A survey on deep learning techniques in image and video semantic segmentation

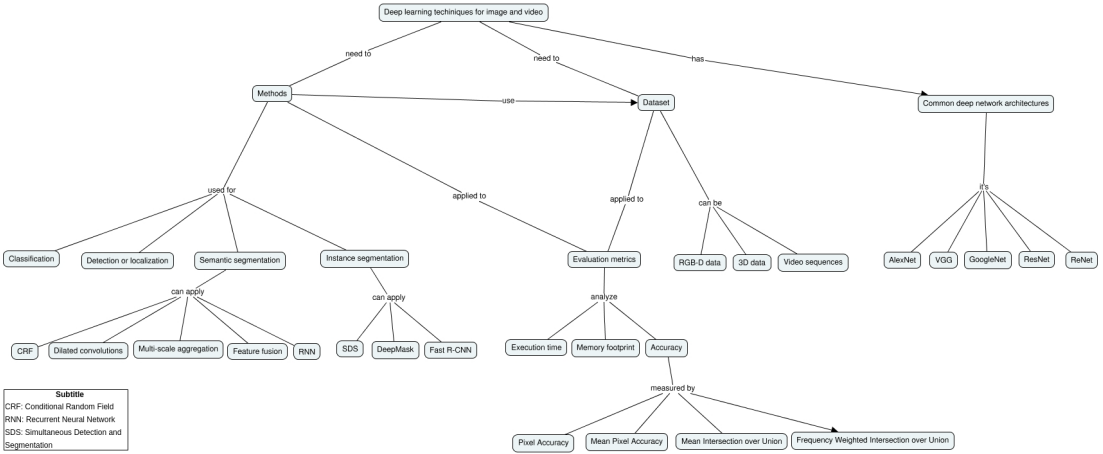
(paper analysis)

Jessica Motta

SENAI CIMATEC

June 2, 2020

Concept Map


Deep learning techniques for image and video
need to
need to
has
Methods
use
Dataset
Common deep network architectures
used for
applied to
applied to
can be
it's
Classification
Detection or localization
Semantic segmentation
Instance segmentation
Evaluation metrics
RGB-D data
3D data
Video sequences
AlexNet
VGG
GoogleNet
ResNet
ReNet
can apply
can apply
analyze
CRF
Dilated convolutions
Multi-scale aggregation
Feature fusion
RNN
SDS
DeepMask
Fast R-CNN
Execution time
Memory footprint
Accuracy
measured by
Pixel Accuracy
Mean Pixel Accuracy
Mean Intersection over Union
Frequency Weighted Intersection over Union
Subtitle
CRF: Conditional Random Field
RNN: Recurrent Neural Network
SDS: Simultaneous Detection and Segmentation

CNN- How it works?

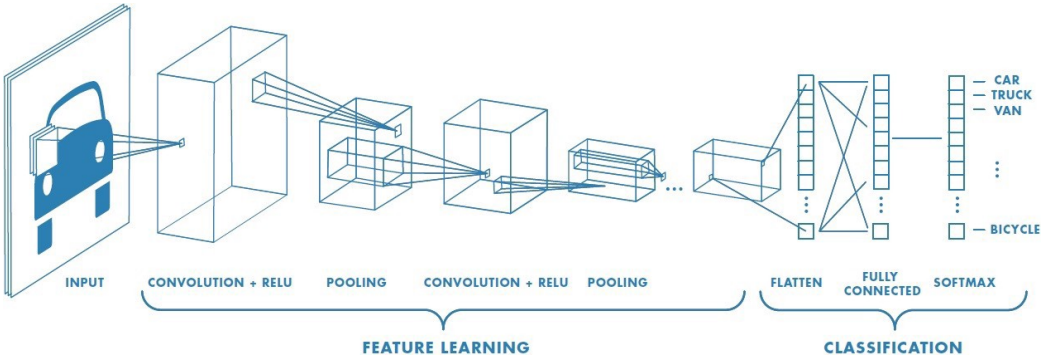


Figure: Convolutional Neural Network [Sha19]

Common deep networks architecture

COMPARATIVE FOR COMMON DEEP NETWORK ARCHITECTURES			
Network	**Year champion ILSVRC***	**Number of Layers**	**Accuracy**
AlexNet	2012	3	84.6%
VGG	2013	16	92.7%
GoogleNet	2014	22	93.3%
ResNet	2016	152	96.4%

Table: Deep network architectures. [GGOEO$^+$18]

*ILSVRC (ImageNet Large Scale Visual Recognition Challenge)

Methods to image analysis

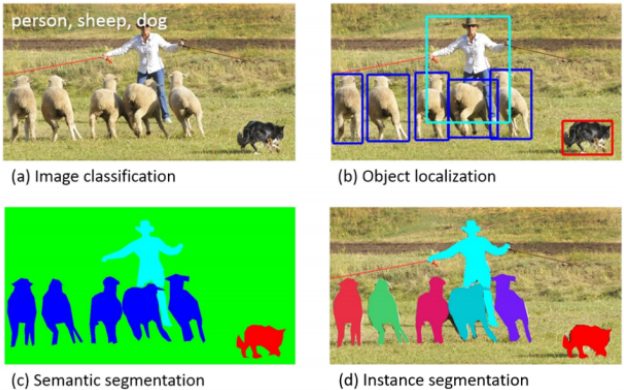


Figure: Methods to image analysis. [LMB+14]

Semantic Segmentation applied in video

Semantic Segmentation [Zha17]

Semantic Segmentation

Use **ImageNet** pre-trained networks

Smaller dataset, even **worse** for RGB-D and 3D datasets

Use **synthetic datasets** extracted from commercial video games

Evaluation Metrics

Execution time

Memory footprint

Accuracy

Accuracy- IoU calculation

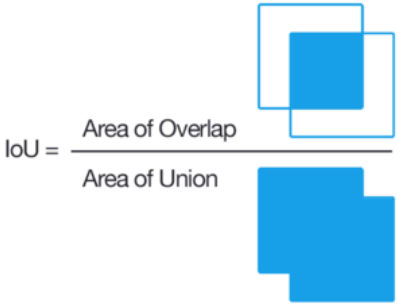


Figure: IoU calculation visualized. [Tiu19]

Figure: Accuracy evaluation. [Ros16]

Wich cases doesn't apply deep learning?

For **high perfomance**, deep networks require **extremely large** datasets.

It's **expensive** to get data, computer power and hiring researchers.

Deep networks **aren't easily interpreted** as classical Machine Learning algorithms.

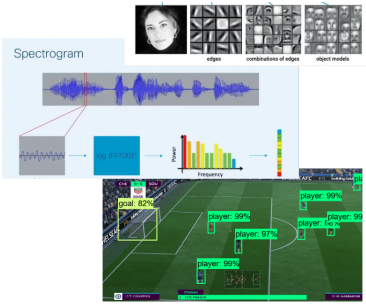
Advantages to use Deep learning against to Classical methods

Better performance (accuracy results)

More data works to DP **but not** with CML

DP **no need** for feature engineering

It's **adaptable** to differents domains and applications



Advantages to use Classical methods against to Deep learning

Works better with **small dataset**

Low computional and financial cost

The algorithms it's **easier** to understand and interpret

Conclusion

A survey to **help** researchers to choose the **best method and dataset** it's appropriate for their application

Semantic segmentation has been approached with many **success** stories but has some **problems** whose solution would be useful for real-world applications

And **deep learning** has proved to be extremely **powerful** to solve these problems

Future research directions

- 3D datasets
- Sequence datasets
- Point cloud segmentation using Graph Convolutional Networks (GCN)
- Real-time segmentation
- Memory
- Temporal coherency on sequences
- Multi-view integration

References I

- Alberto Garcia-Garcia, Sergio Orts-Escolano, Sergiu Oprea, Victor Villena-Martinez, Pablo Martinez-Gonzalez, and Jose Garcia-Rodriguez, *A survey on deep learning techniques for image and video semantic segmentation*, Applied Soft Computing **70** (2018), 41–65.
- Tsung-Yi Lin, Michael Maire, Serge Belongie, James Hays, Pietro Perona, Deva Ramanan, Piotr Dollár, and C Lawrence Zitnick, *Microsoft coco: Common objects in context*, European conference on computer vision, Springer, 2014, pp. 740–755.
- Adrian Rosebrock, *Intersection over union (iou) for object detection*, 2016.
- Shashikant, *Convolutional neural network: A step by step guide*, 2019.
- Ekin Tiu, *Metrics to evaluate your semantic segmentation model*, 2019.

References II

Hengshuang Zhao, *Icnet for real-time semantic segmentation on high-resolution images*, 2017.