TRACKING FAST MOVING OBJECTS BY SEGMENTATION NETWORK

Zita, A., Šroubek, F.
Department of Image Processing
Institute of Infomation Theory and Automation
Czech Academy of Sciences

World of Fast Moving Objects

- A (**F**)ast (**M**)oving (**O**)bject is loosely defined as an object traveling the distance larger than its size in a single video frame or image.
- **FMO** appears as a blurred streak in the direction of motion.
- Tracking **FMO**s is a challenging problem due to lack of any texture on the blurred object.

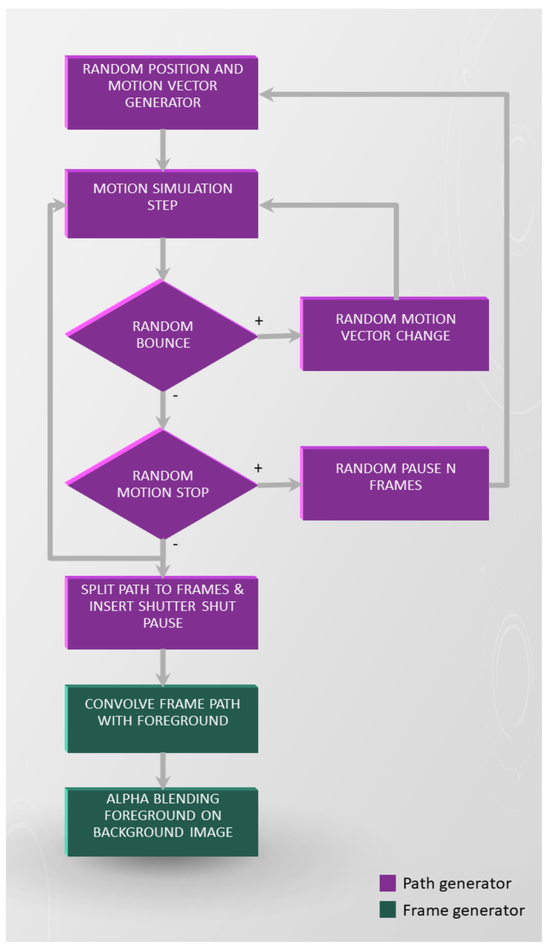
Goal:

Real-time tracking algorithm of balls in sports videos where the balls undergo motion characteristic for FMOs. → Learning-based approach (segmentation neural network)

Synthetic data generator

To train the network, a synthetic-data generator synthesizes the data on the fly.

1. YouTube sport videos were filtered using the median filter to erase any unwanted FMOs. These sequences are used as a background for synthetic data.
2. Motion-trajectory generator simulates plausible motion and creates synthetic trajectories.
3. Trajectories are split into individual frames.
4. Finally, the generated trajectories are convolved with the foreground (ball) and alpha-blended with the background to generate realistic FMOs.

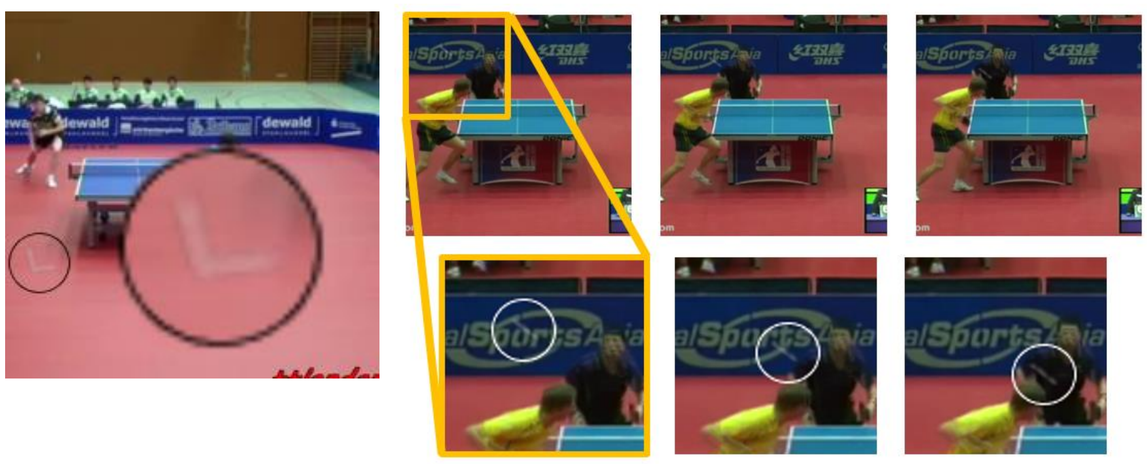


Given that :

$I_t(x)$ - composed image;
$P_t(x)$ - generated path;
b_f - overexposure factor;
$F(x)$ - foreground image (ball);
$M(x)$ - foreground image mask;
$B(x)$ - background image

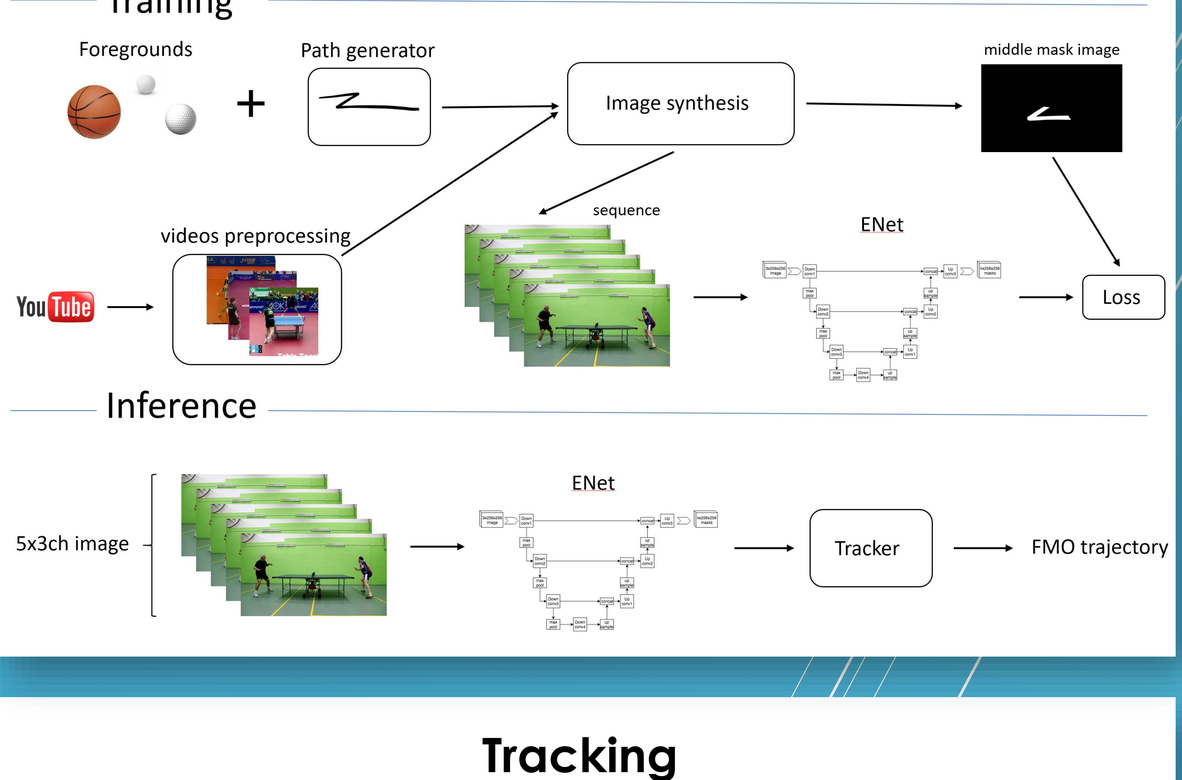
The image synthesis can be described using following formula :

$$I_t(x) = \left[P_t * b_f F\right](x) + (1 - [P_t * M])B(x)$$



Method

The proposed solution is based on the U-Net Inception type network called ENet trained on synthetic data. The network input is a 15-channel image consisting of 5 consecutive RGB frames. The resulting output is a segmentation map of the FMO.



Tracking

The output of the network is a segmentation map with false positives. The most probable blob is identified using blob size and shape heuristics. The selected blob is used as a trajectory estimation for the tracker. Kalman filter is used for prediction and connection of broken trajectories.

Results