Crafting a multi-task CNN for viewpoint estimation
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Task: Category-based viewpoint estimation

Approaches to pose estimation

Regression
Predict continuous orientation θ as position in manifold F

Classification
Predict discretized orientation θ

Joint detection and pose estimation

Geometric structure aware classification [2]

Joint model with classification

Joint model with regression

Output probabilities

Class probabilities

Detection loss

Viewpoint loss

λ balances detection and viewpoint losses

Joint training and pose estimation results on Pascal 3D+ dataset [4]:

Method mAVP24
Regression 2D 13.9
Regression 3D 15.7
Direct classification: 19.3
Geom. structure classification: 18.4

Results

Dataset: Pascal 3D+ [4]

Summary of results and comparison to baselines

Method mAVP24
DPM-VOC-VP [1] 13.6
Render for CNN [2] 19.8
Classification Approach & AlexNet 19.3
+ our joint training 21.1
+ VGG16 instead of AlexNet 27.3
+ ImageNet data 34.4
+ synthetic data 36.1

Comparison with state of the art for different metrics

More results in the paper

Code available at imagine.enpc.fr/~suzano­f/bmvc2016­pose/

References


Class: Chair

Orientation:

2D manifold

3D manifold

F_{2D}^θ(θ)=[\cos(θ), \sin(θ)]

F_{3D}^θ(θ)=[\cos(θ-\frac{\pi}{3}), \cos(θ), \cos(θ+\frac{\pi}{3})]

Exploits continuity between close viewpoints
Penalizes less small angle errors

Geometric structure classification [2]

Orientations

Class probability

Predicted angle bin

Joint regression 2D

Joint regression 3D

Joint classification

Joint detection and viewpoint estimation results on Pascal 3D+ dataset [4]:

Method mAVP24
Joint Regression 2D 49.2 15.7 51.6 16.4
Joint Regression 3D 49.6 17.1 51.6 17.4
Joint classification 48.6 21.1 51.6 20.5

Dataset:
Pascal 3D+ [4]

Method mAVP24
Joint detector mAP mAVP24 mAP mAVP24
Joint Regression 2D 49.2 15.7 51.6 16.4
Joint Regression 3D 49.6 17.1 51.6 17.4
Joint classification 48.6 21.1 51.6 20.5

New state of the art on Pascal 3D+ dataset [4]

Σ

Class probability

Class probability

Predicted angle bin

predicted angle bin

arg max

arg max

Ours

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