Accel: A Corrective Fusion Network for Efficient Semantic Segmentation on Video

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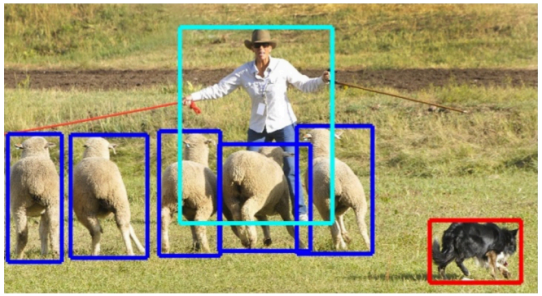
Semantic segmentation

Image classification



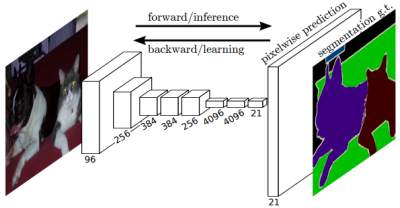
Object detection

Semantic segmentation

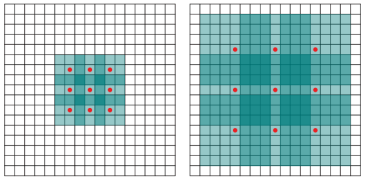
Evolution

Efficient Graph-Based Image Segmentation (2004)

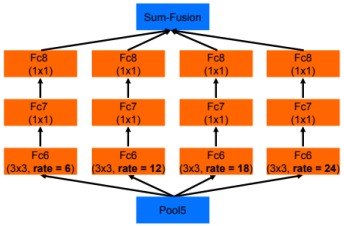
...



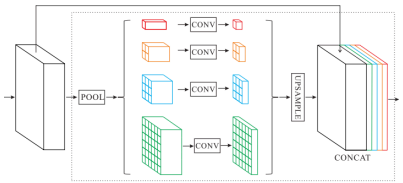
Fully Convolutional Networks for SS (2014)



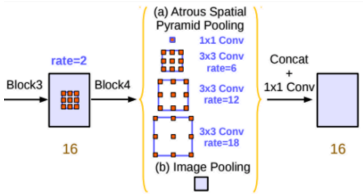
Multi-Scale Aggregation by Dilated Convolutions (2015)



DeepLab-v2 (2016)

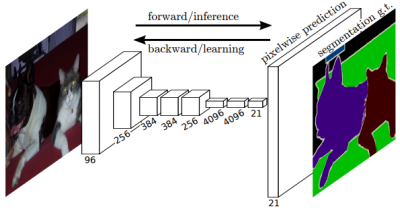


PSPNet (2017)

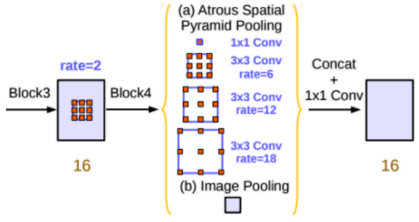


DeepLab-v3 (2017)

Evolution



Fully Convolutional Networks (2014)



DeepLab-v3 (2017)

Dataset	Pascal VOC 2012	
Accuracy (mIoU)	62.2	85.7
Inference Time	175 ms	750 ms

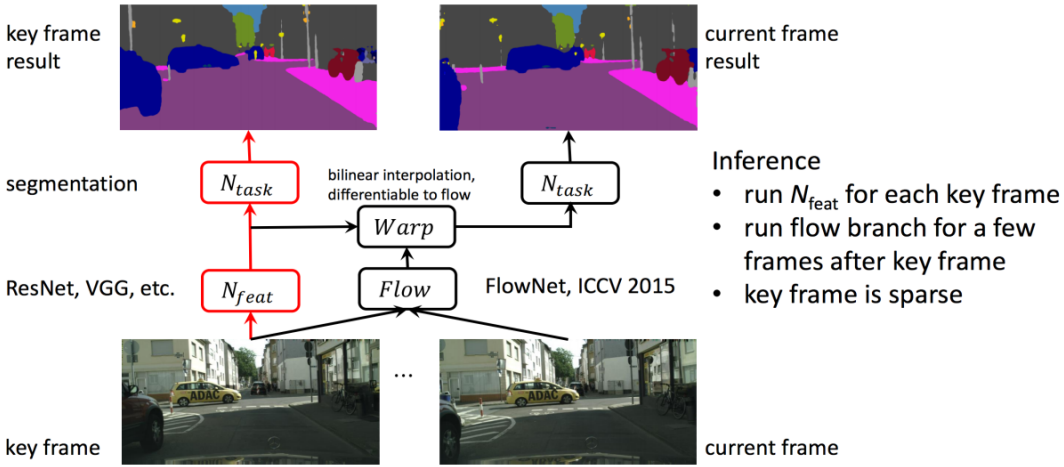
Motivation

- Image models don’t translate to video
  - High frame rates (e.g. 30 fps)
  - High resolution (e.g. full-HD, 1920 x 1080 p)
  - Scene complexity (e.g. ego motion, urban streets)

Cityscapes dataset: Frankfurt

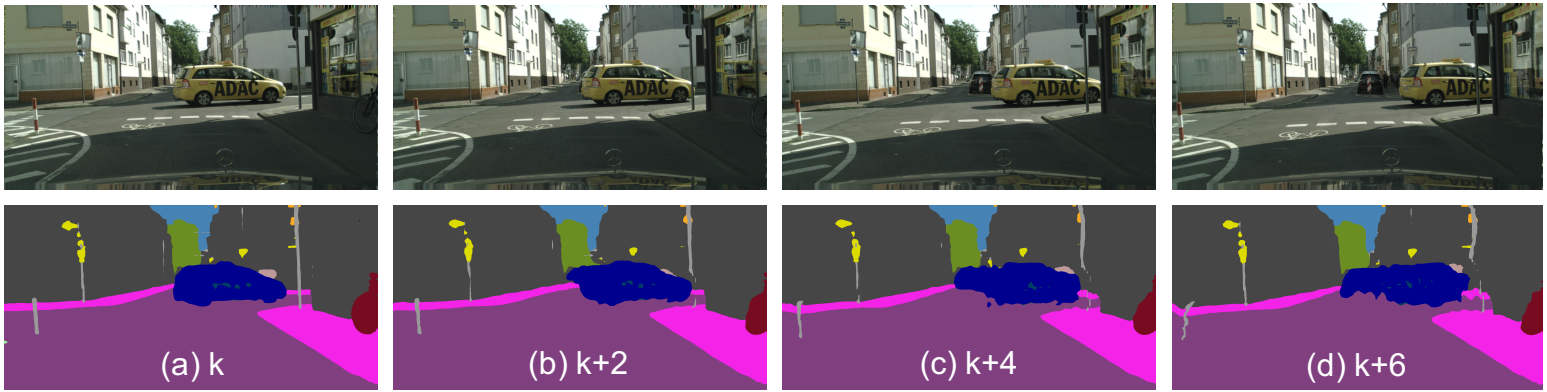
Deep Feature Flow

- Idea: run feature net on **keyframes**, warp features to **intermediate frames**

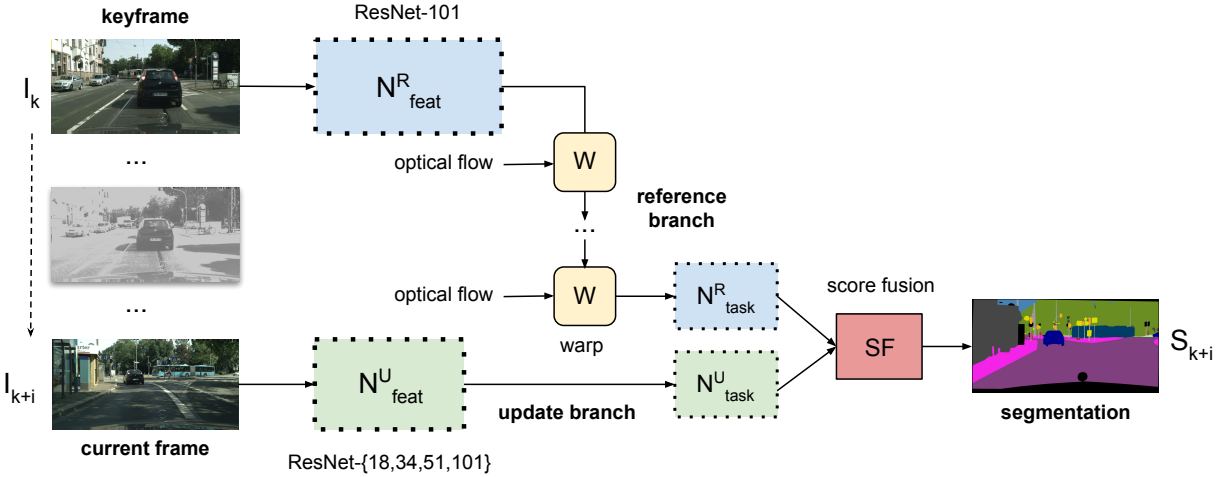


Problems

- Accuracy degradation
  - Warping with a flow field is a coarse operation
  - Non-translational temporal change (e.g. new objects, occlusions, lighting) ignored



Accel



Accel: a family of corrective, two-stream fusion networks combining:

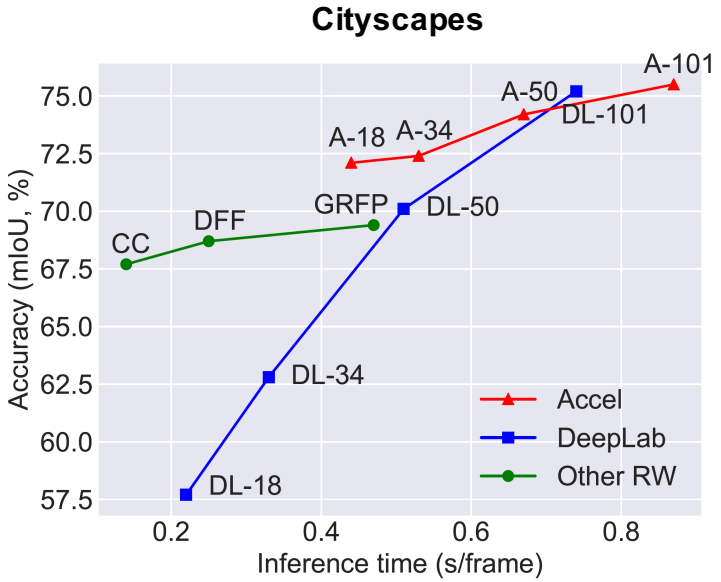
(1) N^R (**reference branch**) – optical flow-based keyframe feature warping

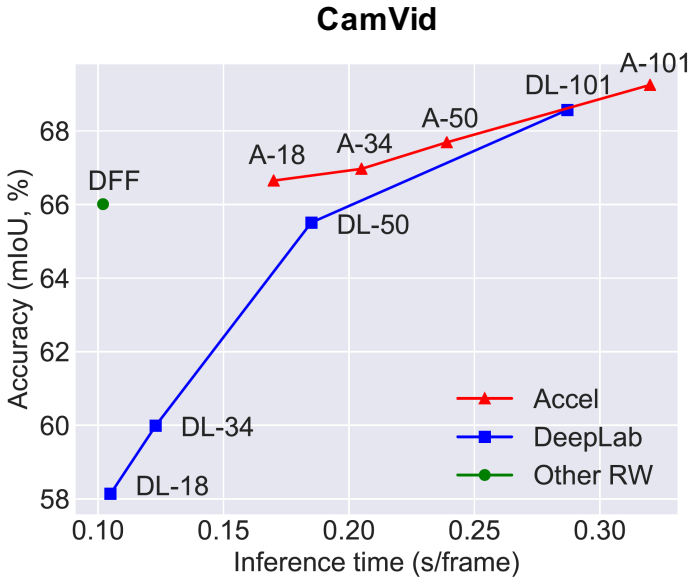
(2) N^U (**update branch**) – per-frame correction with residual segmentation network

Accel

N^R_{feat} (reference branch)	N^U_{feat} (update branch)	$N^R + N^U$ (full network)
ResNet-101	**ResNet-18**	**Accel-18**
ResNet-101	ResNet-34	Accel-34
ResNet-101	ResNet-51	Accel-51
ResNet-101	**ResNet-101**	**Accel-101**

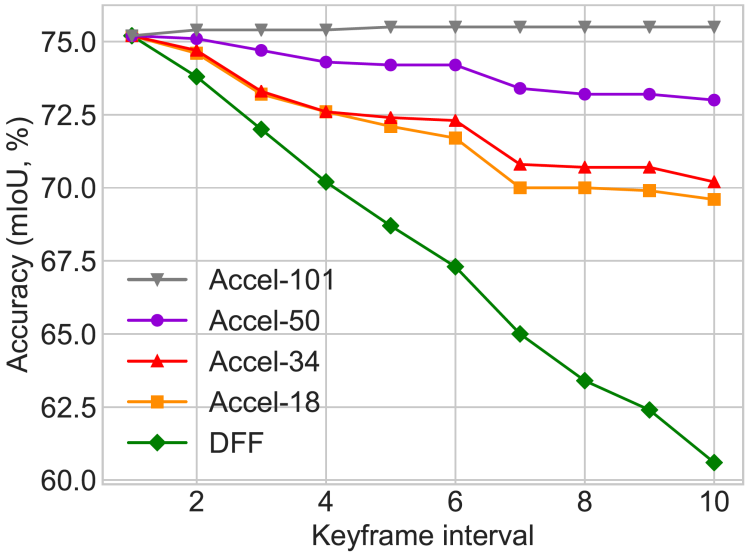
Results





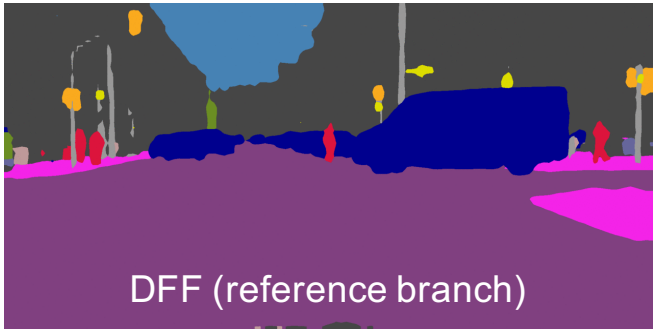
Accuracy (mIoU) vs. **inference time** (s/frame)

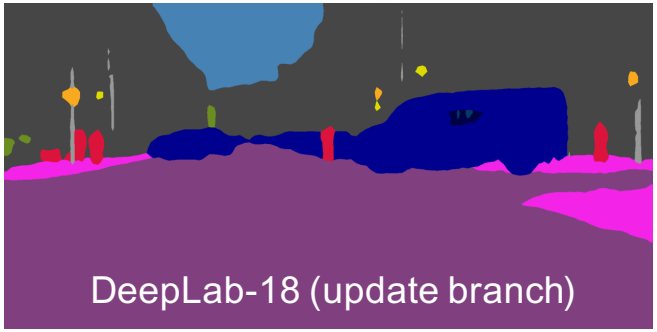
Results

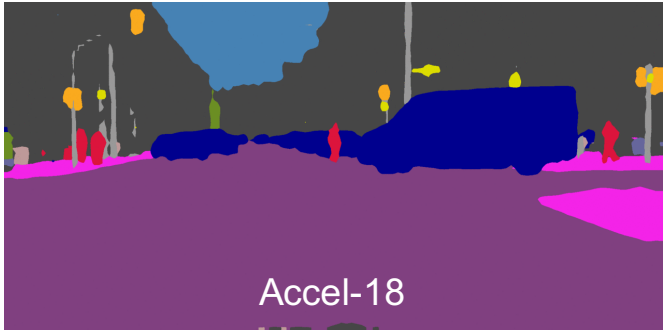


Accuracy (mIoU) vs. **keyframe interval**

Visualizations







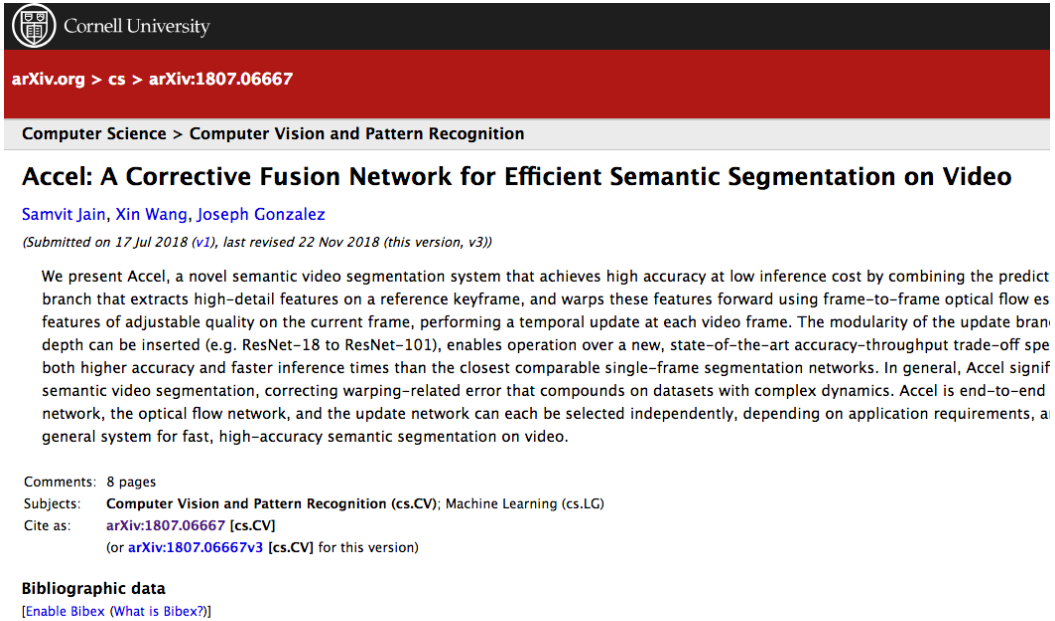
Thank you!

Accel: A Corrective Fusion Network for Efficient Semantic Segmentation on Video

S. Jain, X. Wang, J. Gonzalez

In: CVPR 2019 (oral)

https://arxiv.org/abs/1807.06667



Cornell University

arXiv.org > cs > arXiv:1807.06667

Computer Science > Computer Vision and Pattern Recognition

Accel: A Corrective Fusion Network for Efficient Semantic Segmentation on Video

Samvit Jain, Xin Wang, Joseph Gonzalez

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We present Accel, a novel semantic video segmentation system that achieves high accuracy at low inference cost by combining the predict branch that extracts high-detail features on a reference keyframe, and warps these features forward using frame-to-frame optical flow es features of adjustable quality on the current frame, performing a temporal update at each video frame. The modularity of the update bran depth can be inserted (e.g. ResNet-18 to ResNet-101), enables operation over a new, state-of-the-art accuracy-throughput trade-off spe both higher accuracy and faster inference times than the closest comparable single-frame segmentation networks. In general, Accel signif semantic video segmentation, correcting warping-related error that compounds on datasets with complex dynamics. Accel is end-to-end network, the optical flow network, and the update network can each be selected independently, depending on application requirements, a general system for fast, high-accuracy semantic segmentation on video.

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(or **arXiv:1807.06667v3 [cs.CV]** for this version)

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