



Generative Latent Implicit Conditional Optimization when Learning from Small Sample

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The Small Sample Learning problem

- Shortage in data is a major pitfall in solving problems through deep learning.
- \succ Hard to collect large dataset.

BIG DATA



SMALL SAMPLE



> Solution: synthetically generate new images.

Small Sample Learning Challenges



Few-Shot– The learner has access to many labeled examples from classes not participating in the current classification task.



Small Sample relies on a small number of labeled examples from each class



Small Sample Learning ≠ Few Shot Learning

Augmentations with Generative Models



Motivation: GANs can generate very realistic synthetic images

Problem: GANs Require large training set.

Our approach:

- 1. Instead of learning data distribution -> learn image representation independently.
- 2. Enrich dataset using the trained model, by sampling the area around every learned vector.



GLICO-Generative Latent Implicit Conditional Optimization



Notations

- $\blacktriangleright \{(x_1, y_1), \dots, (x_n, y_n)\}$ set of labeled images
- → $\{z_i | z_i \in \mathbb{R}^d\}$ set of **learnable** random vectors
- \succ G_{θ} is a generator
- $\succ \quad \mathcal{L}_{CE}\text{-} \text{ cross-entropy loss}$
- $\succ \quad \mathcal{L}_{recon} \text{-} \text{ reconstruction loss}$
- $\blacktriangleright \quad \mathcal{L} = \mathcal{L}_{recon} + \mathcal{L}_{CE}$



Small Sample Image Classification Using GLICO



ICP

- Slerp- spherical linear interpolation
- r~ Uniform[0, 0.4]

Examples of Synthesized Images

CIFAR-10 image generation



CUB-200 reconstruction



Are We Synthesizing Trivial Samples?



Top-1 and Top-5 accuracy (%) when augmenting a small dataset (CIFAR-100, 50 samples per class), by GLICO alone (second row), Auto Augment alone (third row), or both (fourth row).

AutoAugment [2]		Ours	Top-1 Acc.	Top-5 Acc.
			50.37±0.05	75.61±0.01
		\checkmark	53.35±0.23	77.60±0.12
	\checkmark		53.80±0.10	79.18±0.13
	\checkmark	\checkmark	56.31±0.02	80.66±0.04

Expermintal Results



Top-1 accuracy (%) including STE with a different number of training samples per class (labeled data only).

CIFAR-10



* Indicates that the reported results, as obtained in our experiments, don't match the reported results in the paper





- A novel conditional generative model (GLICO)
- Light and fast augmentation method with image generation method
- State-of-the-art of classification in the small sample settings

