

Case ID:M23-231P^

Published: 2/9/2024

Inventors

Pavan Turaga

Rajhans Singh

Ankita Shukla

Contact

Physical Sciences Team

Improving Shape Awareness and Interpretability in Deep Networks

Advances in deep learning have resulted in state-of-the-art performance for a wide variety of computer vision tasks. The large quantity of training data and high computation resources have made convolutional neural networks (CNNs) a common backbone model for many of these tasks, including image classification, object detection, segmentation, unsupervised learning, and generative modeling. However, current CNN architectures tend to be more attuned to texture information than the actual shape of objects in images leading to challenges in simplicity, interpretability, and adherence to established mathematical definitions of shape. There is a need for a deep-learning model inspired by geometric moments for quantifying shape-related properties to promote shape awareness in computer vision tasks.

Researchers at Arizona State University have developed a geometric moment-based deep learning model designed to systematically capture shape-related information in an end-to-end learnable framework. This deep geometric moment model not only enhances feature interpretability but also excels in learning discriminative features crucial for image classification tasks. Its distinctive feature lies in its ability to provide interpretability at various levels, facilitating easy finetuning on diverse datasets. The model demonstrates robustness in capturing object shapes even under extreme affine and color aberrations, surpassing existing approaches. The model's versatility extends beyond image classification, holding the potential to enhance the performance of various computer vision tasks, including object detection and generation, across different modalities such as video, RGBD, and volumetric data.

Related Publication: [Improving Shape Awareness and Interpretability in Deep Networks Using Geometric Moments](#)

Potential Applications:

- Used in the analysis of detailed object shapes in visual imagery in fields such as:
 - Medical imaging
 - Augmented reality and/or virtual reality
 - Satellite image analysis
 - Manufacturing quality control

Benefits and Advantages:

- Enhanced interpretability
- Discriminative feature learning
- Robustness to aberrations

- Versatility across industries