



COMPUTER VISION University of Freiburg

Multi-view 3D Models from Single Images with a Convolutional Network

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Skoltech - 2nd Christmas Colloquium on Computer Vision

M. Tatarchenko "Multi-view 3D Models From Single Images with a Convolutional Network"

Humans have prior knowledge about 3D



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Humans have prior knowledge about 3D





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Side view?

Humans have prior knowledge about 3D





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Side view?





How can we teach similar 3Dawareness to neural networks?



Convolutional network



*slides partially provided by Alexey Dosovitskiy



Up-convolutional network



Up-convolutions



Up-convolution ↔ Unpooling + Convolution



Generating chairs



Alexey Dosovitskiy



Jost Tobias Springenberg



Thomas Brox











- Chairs from [Aubry et al. 2014]
- Cars and tables from ShapeNet



Training data

- Chairs from [Aubry et al. 2014]
- Cars and tables from ShapeNet



CNN for generating objects



[1] A. Dosovitskiy, J. T. Springenberg and T. Brox "Learning to Generate Chairs with Convolutional Neural Networks", CVPR 2015

[2] A. Dosovitskiy, J. T. Springenberg, M. Tatarchenko and T. Brox "Learning to Generate Chairs, Tables and Cars with Convolutional Neural Networks", PAMI 2016

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Generated images - transformations

Translation

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Rotation

Zoom

Squeeze

Saturation

Brightness

Color



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Style interpolation - chairs







Style interpolation - chairs









Style interpolation - cars

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Style interpolation – chairs to tables

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Chair arithmetic

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- "Source set" : 90% styles, all viewpoints available
- "Target set": 10% styles, only some viewpoints available
- Task: Interpolate missing angles in the target set





15 azimuth angles available



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Let's add an inference network!



Novel view prediction

• Adding an inference net



M.Tatarchenko, A. Dosovitskiy, and T. Brox "Multi-view 3D Models from Single Images with a Convolutional Network", ECCV 2016



Performance on synthetic data







Performance on synthetic data





Performance on synthetic data - video

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Training data



Network predictions





Segmentation - video



Trained on synthetic, works on natural

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Network learns consistent 3D representation





Network learns consistent 3D representation







Network learns consistent 3D representation



3D reconstruction - video

Comparison with IGN

Kulkarni et al., NIPS 2015

Dosovitskiy et al., CVPR 2015

Yang et al., NIPS 2015

Zhou et al., ECCV 2016

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Interpolation between cars

Internal representation is invariant

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Internal representation is invariant

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pairwise distances

Internal representation is invariant

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pairwise distances

- High-resolution images can be generated with a convolutional network from a set of high-level parameters
- Network learns meaningful continuous manifolds
- Adding an encoder allows to infer 3D representation from a single image
- Internal 3D representation can be explicitly decoded into a consistent point cloud by fusing multiple output depth maps

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Thank you!

Code availble:

http://lmb.informatik.uni-freiburg.de/resources/software.php

