

Supplementary Note 1

Building training samples for a short video

October 30, 2017

For a short video where the length is less than the training sample required, duplicate video frames are added to the beginning of the video sequence to estimate background model. Fig. 1 illustrates the process of constructing the training samples from a short video.

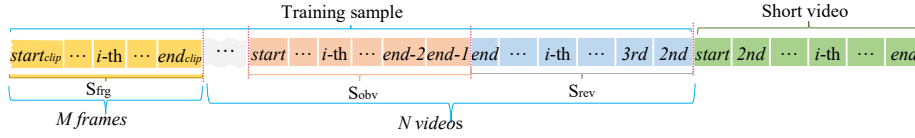


Figure 1: Building training samples for a short video.

The green frame series in Fig. 1 indicates the original time-lapse zebrafish larvae microscopic short video \mathbb{V} . The frames in front of this video are its training sample \mathbb{S} , used to estimate the background model parameters of \mathbb{V} . The set of training samples \mathbb{S} consists of: S_{obv} , frames from the original short video \mathbb{V} in obverse order from $[start, end - 1]$ frames, shown by the pink frame series; S_{rev} , frames from the original video short video \mathbb{V} in reverse order from $[end, 2nd]$ frames, shown as the light blue; and, S_{frag} , the video fragment shown in orange. The obverse order frame series S_{obv} and reverse order frame series S_{rev} are alternately linked to each other to construct the training sample, and the last frame to connect to the original video is the reverse order frame to ensure a smooth background transition between the last frame in the reverse order frame series to the first frame of the original microscopic short video.

To construct a training set with length of L_{sample} images, a video fragment, S_{frag} , taken from the short video studied will be added to the training set for the set length requirement when the S_{obv} and S_{rev} series do not have exact L_{sample} images.

The required number of videos, N and number of frames, M , are calculated using Eq. (1) and Eq. (2).

$$N = L_{sample} \setminus N_{frames} \quad (1)$$

where the MATLAB built-in function `idivide` is applied for the integer division with fractional quotients being rounded toward negative infinity to the nearest integer for implementation.

$$M = L_{sample} - L_{sample} \setminus N_{frames} \quad (2)$$

Based on the required number of videos N (in obverse order and reverse order), the video fragment S_{frag} is constructed according to Eq. (3).

$$S_{frag} = \begin{cases} \{S_{rev}(i) \mid i = M + 1, \dots, 3, 2\}, & \frac{N}{2} \text{ is even} \\ \{S_{obv}(i) \mid i = 2, \dots, 3, M + 1\}, & \frac{N}{2} \text{ is odd} \end{cases} \quad (3)$$