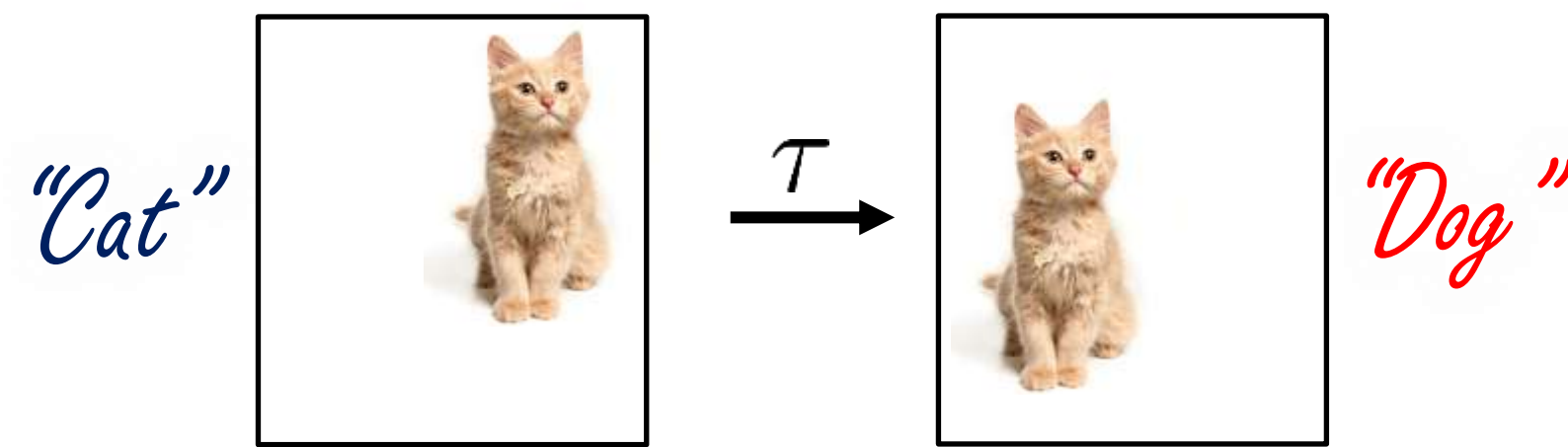


Introduction

CNN classifiers are designed to be “shift invariant”
In practice: CNNs vulnerable to translation attacks



The problem

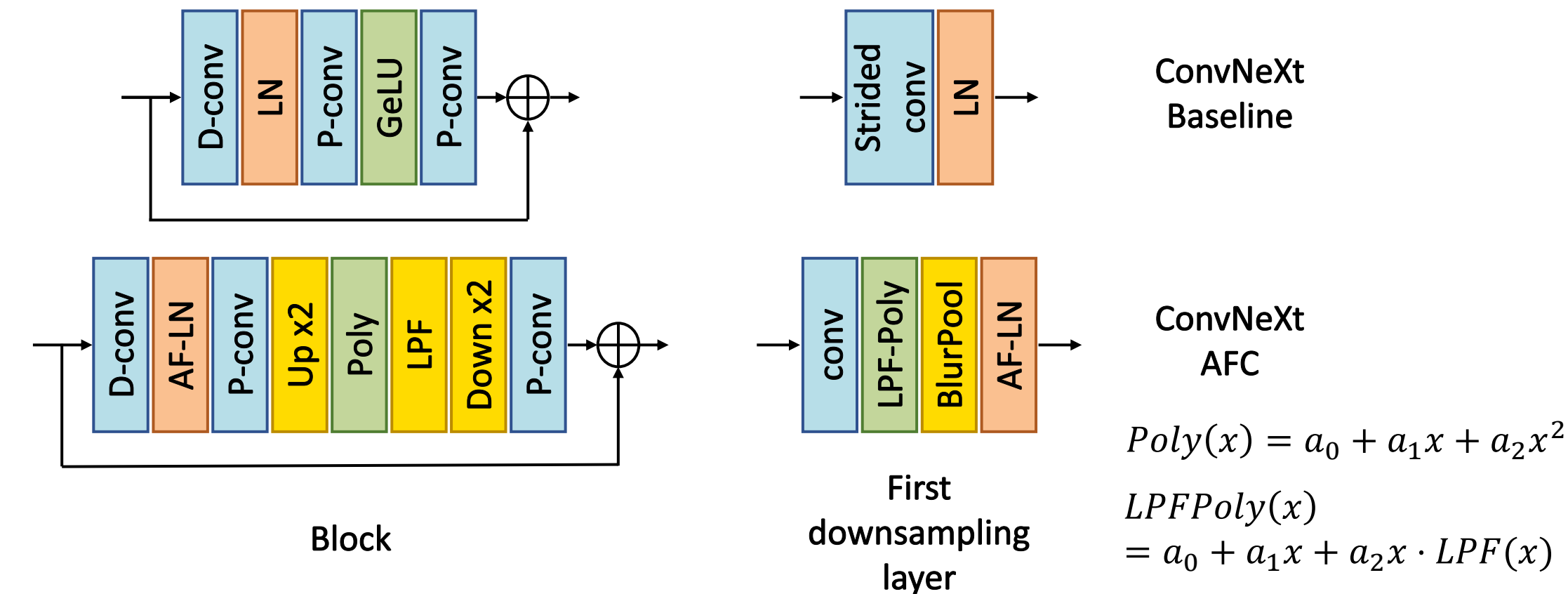
Discrete signals (images) are affected by Aliasing
 ⇒ Pooling + nonlinearities break shift invariance

- Pooling is partially solved, with low-pass filters
- General non-linearities cannot be solved, due to **infinite bandwidth expansion**

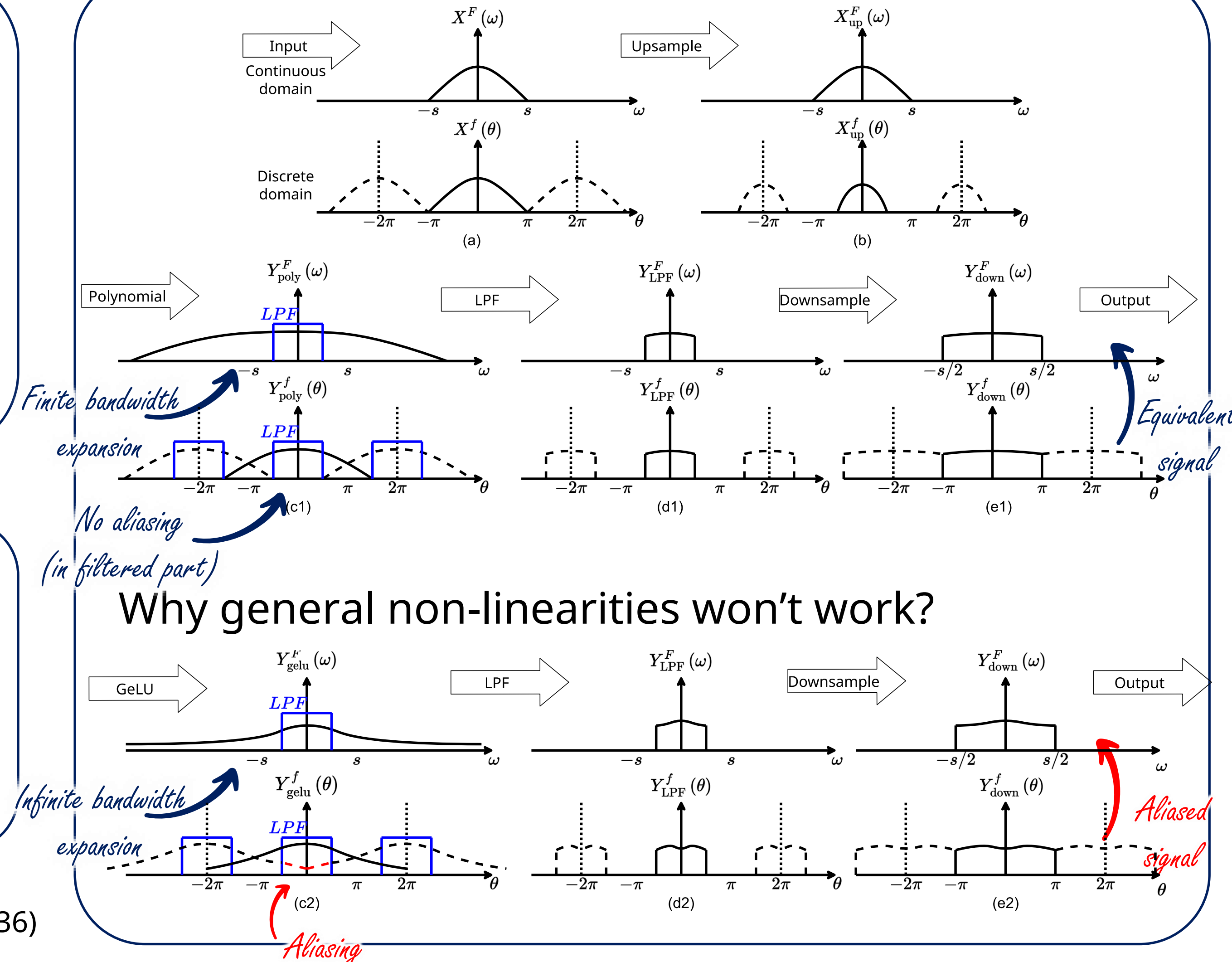
The main idea

Polynomials expand bandwidth only finitely
 ⇒ We use a polynomial activation function to create a completely alias-free convnet

Model modifications



Alias-free activation function



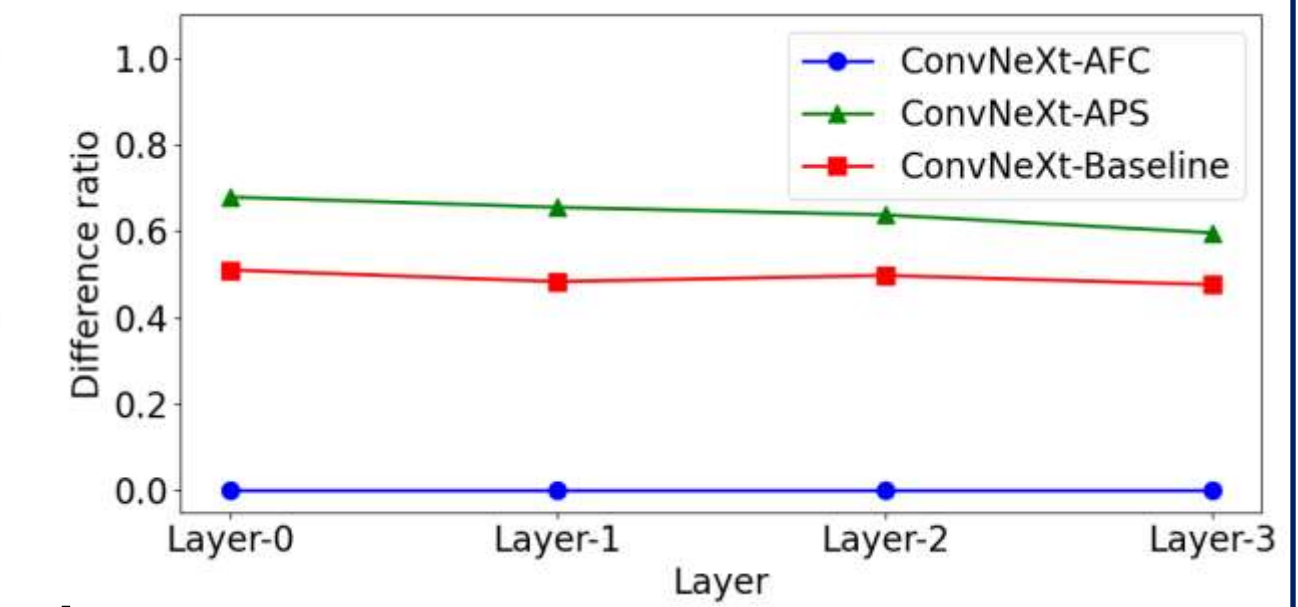
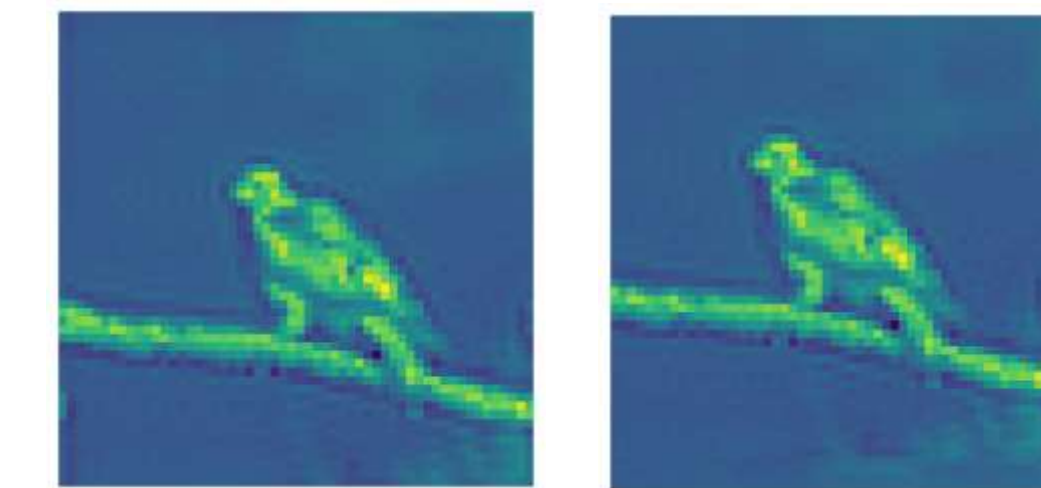
Results

• Certified translation robustness (integer and fractional, cyclic)



Model (ImageNet)	Test Accuracy	Integer grid	Half-pixel grid	Fractional grid
ConvNeXt-Baseline	82.12	76.63	73.65	77.82
ConvNeXt-APS	82.11	82.11	79.68	76.31
ConvNeXt-AFC (ours)	81.04	81.04	81.04	81.04

• Certified shift-equivariant internal representations



• Improved translation robustness in other practical settings

Zero-padding, bilinear interpolation



"Crop-shift"

