Prior-Aware Synthetic Data to the Rescue: Animal Pose Estimation with Very Limited Real Data

Le Jiang  Shuangjun Liu  Xiangyu Bai  Sarah Ostadabbas
Electrical and Computer Engineering Department, Northeastern University

Problem
Human share the world with and learn the behavior from with billions of animals. However, low cooperativity and high species diversity prevent us from building comprehensive large-scale datasets to know our neighbors. Further, the small data training is like cultivating on a tundra.

- Small data training makes the model lack of robustness and thus difficult to cope with more free-ranging movements, occlusions and environments.
- The synthetic animal data used as a supplement lacks realism of poses and it is difficult to be blended into the real background.

Approach
We present a cost-effective and generic prior-aware synthetic data generation pipeline, called PASyn, for animals pose estimate tasks that suffer from severe data scarcity.

- A novel variational autoencoder (VAE)-based synthetic animal data generation pipeline PASyn to generate probabilistically-valid pose data
- A style transfer strategy to mitigate the inconsistency between synthetic animal and real background
- A synthetic animal pose (SynAP) dataset, containing 3,000 zebra images and 3,600 images of six common quadrupeds

Prior-Aware Synthetic Data Generation
Our Prior-Aware Synthetic Data Generation (PASyn) Pipeline includes three main steps:

- Pose Augmentation
- Capturing Animal Pose Prior
- Training

Why style transfer
- Enrich the texture diversity in a reasonable way
- Blend the synthetic animal image into the real backgrounds

Architecture
Style
Content
Fusion

Stylization
Why style transfer
- Enrich the texture diversity in a reasonable way
- Blend the synthetic animal image into the real backgrounds

Synthetic Animal Pose (SynAP) Dataset
Size
- SynAP contains 3,000 synthetic zebra images and SynAP+ extends the SynAP with 3,600 images of horses, cows, sheep, dogs, giraffes and deer.

Background
- 300 grass, savanna, and forest real scenes are collected from Internet to stylize the synthetic animal.

Results

- Evaluation Over SynAP
  - The effect of SynAP with large real data

Ablation Study

Visualized Results
In conclusion, our synthetic animal pose dataset SynAP and its extended version SynAP+, and the real data is verified on different backbones and achieves state-of-the-positive effect of them on pose estimation task of animals with a small amounte-art performance.