Motivation: Discover articulated parts from input 2D characters drawn in various poses. Resulting parts can be used for animation and puppet creation.

Challenges: Characters can have a wide range of different structure, which prevents a single template from working across all characters; limited available data of rigged, animated characters; poses shown in sprite sheets have both articulated variation and non-rigid deformation.

Earlier work: Prior image co-part segmentation methods pretrain networks with natural images, fail to capture large pose variation, and assume fixed articulation structure.

Our approach: automatically extracts articulated parts from 2D characters by combining deep learning and linear programming optimization.

Key ideas of our method:
- A correspondence module predicts pixel-level correspondence (motion mapping) between a pair of different poses.
- A clustering module clusters pixels into articulated moving parts without relying on a known character template.
- An optimization procedure based on integer linear programming relaxation for finding parts that best reconstruct the given sprite poses.

Overview

Architecture: an overview of our pipeline to extract parts from sprite sheet.

Correspondence module: predicts motion mapping of foreground pixels between a pair of images. Given each foreground pixel in the source image, its corresponding pixel in the target image is found as the pixel with the most similar feature vector.

Clustering module: discovers articulated parts by grouping pixels with similar motion transformations. We predict rotation and translation for each superpixel and choose the one with the minimal reconstruction error.

Part selection: selects a compact set of parts from a “soup” of candidate parts as a set cover problem. We measure the quality of possible solutions by deforming the selected parts to reconstruct all the poses via ARAP deformation and choose the one with the minimal reconstruction error.

Training: Correspondence and clustering modules are trained in a supervised manner on our synthetic dataset. Correspondence module is pretrained on Creative Flow+ dataset. Part selection is done with differentiable spectral clustering.

Method

Results

Quantitative comparison with alternatives

Qualitative comparison with alternatives

For paper, code and dataset, please visit our project page:
https://zhan-xu.github.io/parts/