MarrNet: 3D Shape Reconstruction via 2.5D Sketches

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Single-Image 3D Shape Reconstruction

Goal: Reconstructing 3D shapes with fine details from a single image

Observation: Existing methods have limitations.

Blurry or Noisy Output

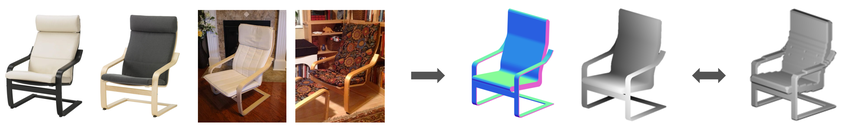
Simple Geometry Only

Solution: incorporating 2.5D sketches, inspired by Marr's vision theory

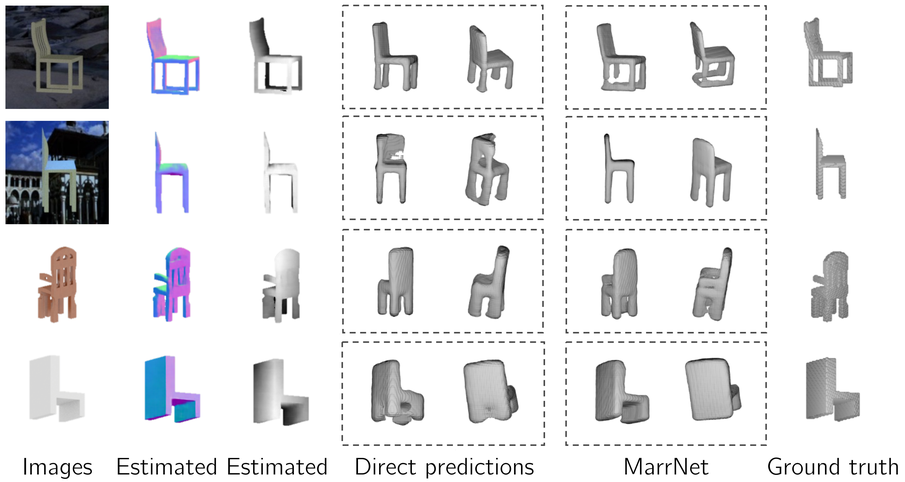
Advantages

- The use of 2.5D sketches disentangles the problem into object recognition and 3D shape completion, and improves performance.
- The differentiable consistencies between 2.5D sketches and 3D shape enable end-to-end fine-tuning without 3D annotations.

2.5D Sketches as an Intermediate Representation

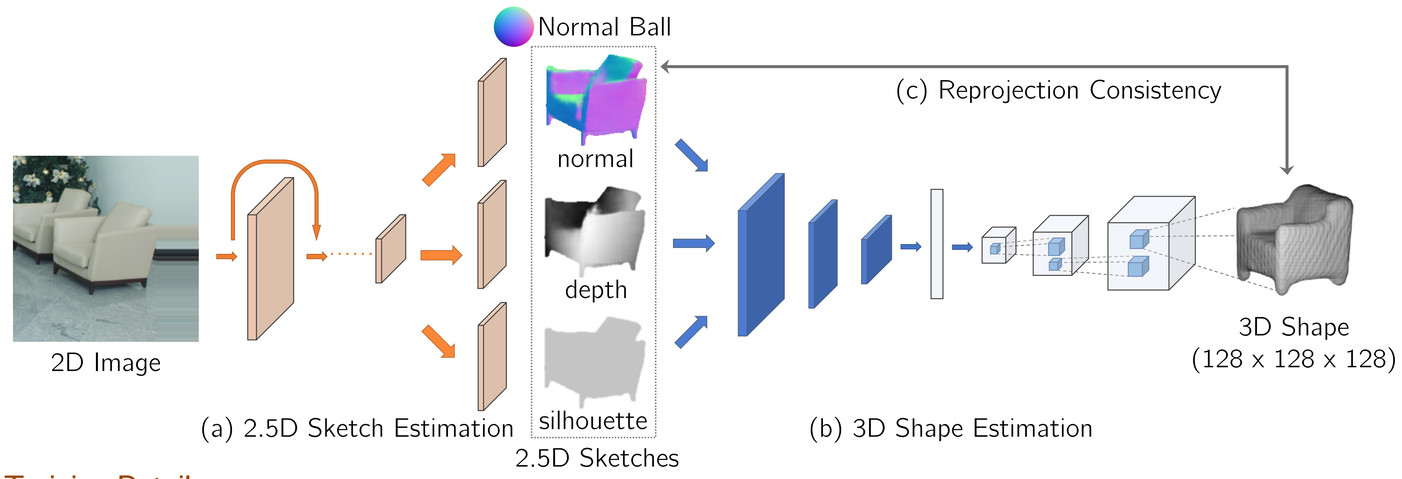


(a) Images (b) 2.5D Sketches (c) 3D Shape



Images Estimated normals Estimated depths Direct predictions w/o 2.5D sketches MarrNet Ground truth

MarrNet



Training Details

- Pre-train the 2.5D sketch estimation network and the 3D shape estimation network separately
- Fine-tune the encoder of the 3D shape estimation net on real data with the self-supervised reprojection loss

Results