

Attention-based Part Assembly for 3D Volumetric Shape Modeling

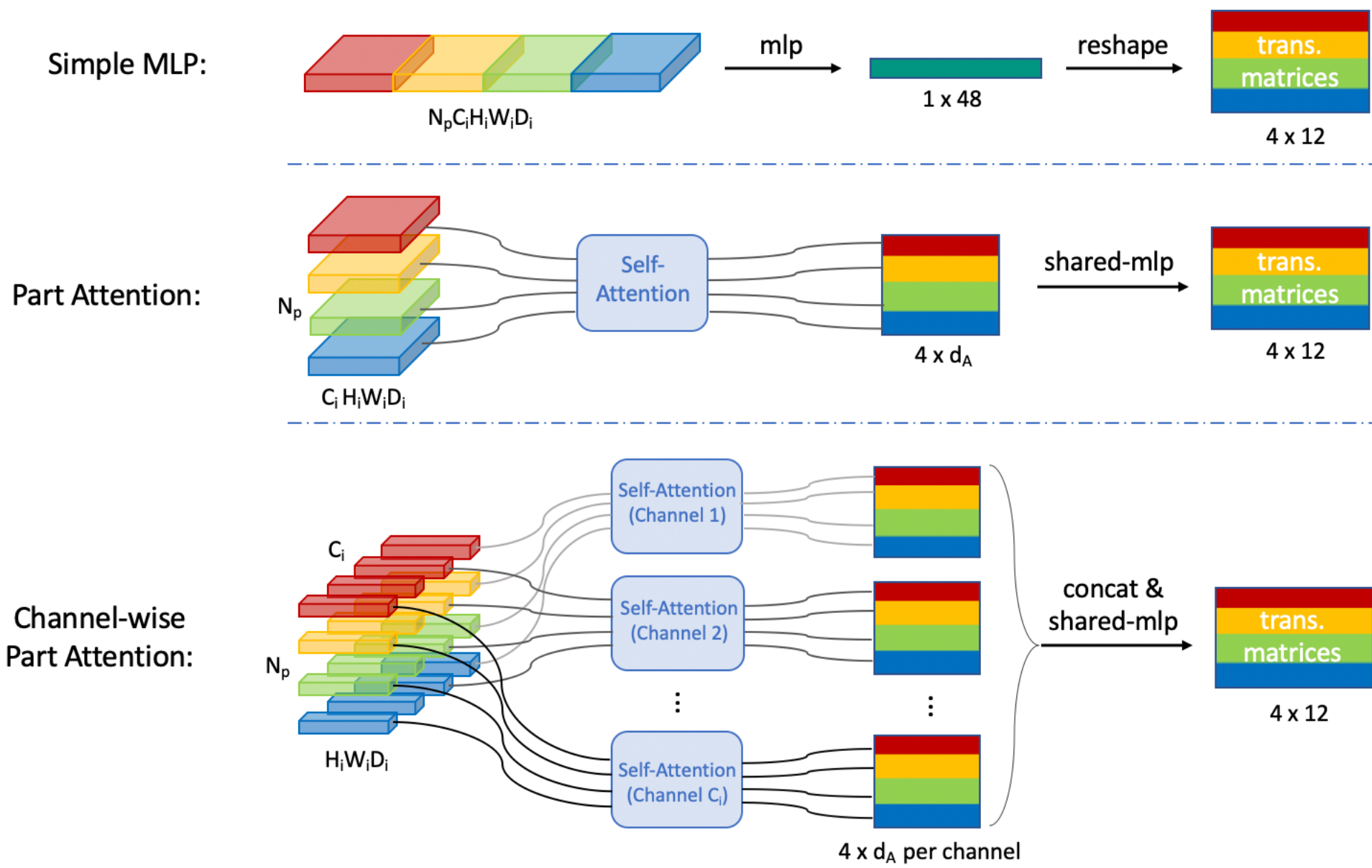
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Motivation

Disadvantage of current 3D shape modeling methods:

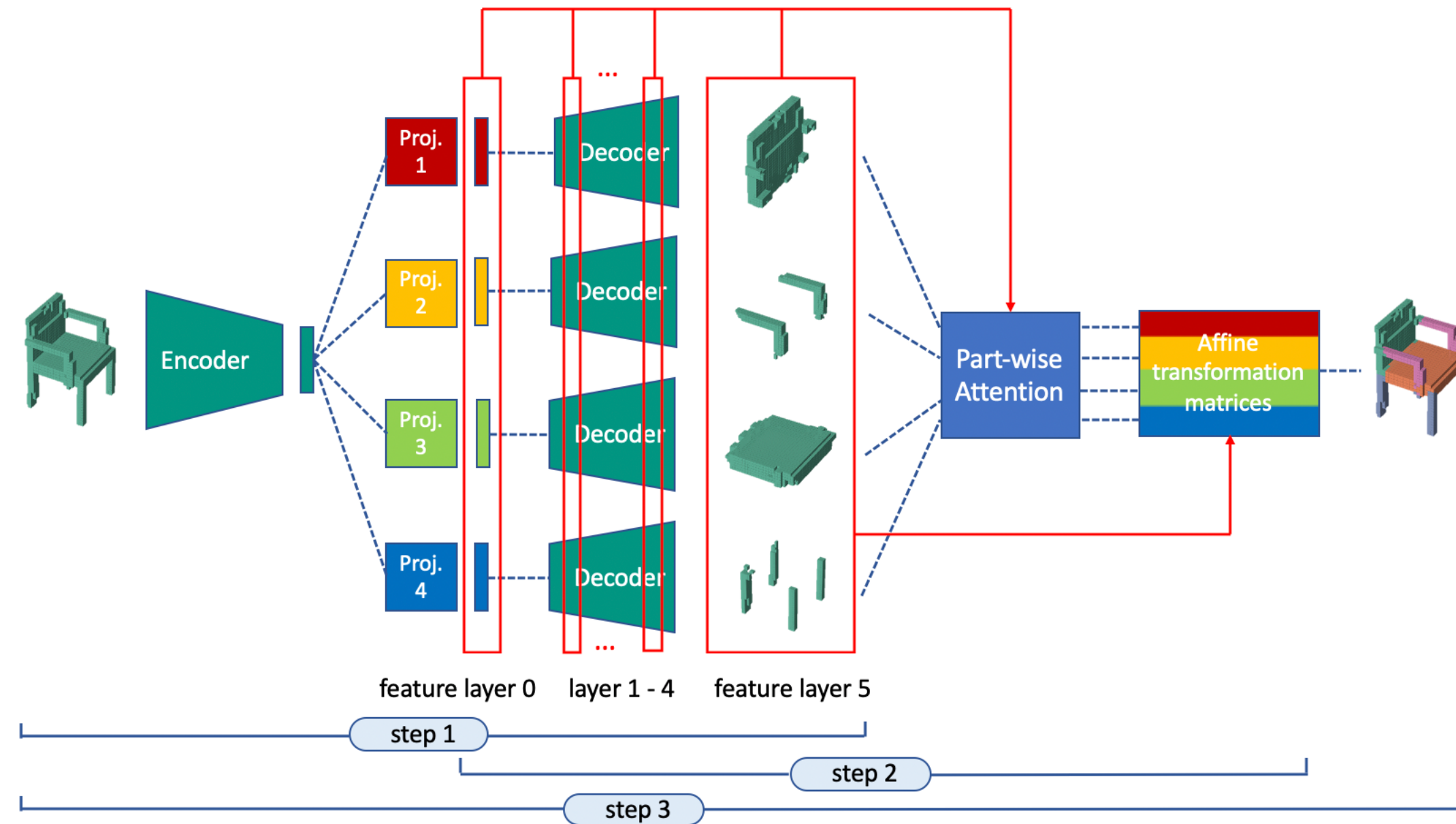
- (i) Structure-oblivious ones:
 - Latent space is part feature entangled.
 - Not satisfying performance on small volume parts.
- (ii) Structure-aware ones:
 - Part dimension is not preserved when learning transformation matrices.
 - Can not learn relative relations between parts well.

Key Ideas



- A part-based attention neural network to learn semantic part relations for better 3d shape assembly.
- An optional channel-wise attention strategy on top of the normal part attention model for feature learning.
- An additional attention consistency loss to prevent the network from mode collapse when multiple feature layers are used for computing the part relations.

Methodology



Step 1: Part generation

- Loss: identity partition loss, part reconstruction loss
- Metric: part mIoU

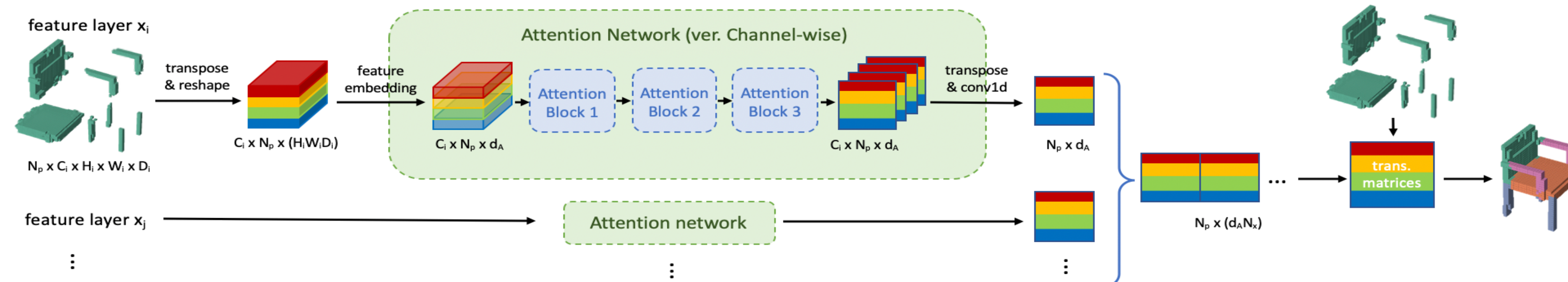
Step 2: Learning transformation matrices

- Loss: transformation matrices loss, consistency loss
- Metric: trans MSE, shape mIoU

Step 3: Fine-tuning the whole model

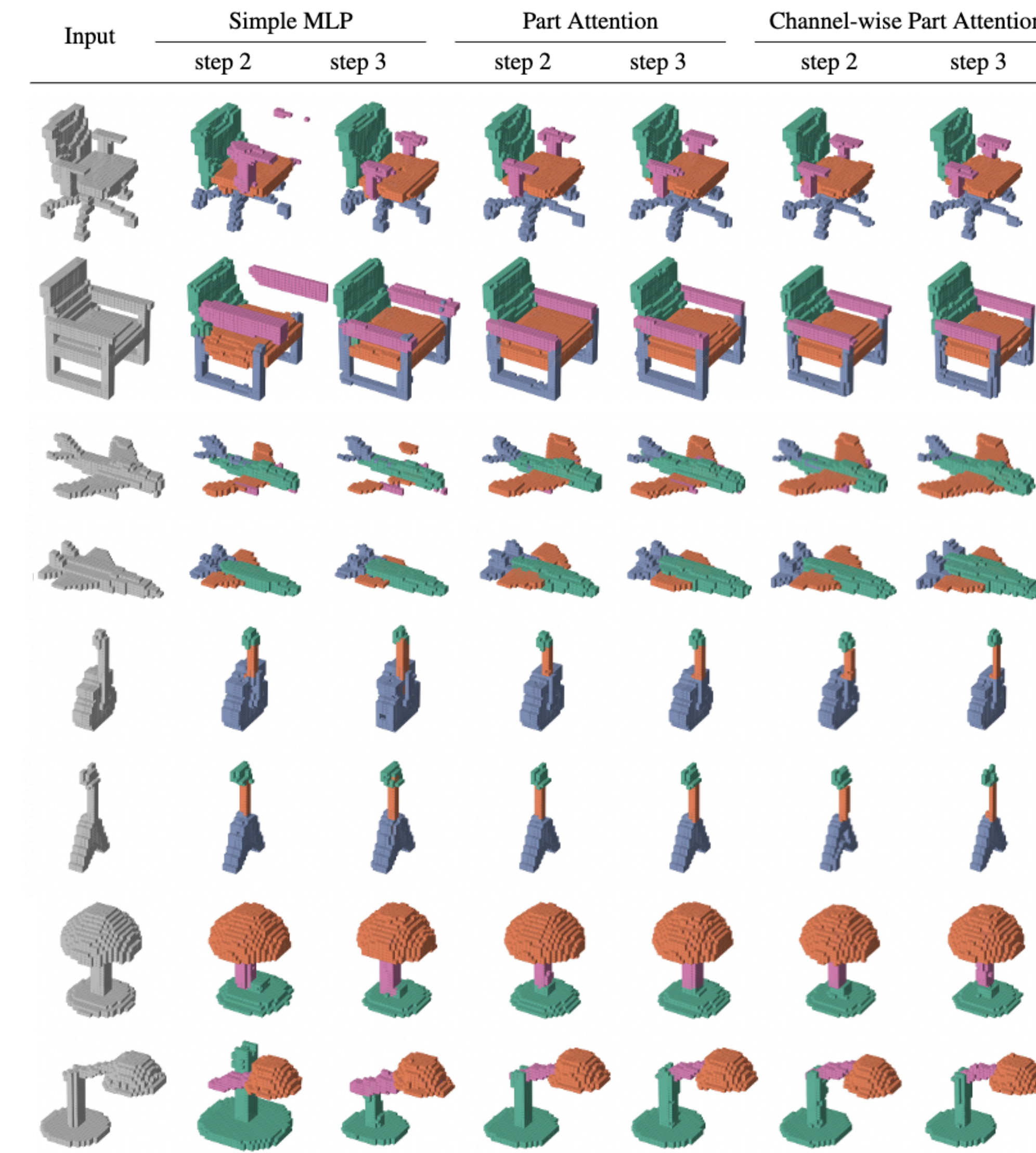
- Loss: above all, shape reconstruction loss
- Metric: part mIoU, trans MSE, shape mIoU

Network Architecture

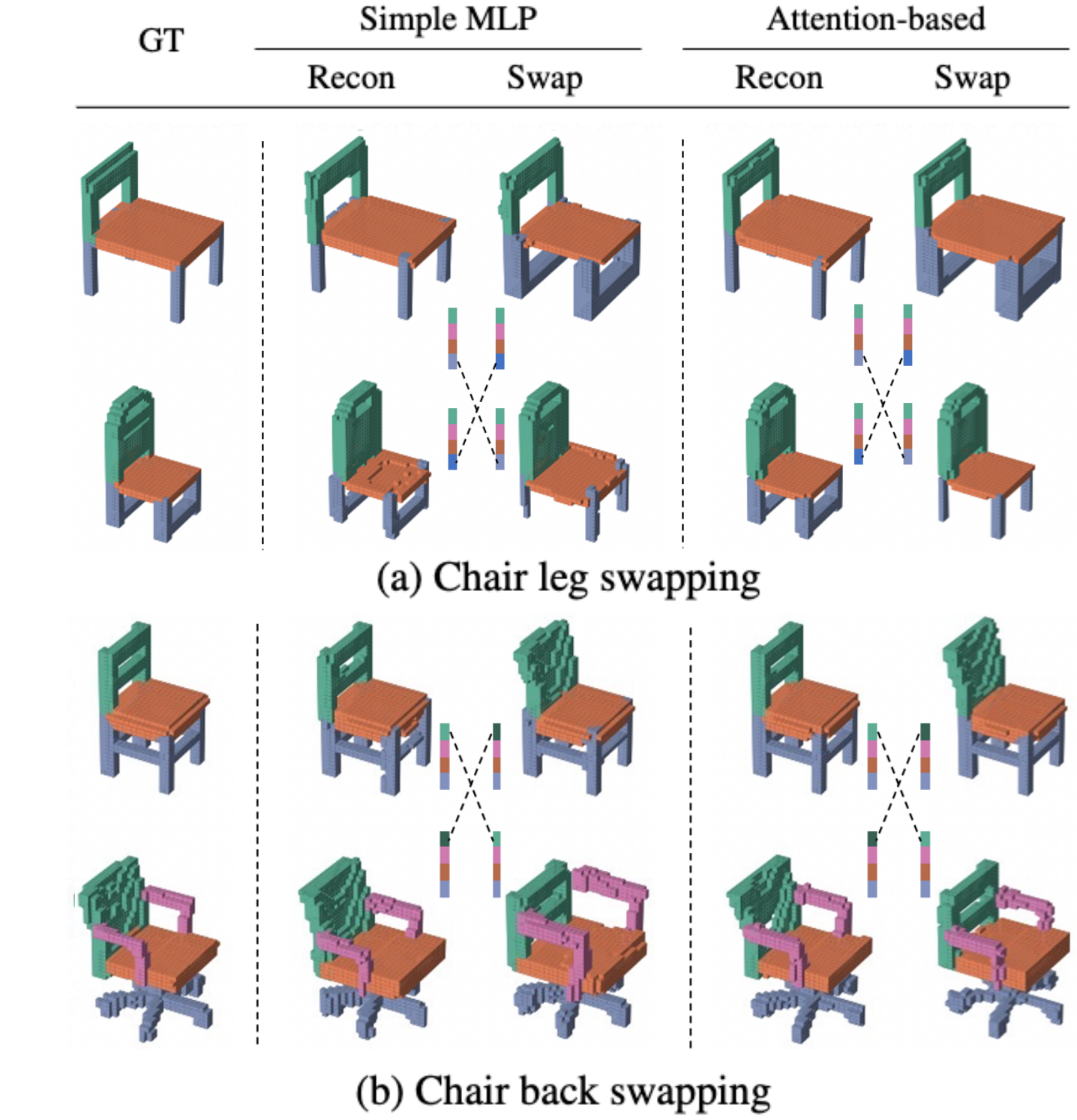


Experimental Results

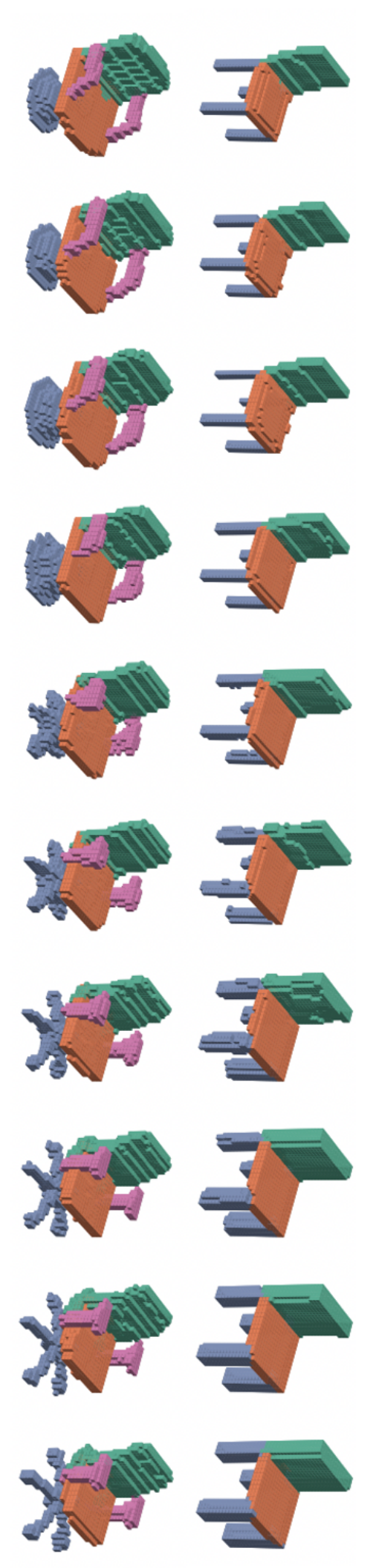
Reconstruction



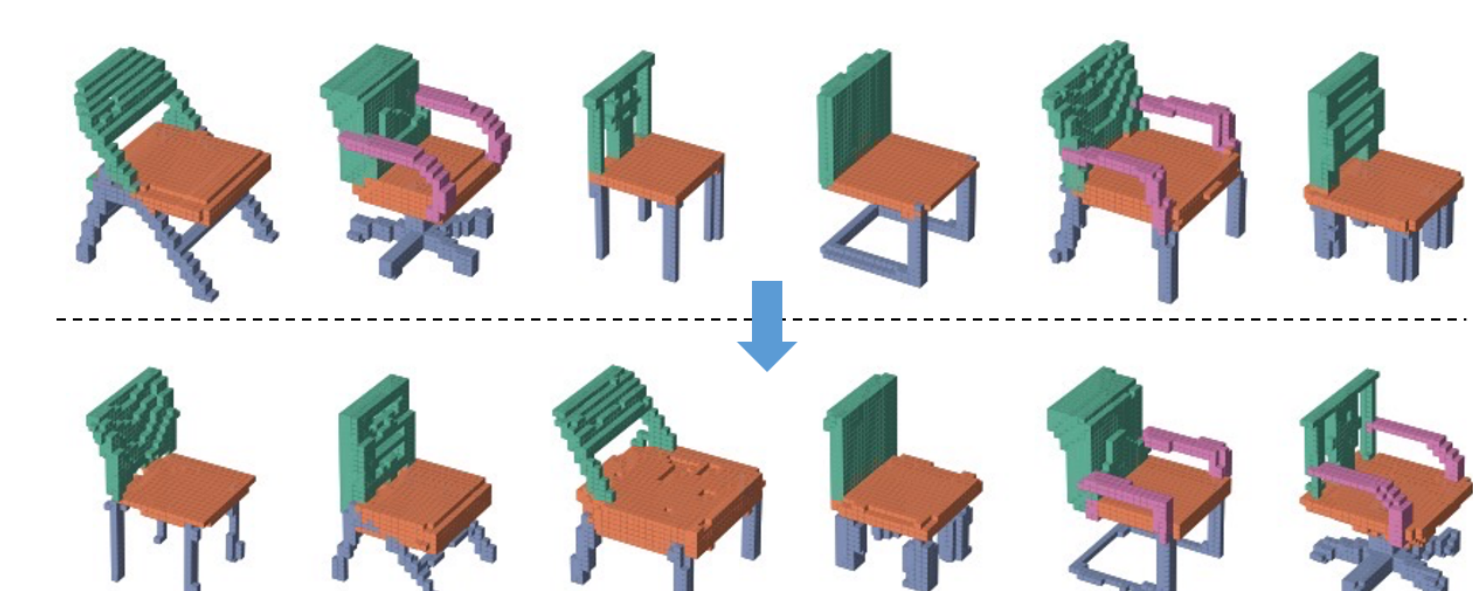
Swap



Interpolation



Mix



Conclusion

- A novel attention-based part assembly method is proposed for 3D shape modeling.
- Both qualitative and quantitative results demonstrate that the proposed method achieves better performance on this task compared to other state-of-the-art methods.
- The channel-wise strategy and the additional attention consistency loss also contribute to the good results.