

Attention-based Part Assembly for 3D Volumetric Shape Modeling

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Motivation

Disadvantage of current 3D shape modeling methods:

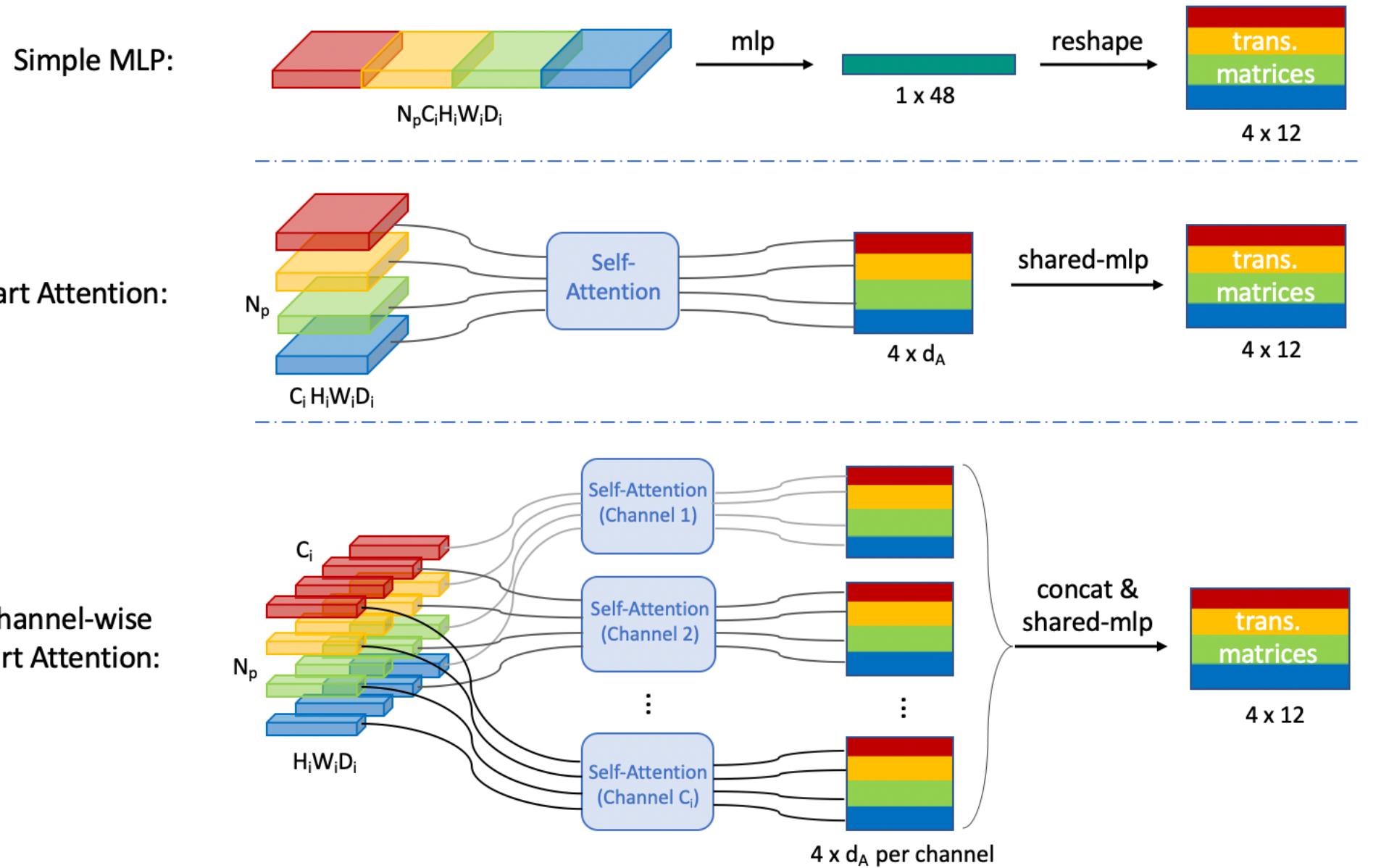
(i) Structure-oblivious ones:

- Latent space is part feature entangled.
- Not satisfying performance on small volume parts.

(ii) Structure-aware ones:

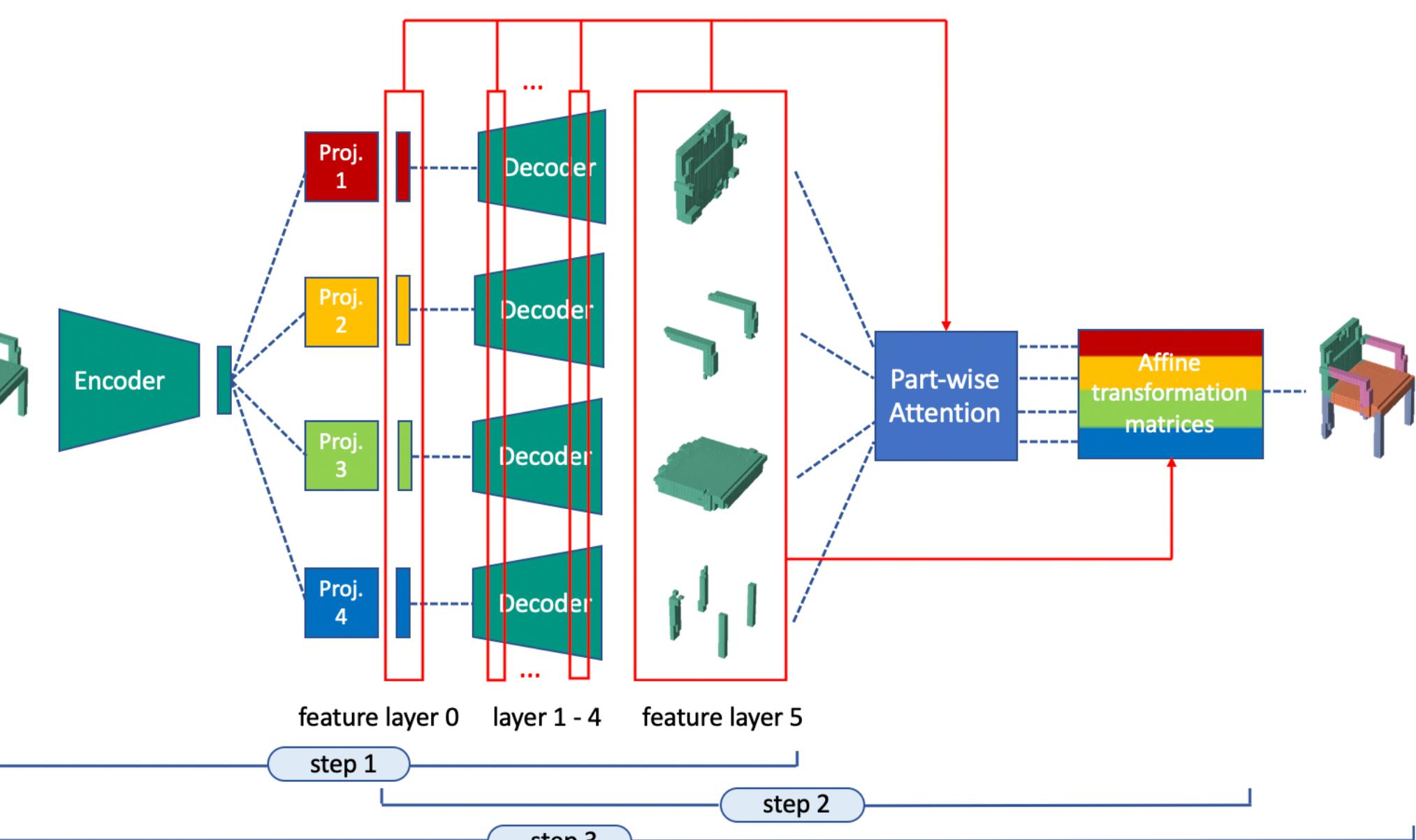
- Part dimension is not preserved when learning transformation matrices.
- Can not learn relative relations between parts well.

Key Ideas



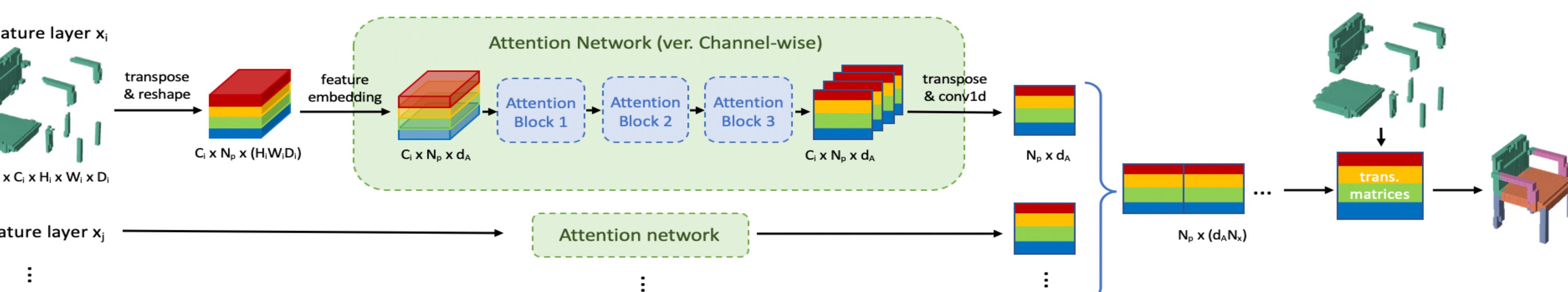
- A part-based attention neural network to learn semantic part relations for better 3d shape assembly.
- An optional channel-wise attention strategy on top of the normal part attention model for feature learning.
- An additional attention consistency loss to prevent the network from mode collapse when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

Methodology



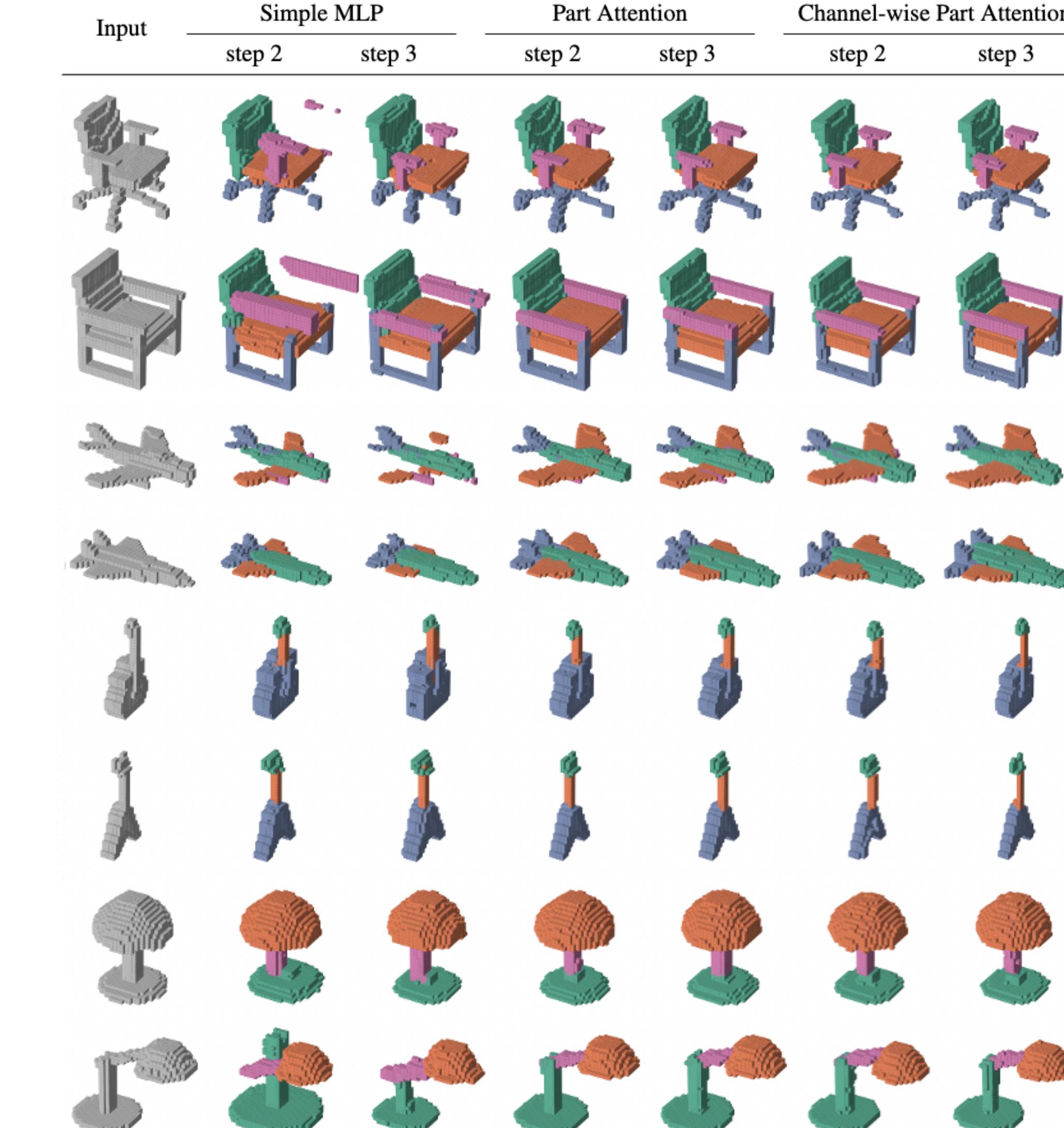
- Step 1: Part generation**
 - Loss: identity partition loss, part reconstruction loss
 - Metric: part mIoU
- Step 2: Learning transformation matrices**
 - Loss: transformation matrices loss, consistency loss
 - Metric: trans MSE, shape mIoU
- Step 3: Fine-tuning the whole model**
 - Loss: above all, shape reconstruction loss
 - Metric: part mIoU, trans MSE, shape mIoU

Network Architecture

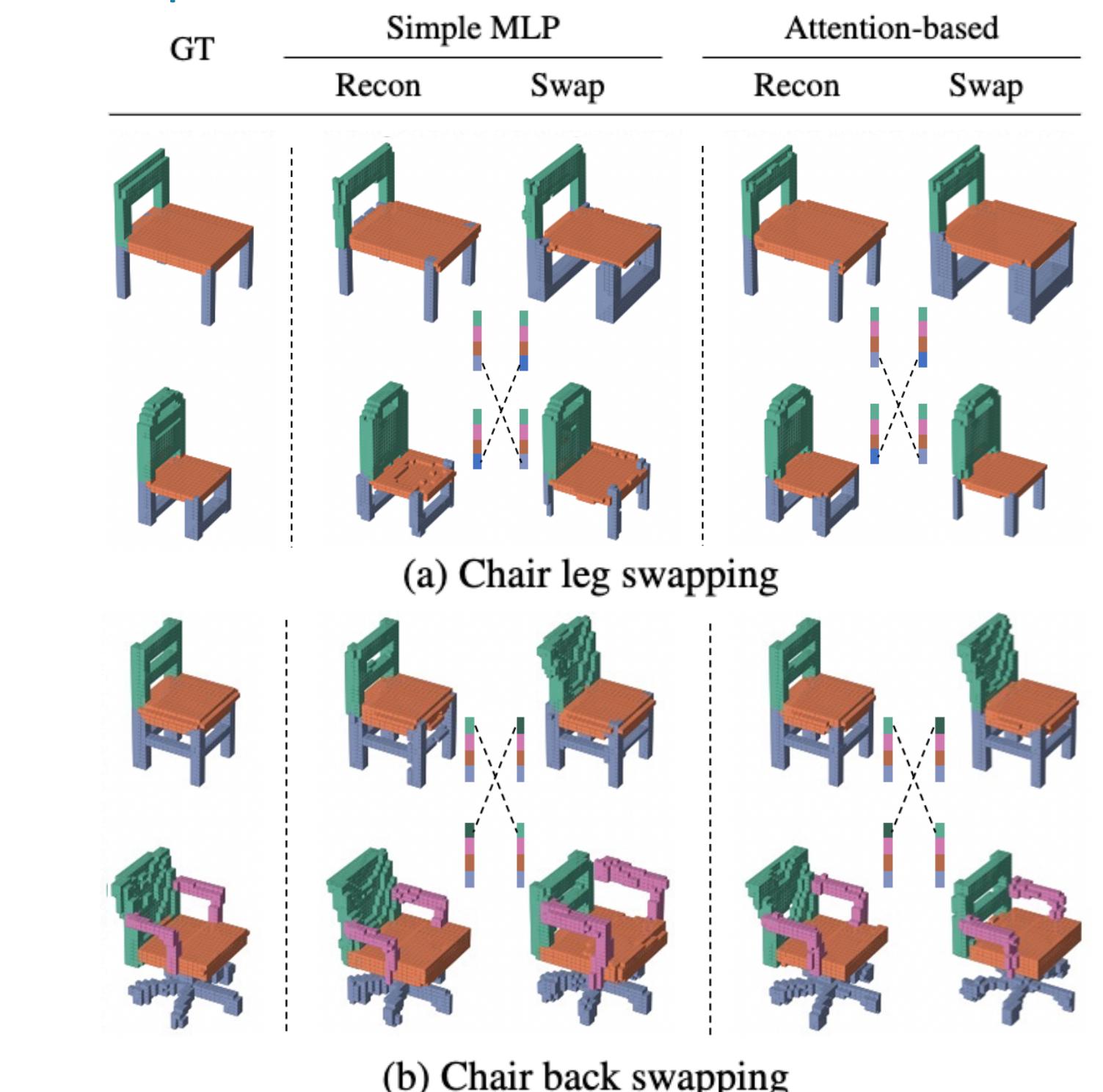


Experimental Results

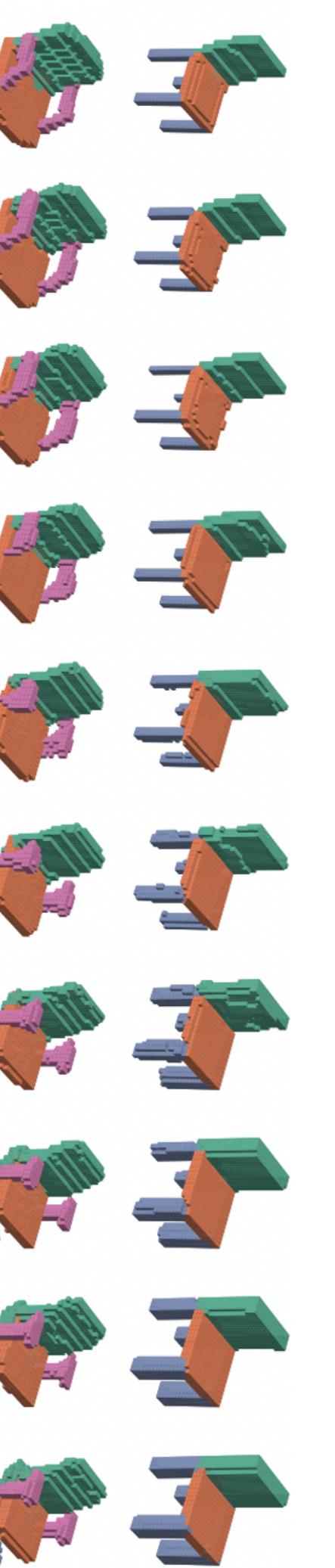
Reconstruction



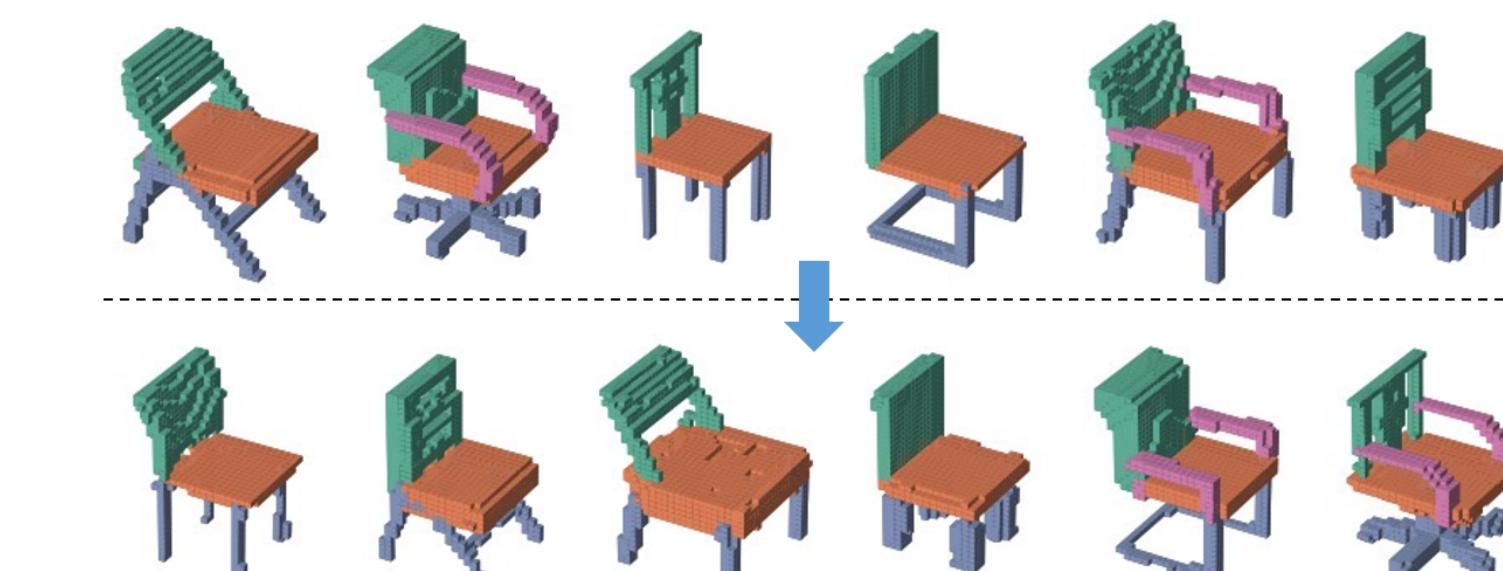
Swap



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.