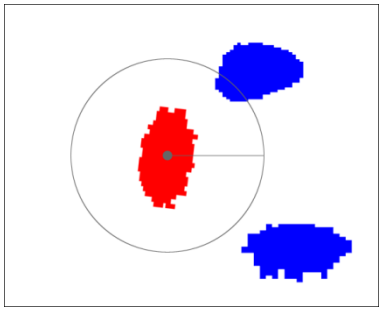
The weights represent the importance of each term in the computation of the cost function. The higher the weight the more important is that term.

Some possible scenarios for cell tracking: Problem 1 is our typical problem encountered in most cases, when cells change shape often and go into mitosis and image acquisition rate is high enough that there are good cellular overlaps between consecutive acquisitions. In general, the overlap weight should be proportional to the acquisition rate. Problems 2 and 3 are considered to have low acquisition rates. In problem 2 cells change shape but don't move long distances and in problem 3 like for particle tracking problems where objects don't change shape and we have low image acquisition rate. A proposed weight combination to solve each of these problems is given in the table below. It is important to note that the cell tracker is very robust with regards to the weights. The three weights don't need to be changed for solving similar problems like the ones displayed in the table below.

	Problem 1	Problem 2	Problem 3
Red denotes the current frame *Blue denotes the next frame*			
Weight Cell Overlap	100%	10%	20%
Weight Centroid Distance	50%	100%	50%
Weight Cell Size	20%	50%	100%

Max Centroids Distance

The maximum centroid distance (in pixels) is used to consider which cells could possibly be tracked together. The radius from a cell centroid to the max centroid distance represents the area of a possible cell migration. For example, the red cell represents the current frame, whereas the blue cells represent the next frame. The Cell Tracker would consider the upper blue cell as a possible tracking option to the red cell and the lower blue cell would be ignored.



MAX CENTROIDS DISTANCE EXAMPLE

Frames to Track

This controls the number of frames to be tracked. If “All” is specified then all available frames in the segmented images folder will be tracked. Specific frame tracking is also provided. The syntax for specifying specific frames to be tracked is a comma separated list. A colon can also be used to specify a range of frames. For example “1:2:300” track every other frame until 300. “9:120” track every frame from 9 to 120. “1,5,20,28:50” track frames 1, 5, 20 and 28 to 50