Iterative Scale-Up ExpansionIoU and Deep Features Association for Multi-Object Tracking in Sports Supplementary Material

1. Pseudocode of DeepEIoU

Algorithm 1: Pseudocode of DeepEIoU

Data: Video sequence $\mathcal{V}$; detector $\mathcal{D}$; detection score threshold τ; total number of iteration for scale-up process t_{total}
Result: Tracks $\mathcal{T}$

Initialization: $\mathcal{T} \leftarrow \emptyset$;
for *frame* f_k, $k \leftarrow 1 : K$ **do**
  // Step 1: Predict detection and appearance feature
  $D_{\text{k}} \leftarrow \mathcal{D}(f_t)$;
  $D_{\text{high}} \leftarrow \emptyset$;
  $D_{\text{low}} \leftarrow \emptyset$;
  for d *in* D_k **do**
    if $d.score > \tau$ **then**
      $D_{\text{high}} \leftarrow D_{\text{high}} \cup \{d\}$
    end
    else
      $D_{\text{low}} \leftarrow D_{\text{low}} \cup \{d\}$
    end
  end
  // Step 2: Iterative scale-up association for high score detections
  Initialization: $\mathcal{T}_{\text{matched}} \leftarrow \emptyset$
  for $t \leftarrow 0 : t_{total}$ **do**
    Calculate Expansion scale E_t for current iteration
    Associate $\mathcal{T}$ and D_{high} using appearance and EIoU
    $\mathcal{T} \leftarrow \mathcal{T} \setminus$ matched tracks from current iteration
    $D_{\text{high}} \leftarrow D_{\text{high}} \setminus$ matched detections from current iteration
    $\mathcal{T}_{\text{matched}} \leftarrow \mathcal{T}_{\text{matched}} \cup$ matched tracks from current iteration
  end
  $\mathcal{T}_{\text{unmatched}} \leftarrow$ unmatched tracks after step 2
  $\mathcal{D}_{\text{unmatched}} \leftarrow$ unmatched detections after step 2
  // Step 3: Association for low score detections
  Associate $\mathcal{T}_{\text{unmatched}}$ and D_{low} using EIoU
  $\mathcal{T}_{\text{matched}} \leftarrow$ matched tracks in step 3
  $\mathcal{T}_{\text{unmatched}} \leftarrow$ unmatched tracks after step 3
  // Step 4: Association for unmatched tracks
  Associate $\mathcal{T}_{\text{unmatched}}$ and $D_{\text{unmatched}}$ using EIoU
  $\mathcal{T}_{\text{matched}} \leftarrow$ matched tracks in step 4
  $D_{\text{unmatched}} \leftarrow$unmatched detections after step 4
  // Step 5: Create new tracks and delete unmatched tracks
  for d *in* $D_{unmatched}$ **do**
    $\mathcal{T}_{new} \leftarrow d$
  end
  $\mathcal{T} \leftarrow \{\mathcal{T}_{\text{matched}}, \mathcal{T}_{\text{new}}\}$
end

Note that the Expansion scale E_t in step 2 is different for each iteration, while for step 3 and step 4, the Expansion scale is a constant. More details regarding the tracking parameter setting can be found in the paper's Section 4.4. For simplicity, the track reactivate mechanism [1, 2] is not shown in our pseudocode. Due to the file size limitation, we can not include the demo videos in our submit file. Please refer to drive for more demo videos and visualization results.

References

[1] Alex Bewley, Zongyuan Ge, Lionel Ott, Fabio Ramos, and Ben Upcroft. Simple online and realtime tracking. In *2016 IEEE International Conference on Image Processing (ICIP)*, pages 3464–3468, 2016.

[2] Yifu Zhang, Peize Sun, Yi Jiang, Dongdong Yu, Zehuan Yuan, Ping Luo, Wenyu Liu, and Xinggang Wang. Bytetrack: Multi-object tracking by associating every detection box, 2021. arXiv preprint arXiv:2110.06864.