Tracking by Segmentation

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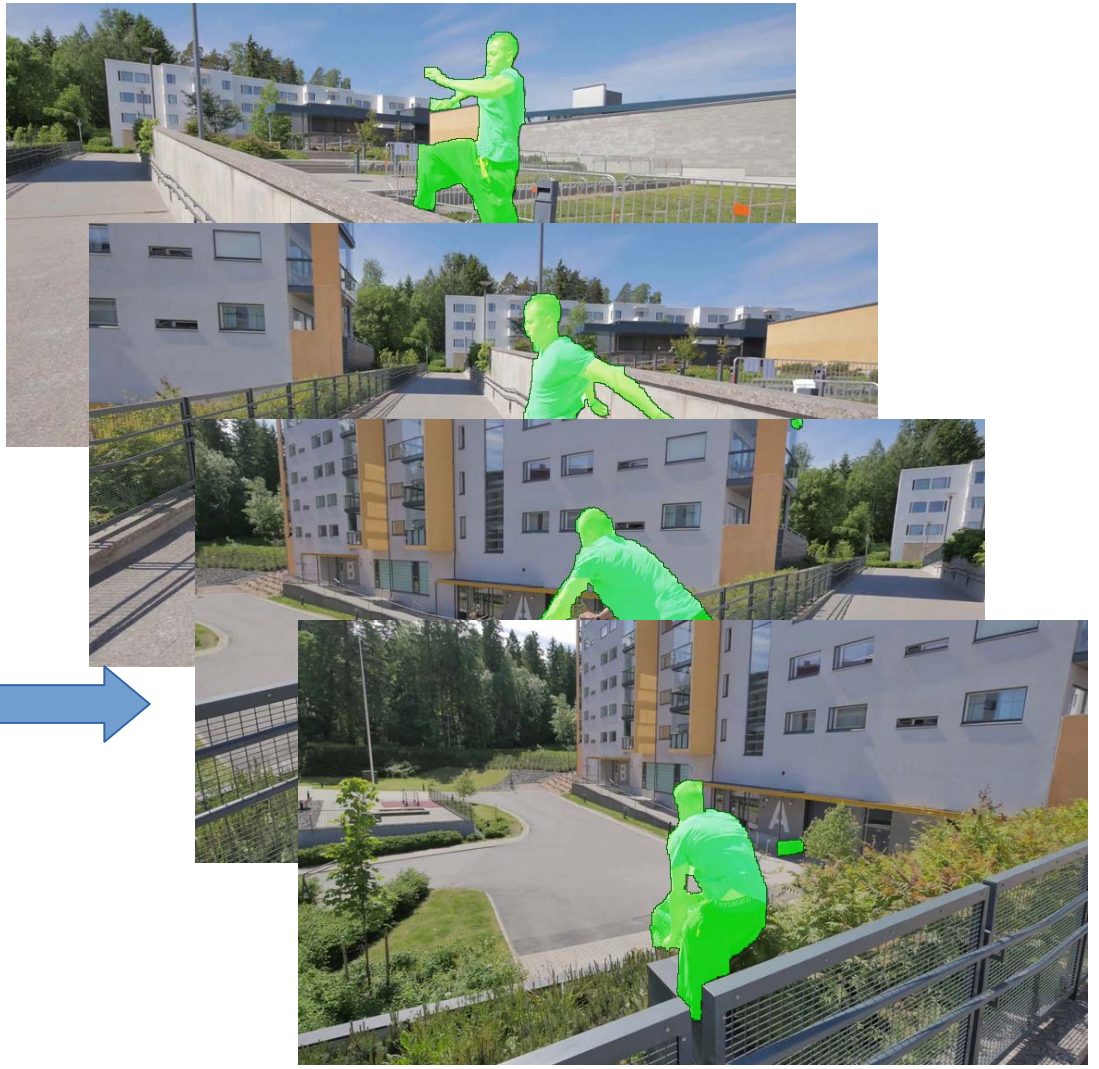
Tracking by segmentation

- Correlation filter trackers
  - Usually axis-aligned bbox
  - Translation OK, Scale ok, rotation ?, Affine X
- Tracking by segmentation
  - Not limited to simple transformations
  - Segmentation captures reality better

Tracking by segmentation

Segmentation on first frame



Segmentation throughout the video

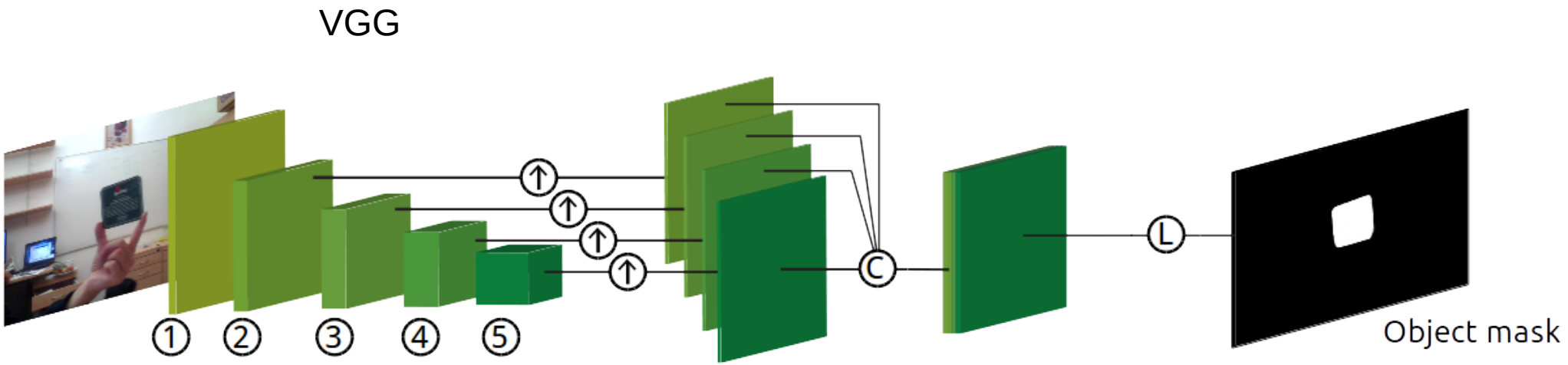
Tracking by segmentation

- DAVIS dataset – Densely Annotated VIdeo Segmentation
  - 50 Full HD videos, 24 fps
  - 3455 annotated frames with pixel-level segmentation

https://youtu.be/8f9y17-OAwI

- F. Perazzi et al. A Benchmark Dataset and Evaluation Methodology for Video Object Segmentation. *IEEE CVPR*, 2016.

OSVOS architecture



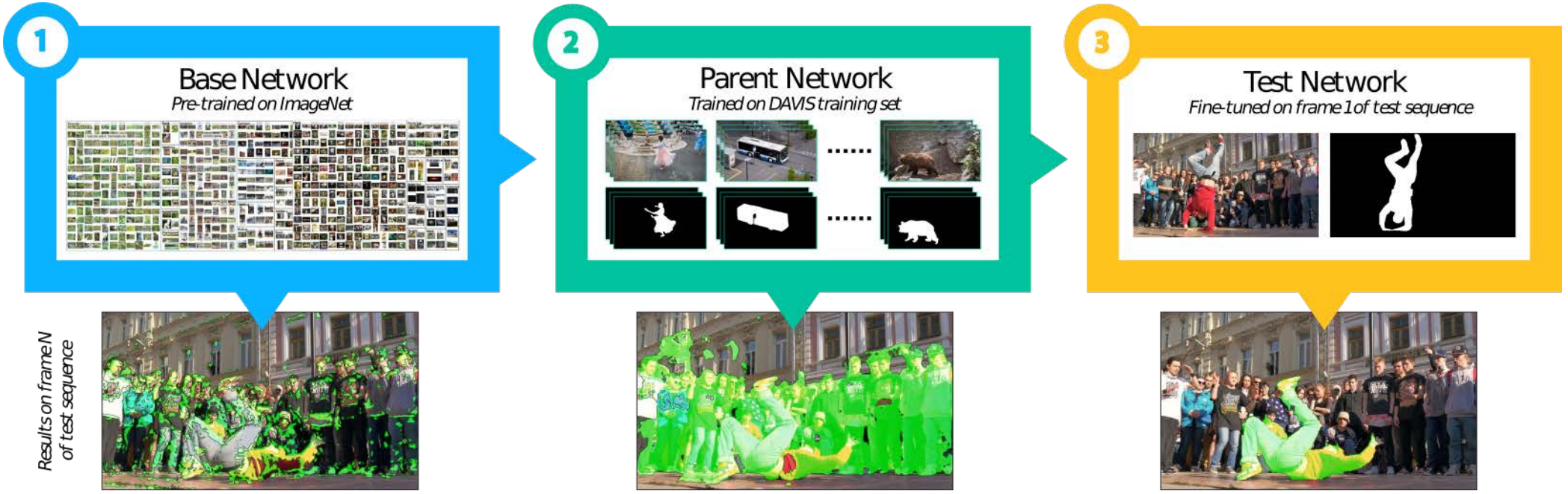
- 1 – 2 x conv(3, 3, 64)
- 2 – maxpool, 3 x conv(3, 3, 128)
- 3 – maxpool, 3 x conv(3, 3, 256)
- 4 – maxpool, 3 x conv(3, 3, 512)
- 5 – maxpool, 3 x conv(3, 3, 512)
- ↑ – conv(3, 3, 16), bilinear_upsampling(H, W)
- C – concat
- L – conv(1, 1, 1), sigmoid

- Simple adaptation of VGG
- Video frames processed one by one independently

- Caelles, Sergi, et al. "One-shot video object segmentation." *CVPR 2017.* IEEE, 2017.

Training

1) Backbone CNN ImageNet pre-training
2) Segmentation pre-training (DAVIS, PASCAL VOC, …)
   - Strip fully connected layers
   - Convert into fully convolutional segmentation CNN
3) Fine-tuning on first frame

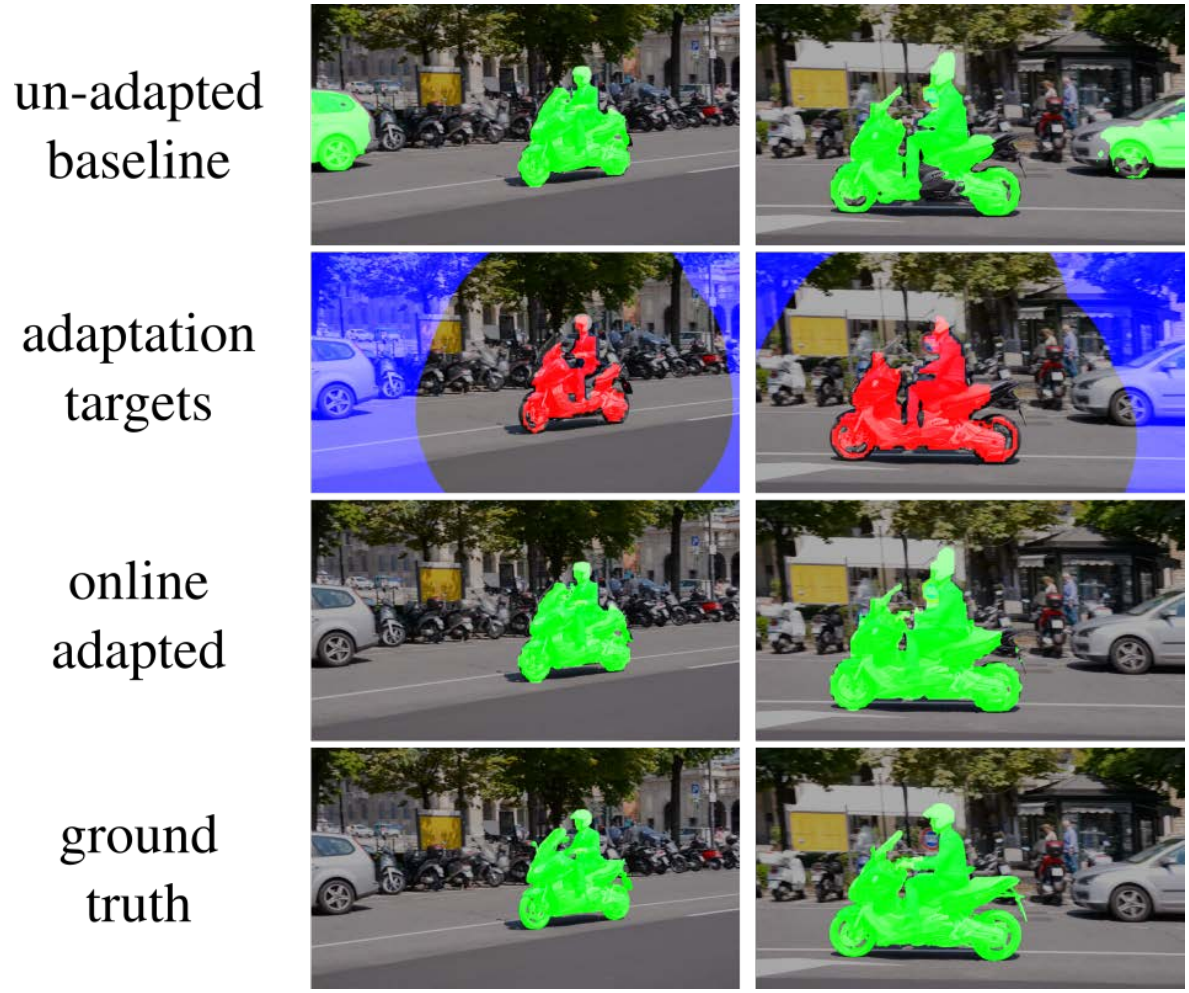


- Caelles, Sergi, et al. "One-shot video object segmentation." *CVPR 2017.* IEEE, 2017.

OnAVOS

- Newly appearing objects – issue for OSVOS

=> Online adaptation

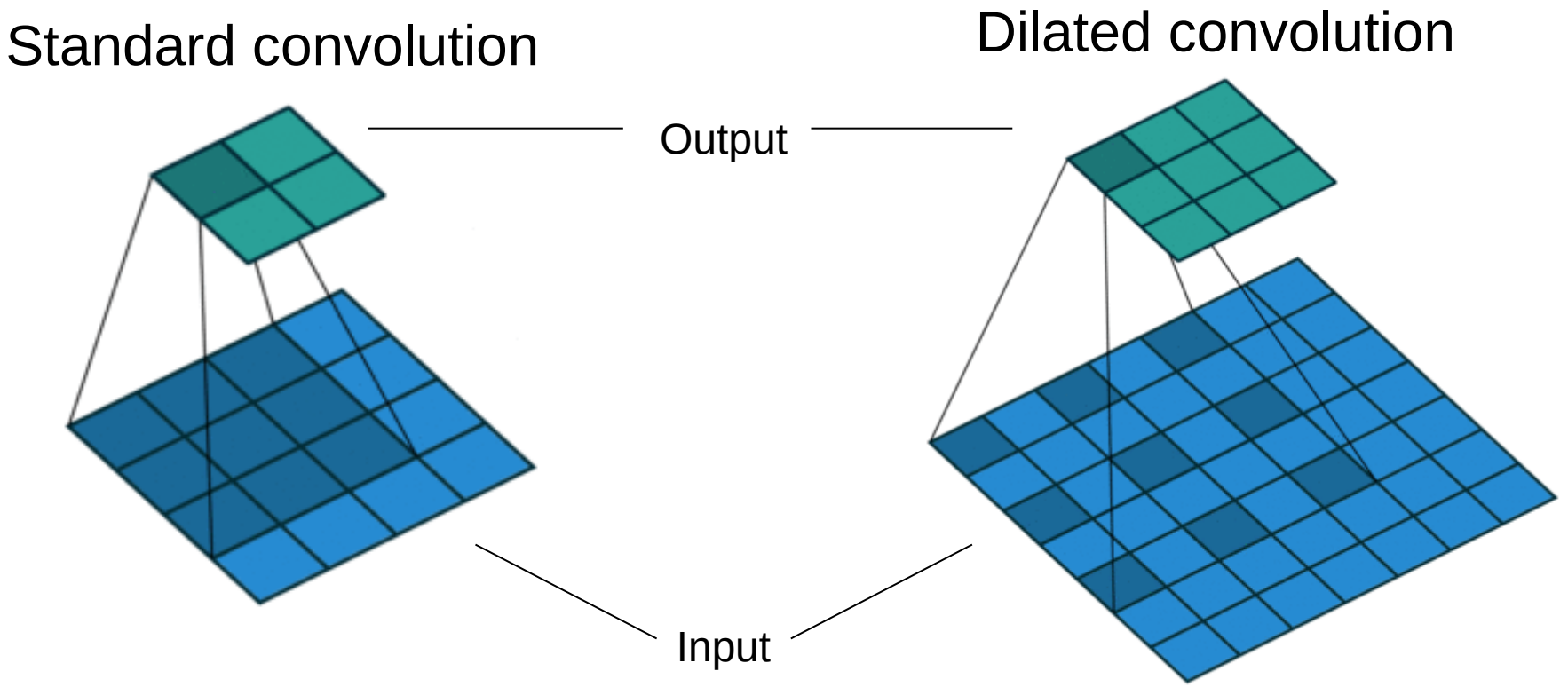


- Voigtlaender, Paul, and Bastian Leibe. "Online adaptation of convolutional neural networks for video object segmentation." *BMVC* 2017.

Dilated (Atrous) convolutions

- Used in current state-of-the-art semantic segmentation DNNs
  - e.g. DeepLabv3+ (top on PASCAL VOC2012 leaderboard 20.4.2018)

- Increase receptive field
- Same number of parameters
- Same number of operations



- Dumoulin, Vincent, and Francesco Visin. "A guide to convolution arithmetic for deep learning." *arXiv preprint arXiv:1603.07285* (2016).

MaskTrack

- Semantic segmentation CNN (DeepLabv2)
  - With dilated convolutions
- **„Refine the segmentation from last frame“**
- Mask as additional input channel - RGB+Mask

https://youtu.be/Ze7dKwwAw8o
https://youtu.be/G8RbuKI_784

- Perazzi, Federico, et al. "Learning video object segmentation from static images." *Computer Vision and Pattern Recognition.* 2017.

LucidTrack

- Like MaskTrack + uses optical flow
- **Complex data augmentation**
  - Very good results without segmentation training phase!
  - Very good even without ImageNet pretraining!

Original image:

Generated image:

https://youtu.be/7aZI0BjmrA8
https://youtu.be/QrsR5w-HR14

- Khoreva, Anna, et al. "Lucid data dreaming for object tracking." *arXiv preprint arXiv:1703.09554* (2017).