# Alpha-Refine: A Powerful Refinement Module for Object Tracking

## Winner of VOT2020 Real-Time Challenge

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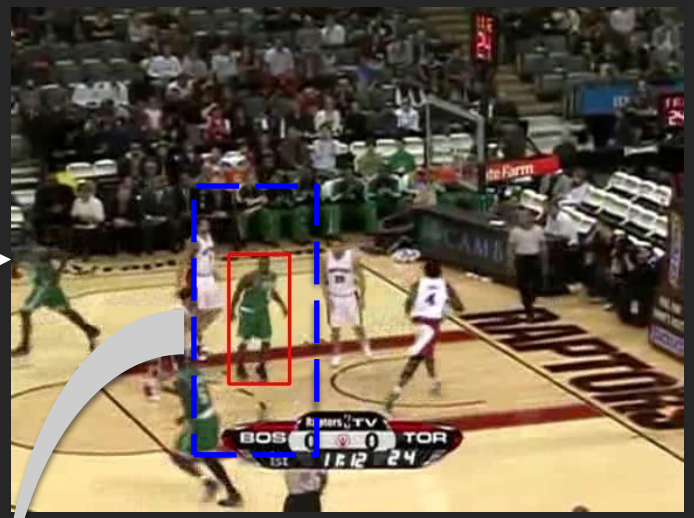
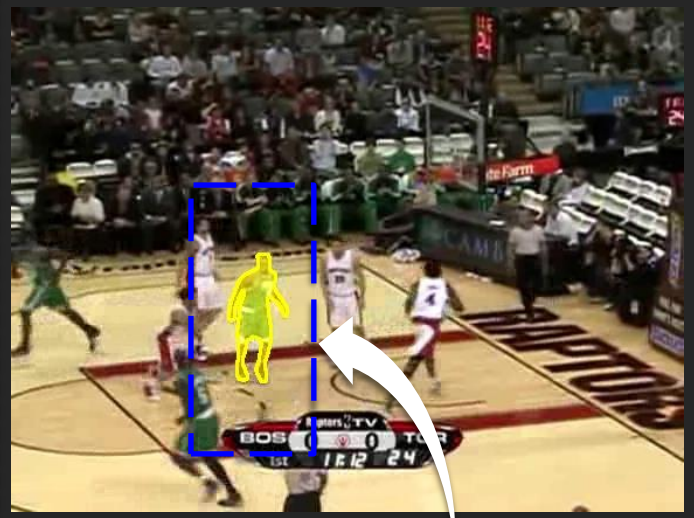
Group Leader: Professor Huchuan Lu

**Project: https://github.com/MasterBin-IIAU/AlphaRefine**

# pipeline

Base Tracker





Robust Target Locailization
(DiMP)

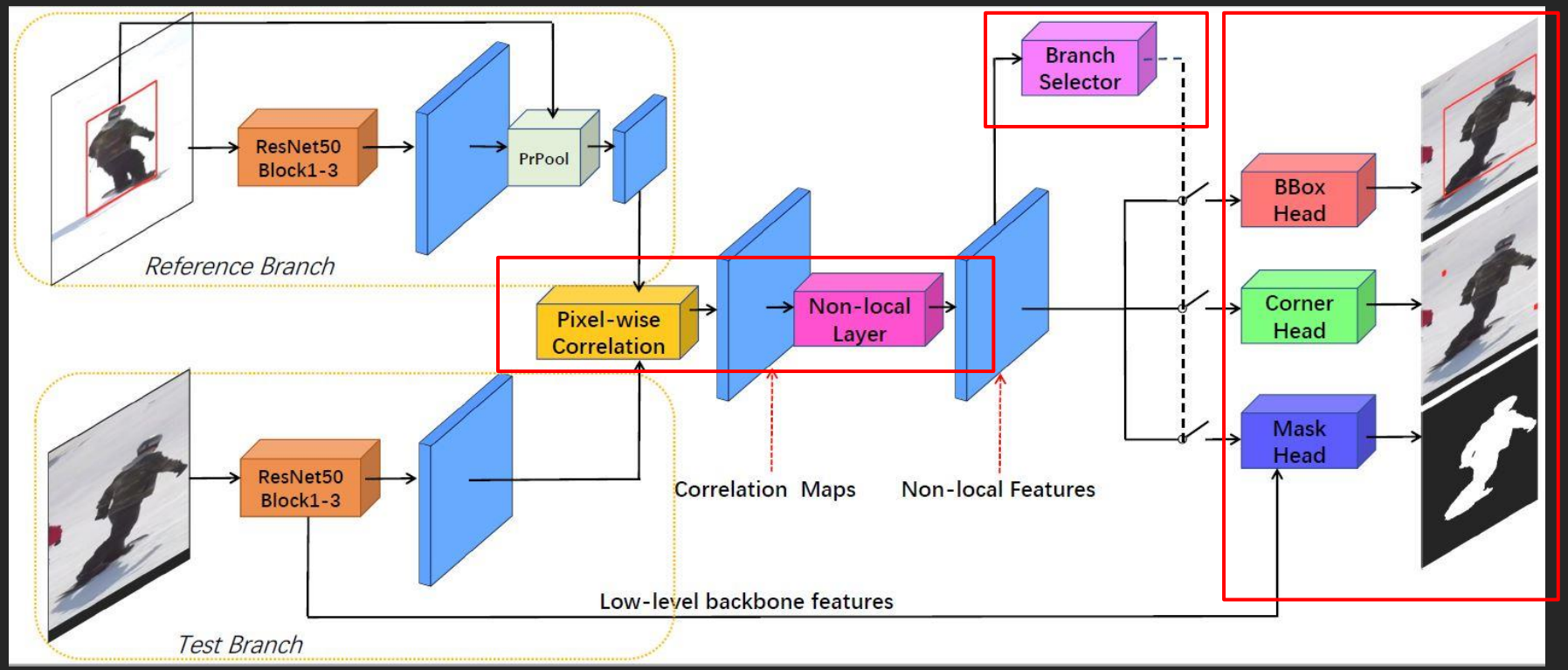
Accurate Mask Prediction
★(Alpha-Refine)

Refinement Module

# Architecture of Alpha-Refine (Base Version)

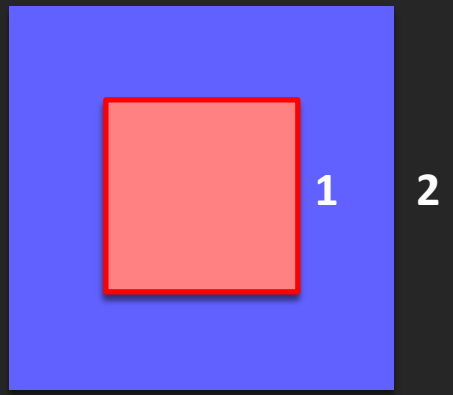
Alpha-Refine (General Refinement module):

- Precise Feature Aggregation & Global Receptive Field
- Three complementary branches (Box, Corner, Mask)
- Farsighted Branch Selector

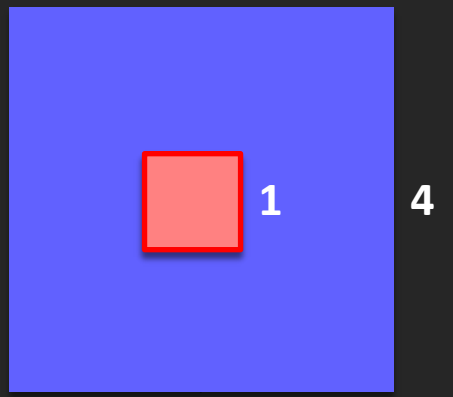



Alpha-Refine uses smaller region than SiamMask

Alpha-Refine




SiamMask



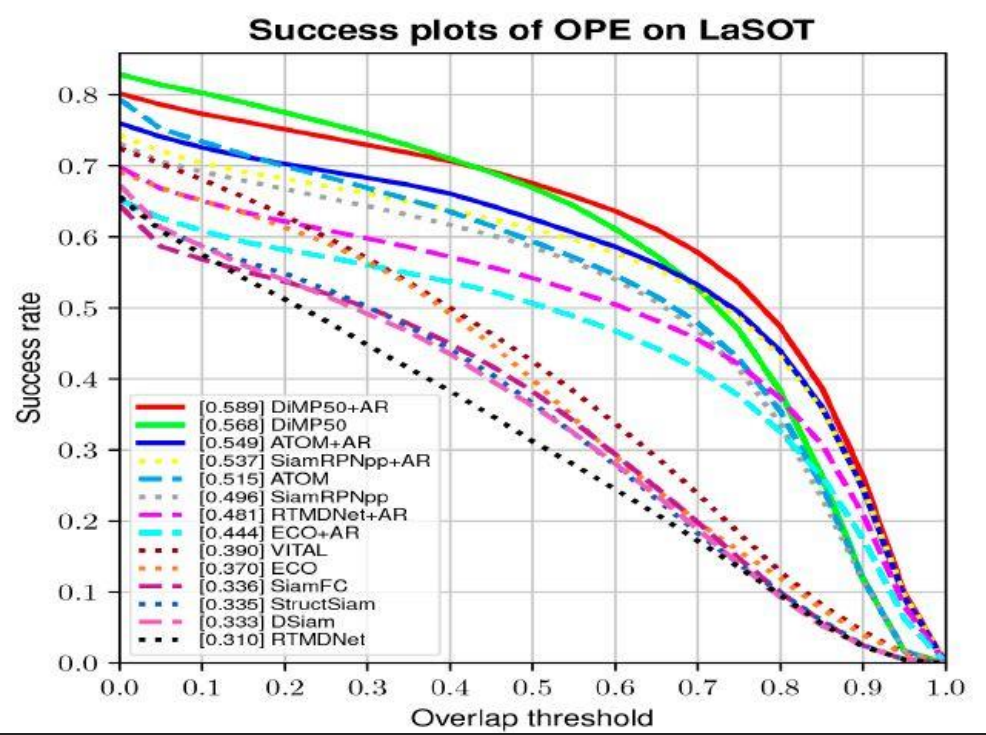

**Paper link of Alpha-Refine:** https://arxiv.org/abs/2007.02024

# Experimental Results

| | Staple [1] | CSRDCF [29] | SiamFC [2] | CFNet [44] | MDNet [32] | UPDT [4] | Dsiam [58] | Dsiam-Update [54] | GFS-DCF [51] | C-RPN [10] |
|---|---|---|---|---|---|---|---|---|---|---|
| P(%) | 47.0 | 48.0 | 53.3 | 53.3 | 56.5 | 55.7 | 59.1 | 62.5 | 56.6 | 61.9 |
| $P_{norm}$(%) | 60.3 | 62.2 | 66.6 | 65.4 | 70.5 | 70.2 | 73.3 | 75.2 | 71.8 | 74.6 |
| AUC(%) | 52.8 | 53.4 | 57.1 | 57.8 | 60.6 | 61.1 | 63.8 | 67.7 | 60.9 | 66.9 |
| | ECO | ECO+AR | RTMDNet | RTMDNet+AR | SiamRPNpp | SiamRPNpp+AR | ATOM | ATOM+AR | DiMP50 | DiMP50+AR |
| P(%) | 55.9 | 69.2 | 53.3 | 69.4 | 69.4 | 73.3 | 64.8 | 72.5 | 68.7 | 74.4 |
| $P_{norm}$(%) | 71.0 | 78.4 | 69.4 | 78.7 | 80.0 | 81.5 | 77.1 | 80.9 | 80.1 | 82.5 |
| AUC(%) | 61.2 | 73.2 | 58.4 | 73.1 | 73.3 | 76.2 | 70.3 | 75.9 | 74.0 | 77.5 |

**TrackingNet**
**Absolute Gain of AUC (%)**

- **DiMP50** **3.5**
- **ATOM** **5.6**
- **SiamRPN++** **2.9**
- **ECO** **12.0**
- **RT-MDNet** **14.7**




**LaSOT test**
**Absolute Gain of AUC (%)**

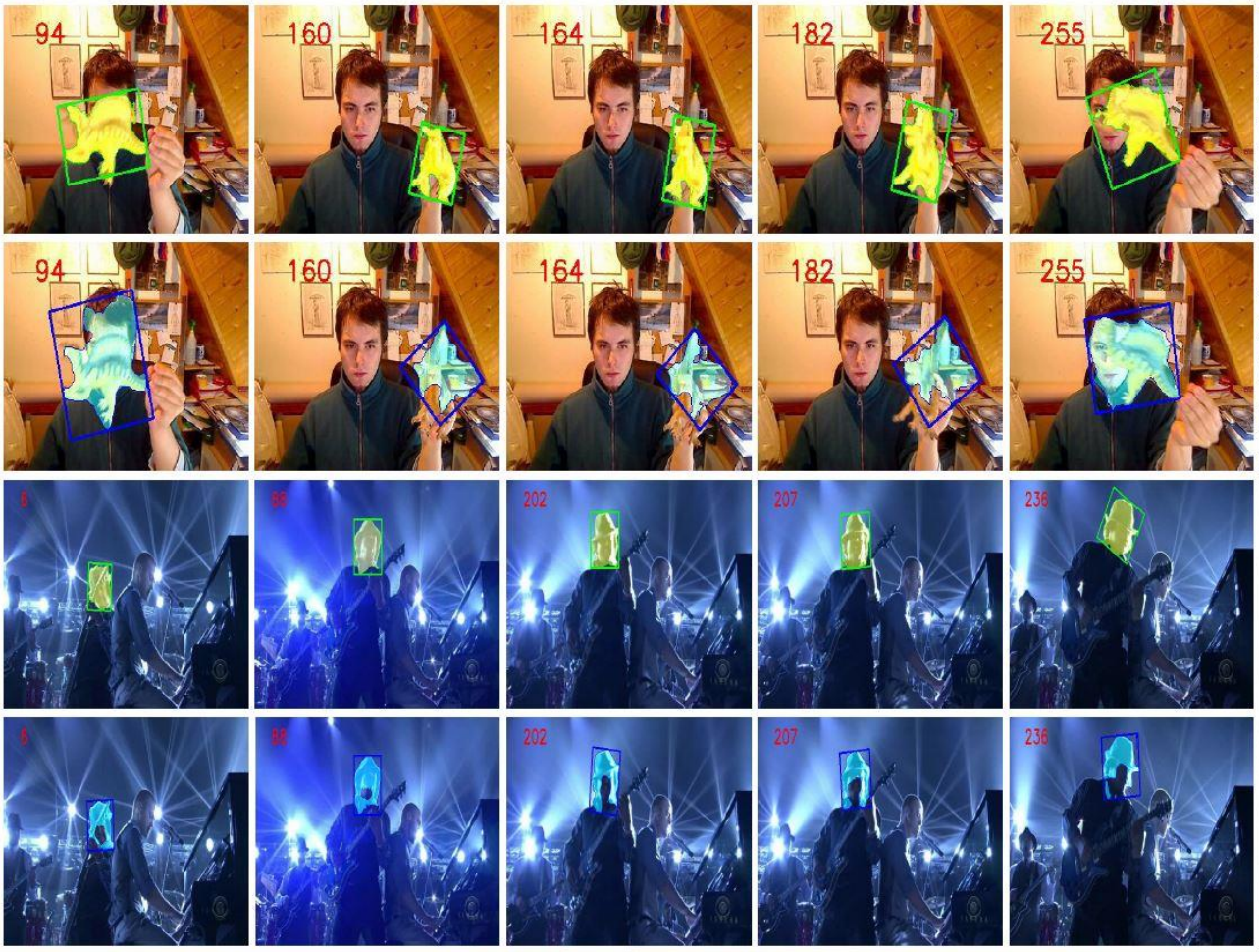
- **DiMP50** **2.1**
- **ATOM** **3.4**
- **SiamRPN++** **4.1**
- **ECO** **7.4**
- **RT-MDNet** **17.1**

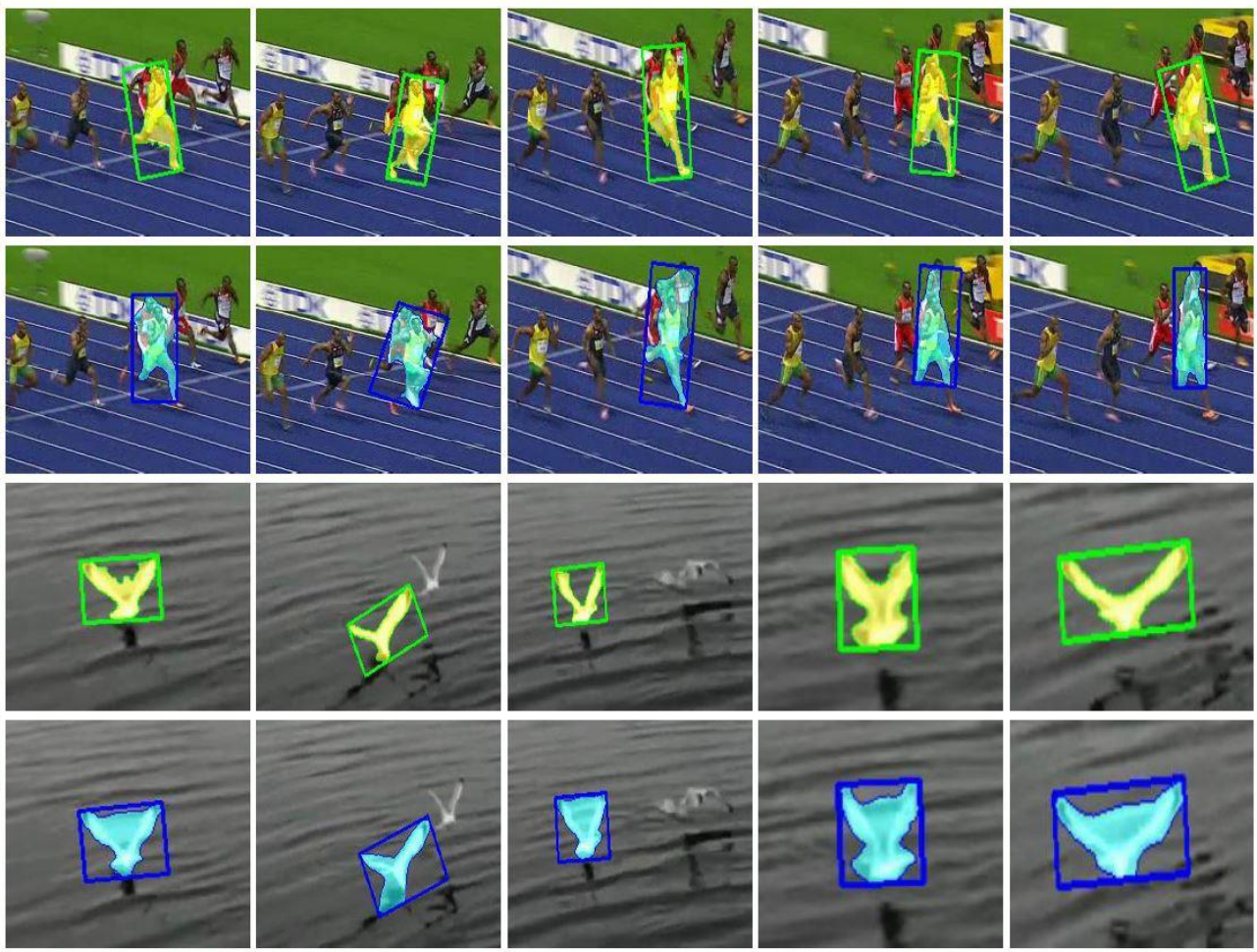
## Conclusion

- **Alpha-Refine can significantly improve existing trackers' performance.**
- **The speed of Alpha-Refine is fast, which promises that trackers can still run in real-time after using Alpha-Refine.**

# Mask Quality Comparison

- **Golden** masks are predicted by **Alpha-Refine**
- Blue masks are predicted by **SiamMask**



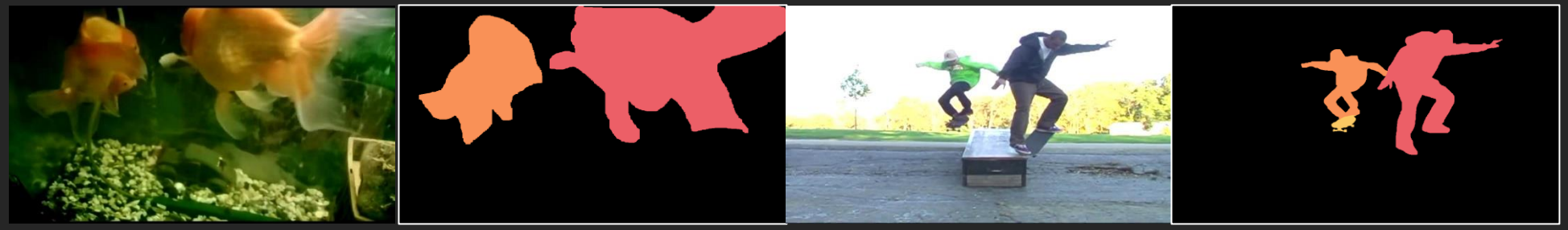



# Alpha-Refine (Strengthened Version)

We use "**DiMP50 + Alpha-Refine**" as our baseline.
Improvements are mainly from the following aspects

- More **diverse mask datasets**
- More **powerful mask prediction structure**
- More **robust base tracker**

Youtube-VOS
(Videos)

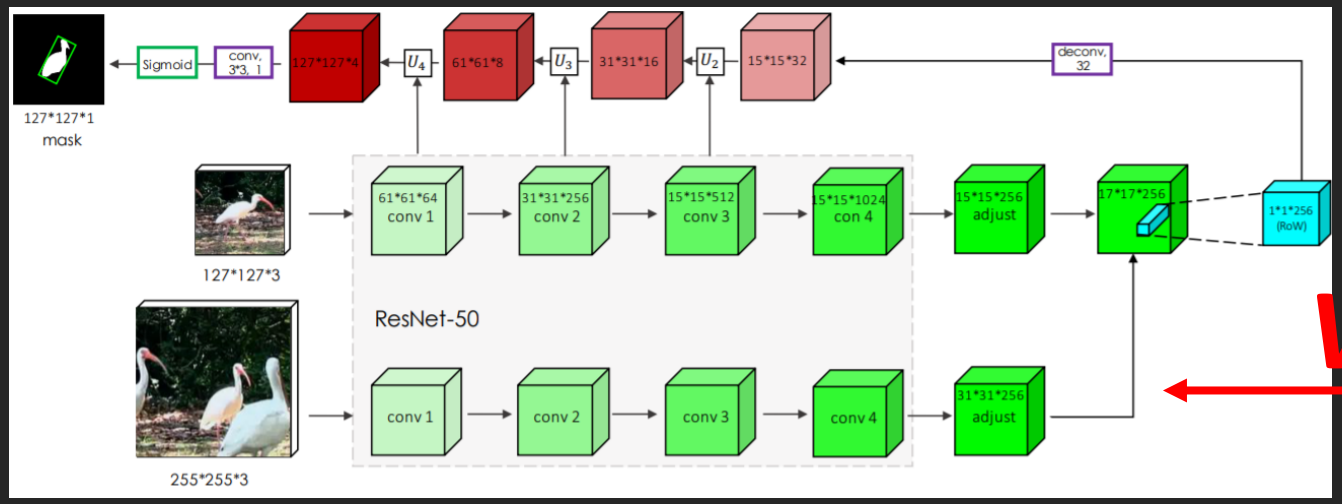


Saliency
(Details)


COCO17 Inst Seg
(Cluttered
Background)

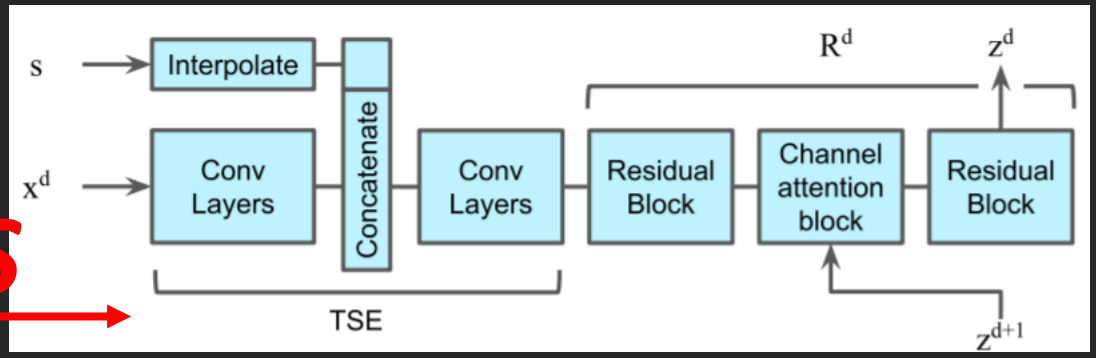
# Mask Prediction Structure & Base Tracker

Fast Online Object Tracking and Segmentation: A Unifying Approach




V.S

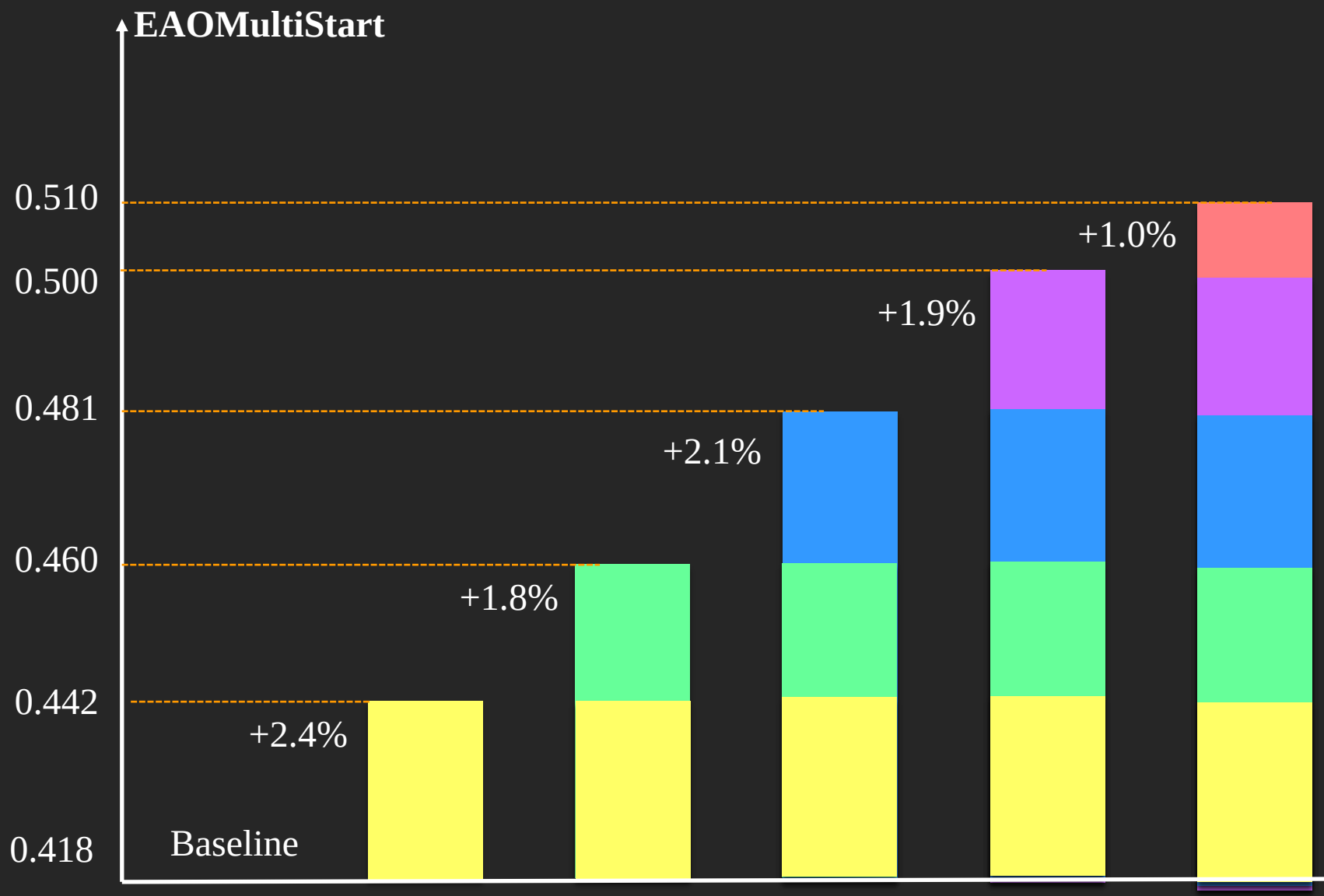
Learning Fast and Robust Target Models for Video Object Segmentation




| Model | VOT18 EAO (%) | OTB100 AUC (%) | NFS AUC (%) | UAV123 AUC (%) | LaSOT AUC (%) | TrackingNet AUC (%) | GOT-10k AO (%) | Links |
|---|---|---|---|---|---|---|---|---|
| ATOM | 0.401 | 66.3 | 58.4 | 64.2 | 51.5 | 70.3 | 55.6 | model |
| DiMP-18 | 0.402 | 66.0 | 61.0 | 64.3 | 53.5 | 72.3 | 57.9 | model |
| DiMP-50 | 0.440 | 68.4 | 61.9 | 65.3 | 56.9 | 74.0 | 61.1 | model |
| PrDiMP-18 | 0.385 | 68.0 | 63.3 | 65.3 | 56.4 | 75.0 | 61.2 | model |
| PrDiMP-50 | 0.442 | 69.6 | 63.5 | 68.0 | 59.8 | 75.8 | 63.4 | model |
| SuperDimp | - | 70.1 | 64.7 | 68.1 | 63.1 | 78.1 | - | model |

https://github.com/visionml/pytracking

# Improvement Logs




Increase Resolution to 384x384
Remove corner and box branch

Replace DiMP with Super DiMP

Use FRTM's Seg Head

Introduce COCO17 Inst Seg
Increase weight of mask branch

Tune mask threshold

Code: https://github.com/MasterBin-IIAU/AlphaRefine

Paper: https://arxiv.org/abs/2007.02024

Resources: https://github.com/wangdongdut/Online-Visual-Tracking-SOTA

# Thank you