

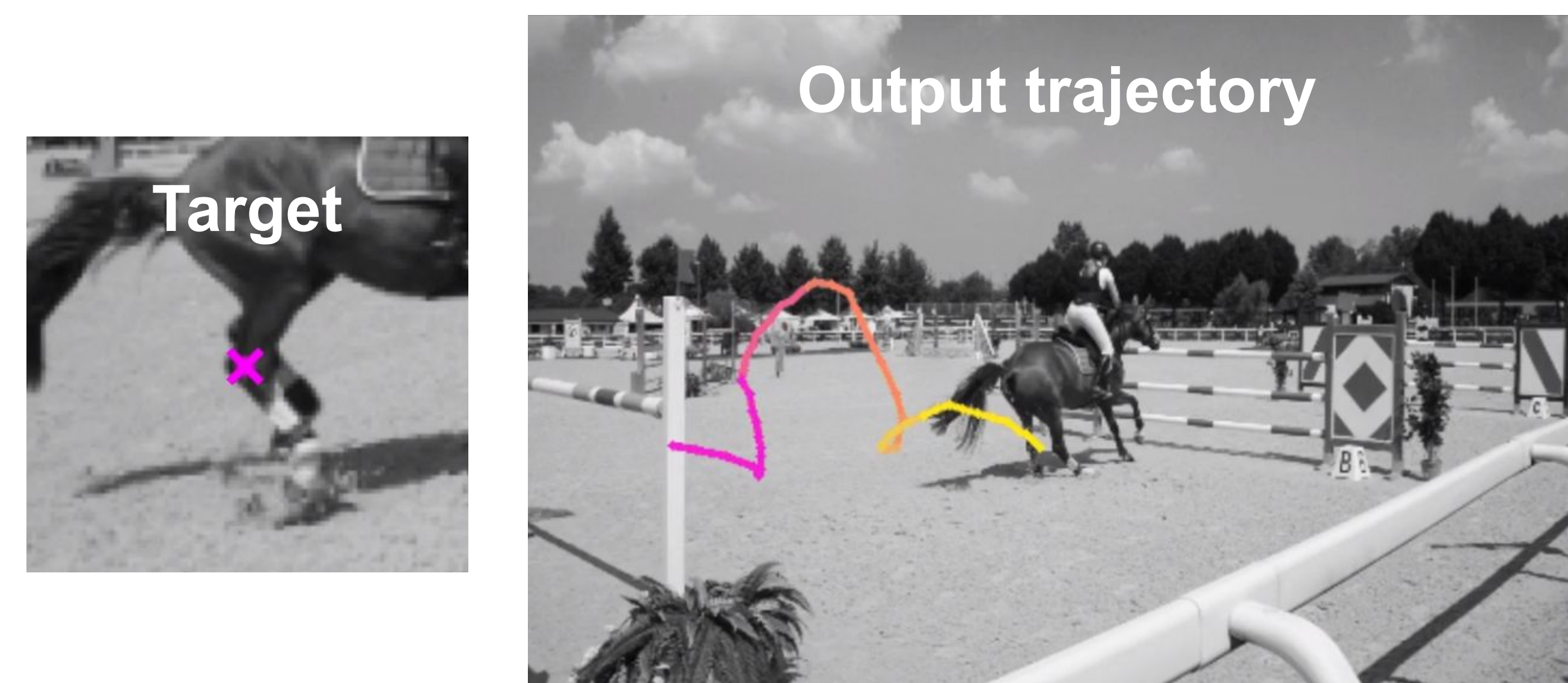
Particle Video Revisited: Tracking Through Occlusions Using Point Trajectories

Adam W. Harley, Zhaoyuan Fang, Katerina Fragkiadaki

<https://particle-video-revisited.github.io>

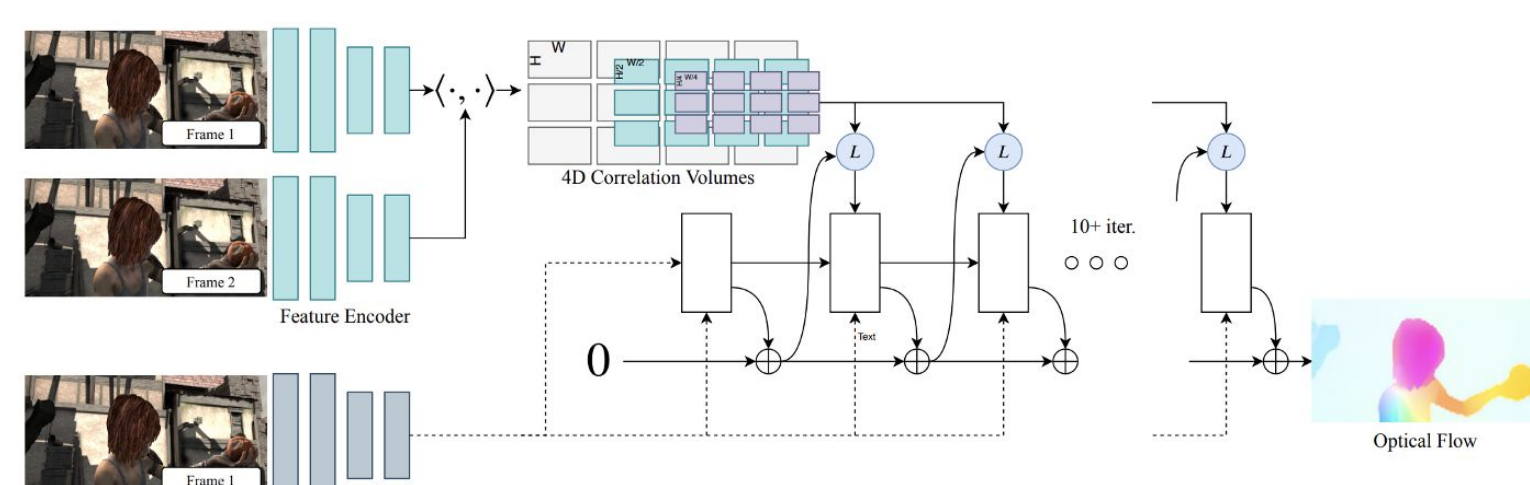
<https://github.com/aharley/pips>

Goal: Given a target pixel specified on the first frame, track that pixel across the whole video.

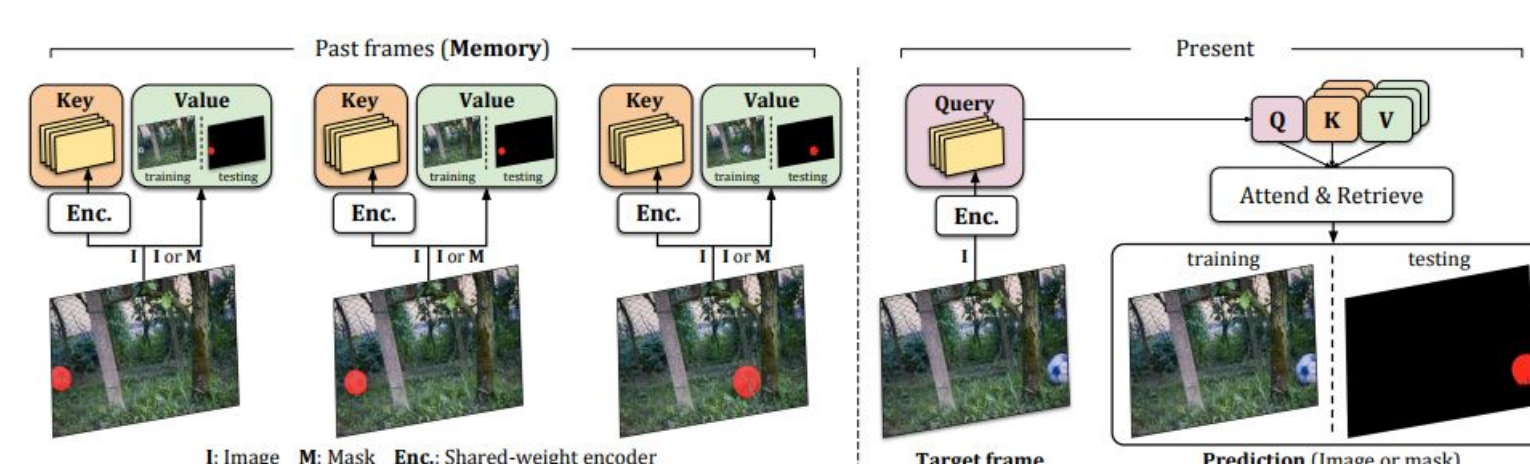


Related: Optical flow and feature matching are general-purpose, but have difficulty with occlusions.

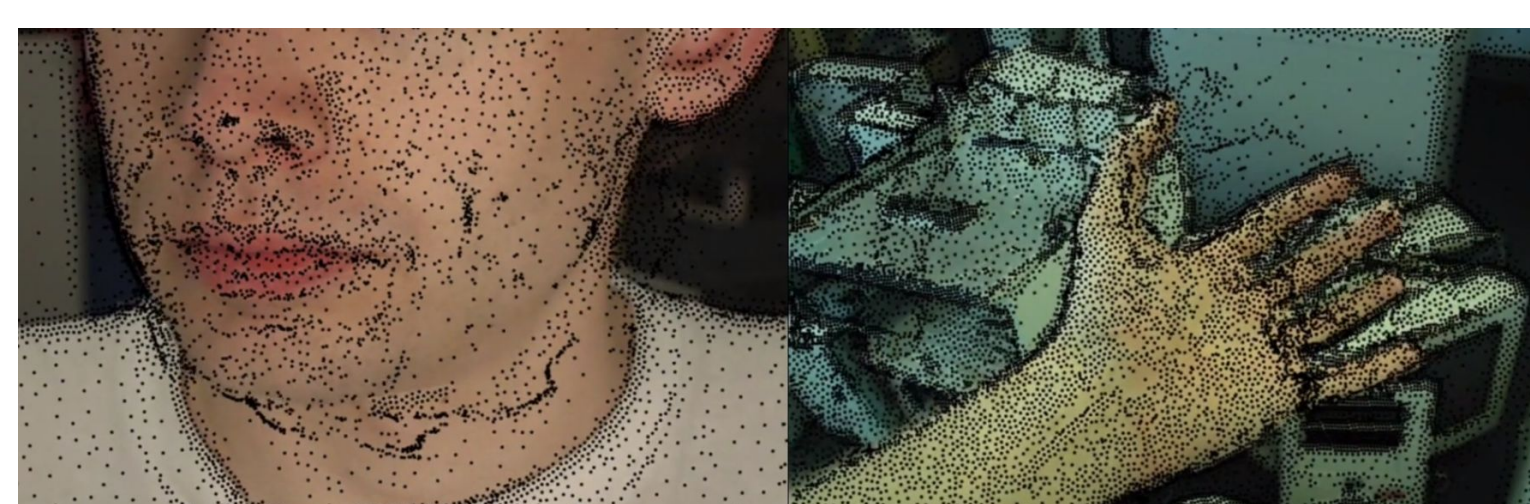
Optical flow provides fine-grained motion, but with a narrow timespan.



Teed & Deng. RAFT: Recurrent All Pairs Field Transforms for Optical Flow ECCV 2020



Lai et al. MAST: A Memory-Augmented Self-Supervised Tracker. CVPR 2020.



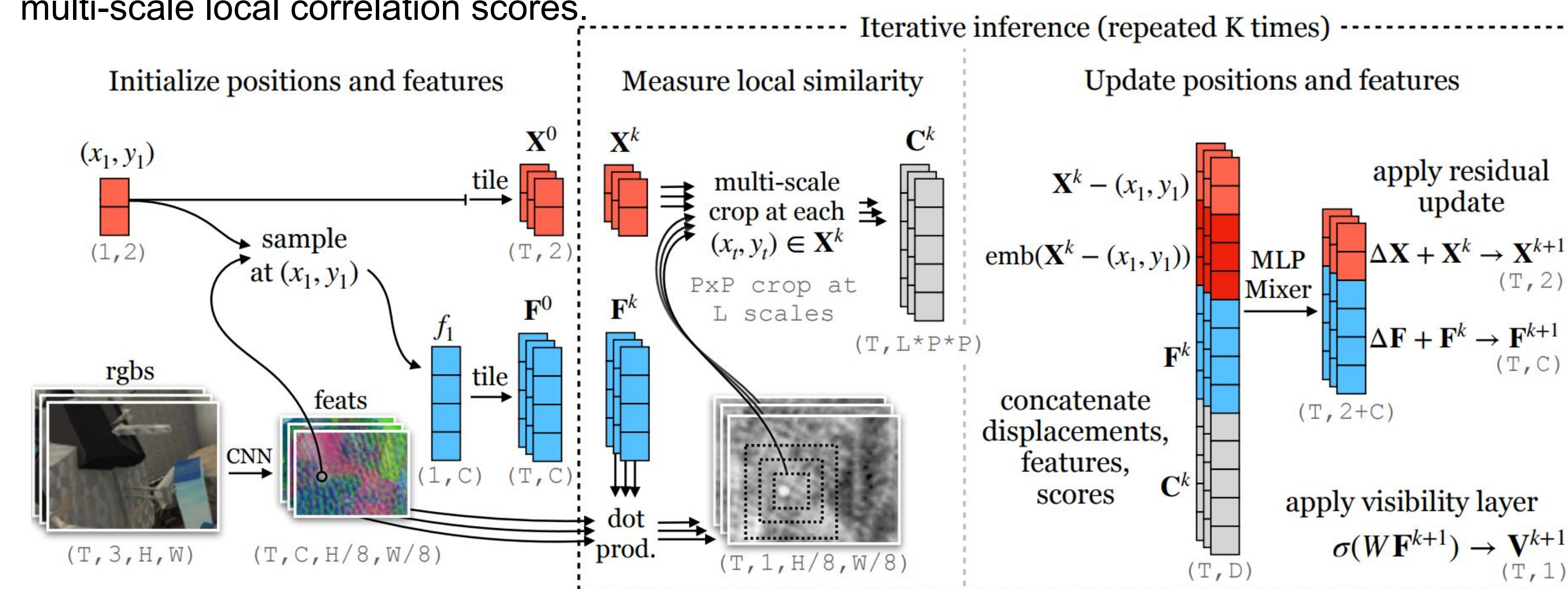
Sand & Teller. Particle Video: Long-Range Motion Estimation Using Point Trajectories. IJCV 2008.



Rajasegaran et al., Tracking People by Predicting 3D Appearance, Location & Pose. CVPR 2022.

Modern trackers for pedestrians and cars use strong temporal priors to help track through occlusions. Can we bring this power to pixel tracking?

Persistent Independent Particles (PIPs): Every particle is tracked independently. We initialize a zero-velocity trajectory for each particle, and iteratively refine it, inspecting multi-frame multi-scale local correlation scores.



PIPs vs. RAFT

8-frame temporal window instead of 2-frame.

Deep temporal prior via MLP-Mixer, instead of shallow one by convGRU.

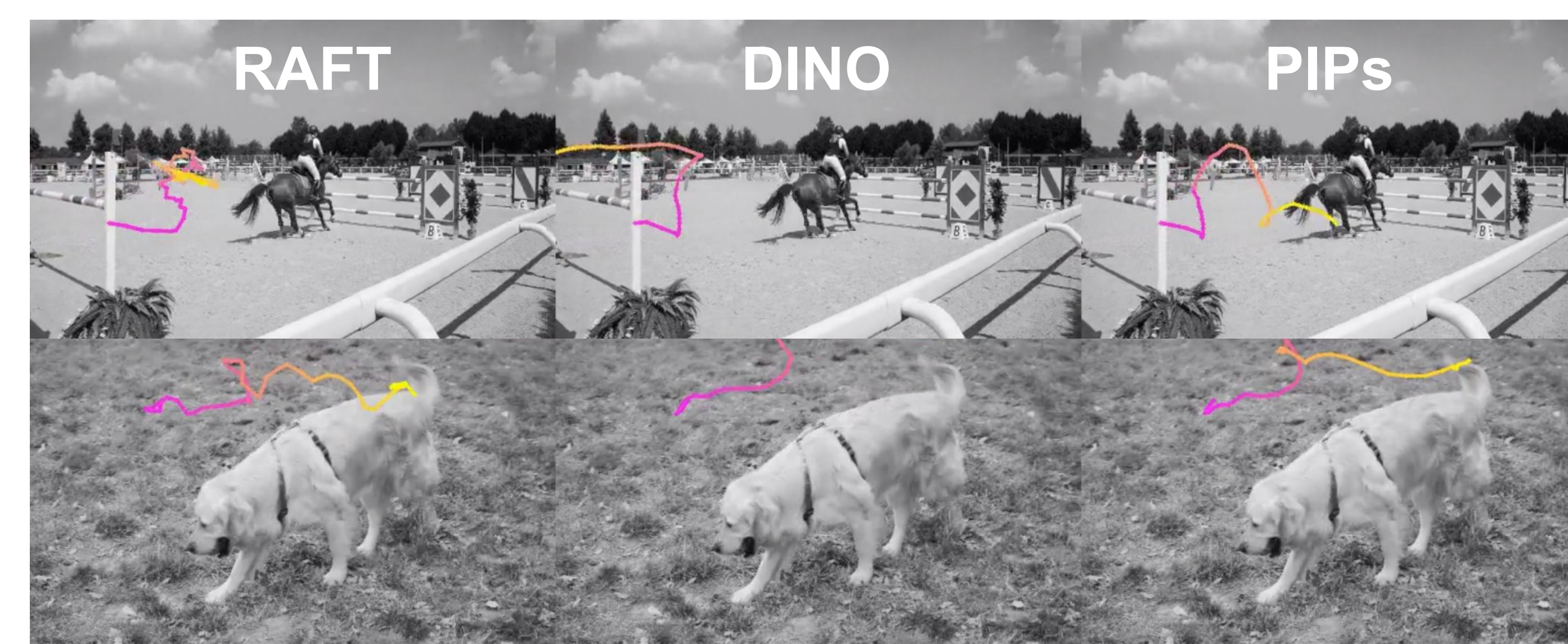
200ms for 8 frames for 256 particles, instead of 200ms/frame.

Results: Outperforms optical flow and feature matching. Despite training on synthetic data, generalizes to YouTube.



Training data consists of “Flying Things” with multi-frame occlusions. All experiments evaluate the same model.

At test time, we chain our 8-frame trajectories to track for arbitrary timespans.



We outperform flow and feature matching in trajectory estimation in FlyingThings, KITTI, CroHD, and BADJA, mostly due to handling occlusions.

Future work: multi-trajectory inference, recurrence.