Oriented Response Networks

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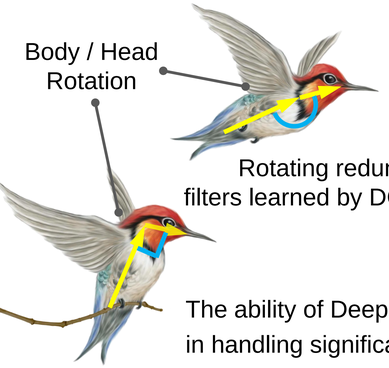
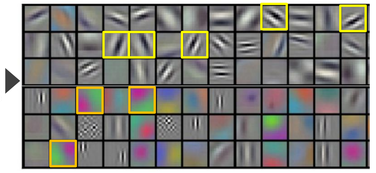
1 Motivation



Rotating redundant filters learned by DCNNs



The ability of Deep Convolutional Neural Networks (DCNNs) in handling significant image rotations remains limited.

2 Our Goal

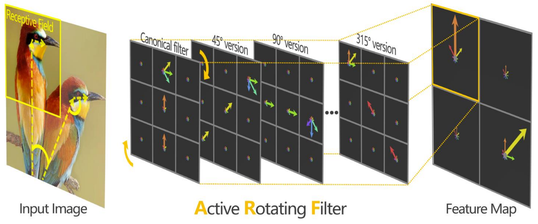
Enabling DCNNs to better understand rotation →

- ✓ Reduce network parameters
- ✓ Prevent over-fitting
- ✓ Boost generalization ability
- ✓ Improve performance

3 Introduce ORN

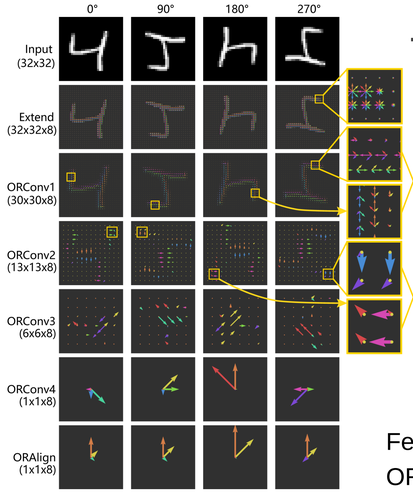
We propose Active Rotating Filters (ARFs) that actively rotate during convolution and produce feature maps with location and orientation explicitly encoded. DCNNs using ARFs are referred to as Oriented Response Networks (ORNs).

Conventional DCNN
↓
Replace filters with ARFs
↓
ORN



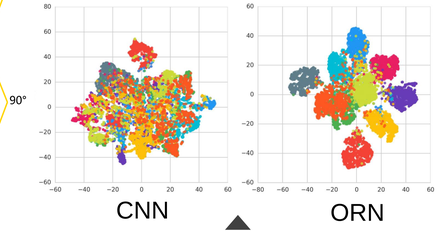
4 Experiment Results

ORN improves performance while using significantly fewer parameters



Method	CNN	ORN
Time(s)	16.4	17.8
Params(%)	100.0	**31.4**
MNIST(%)	0.73	**0.59**
MNIST-rot(%)	2.82	**1.42**

Upgrade

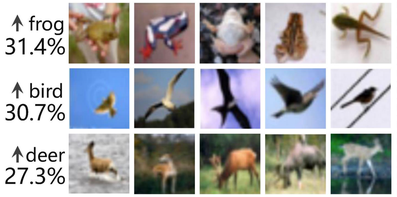


Feature tSNE visualization shows that ORN can handle *unseen* rotated samples

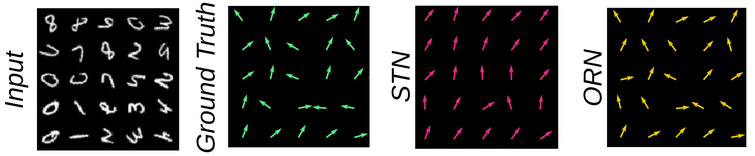
ORN encodes hierarchical orientation information; thus we can perform SIFT-like feature alignment to obtain rotation invariant representation.

Method	WideResNet	ORN
Params	36.5M	**18.2M**
CIFAR10(%)	3.89	**2.98**
CIFAR100(%)	18.85	**16.15**

Upgrade

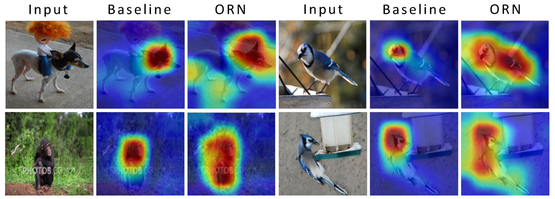


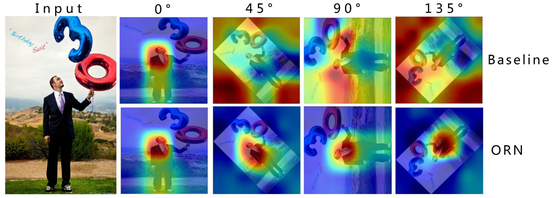
ORN is also effective to natural image classification since rotations could exist in multiple scales (edges, textures, object parts, and objects).



Upgrading STN to ORN yields better performance in Orientation Estimation

Application 5





ORN has great potential for application

6 Conclusion

- ◆ Upgrading to ORN is a simple yet effective strategy to boost the ability of DCNNs in handling image rotations.
- ◆ Modern architectures can be easily upgraded.

Contact

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