Point Completion By Unsupervised Skeleton Learning

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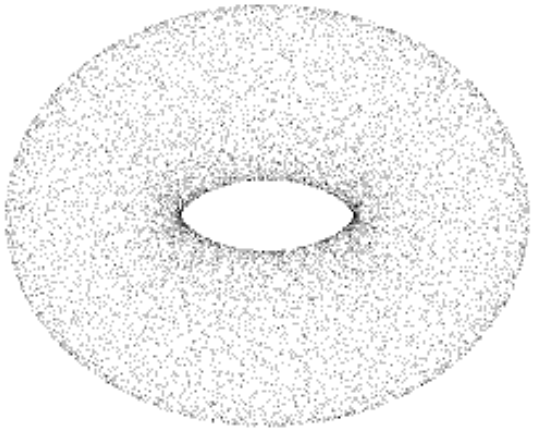
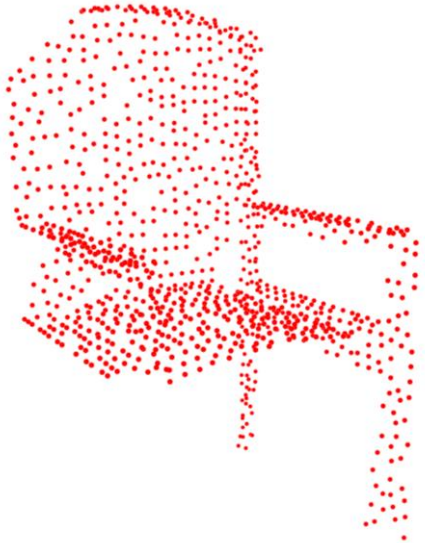
Introduction



Point clouds are used for many purposes, including creating 3D CAD models for manufactured parts and for a multitude of visualization and rendering.

Due to the limitation of view angles or occlusions of devices, raw point cloud is usually incomplete. A point cloud completion method is needed.

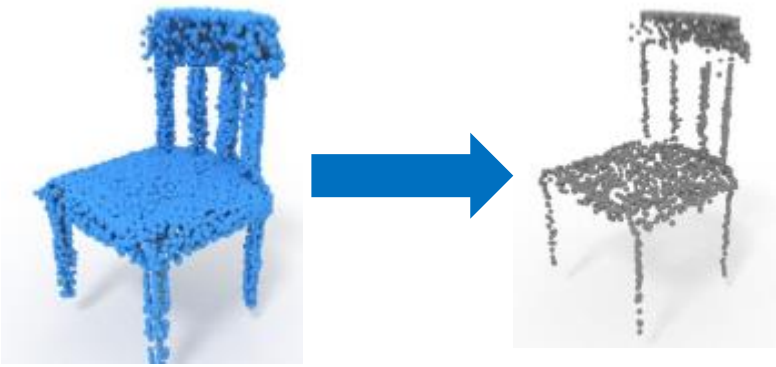


Research Basis

The most common approach is to use an **autoencoder framework**, but the unordered nature of point cloud make it difficult to keep the shape topology.

SK-PCN, a novel point cloud completion model proposed by Nie et.al[1], outperforms the autoencoder-based method by using an intermediate modality meso-skeleton to capture the features of original point cloud.

Limitations: Need both the full point cloud and full skeleton as the ground truth.



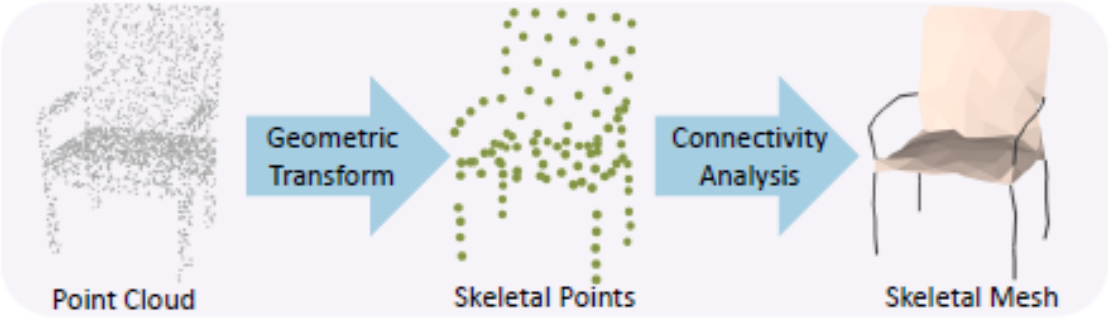
Full point cloud

Skeleton points

Research Basis

Lin[2] proposed an unsupervised method **Point2Skeleton** to generate skeletal mesh from point cloud for complex structures.

We hope to use Point2Skeleton to generate skeleton points conveniently and use the idea of SK-PCN and other methods to obtain a complete point cloud through sparse skeleton points.

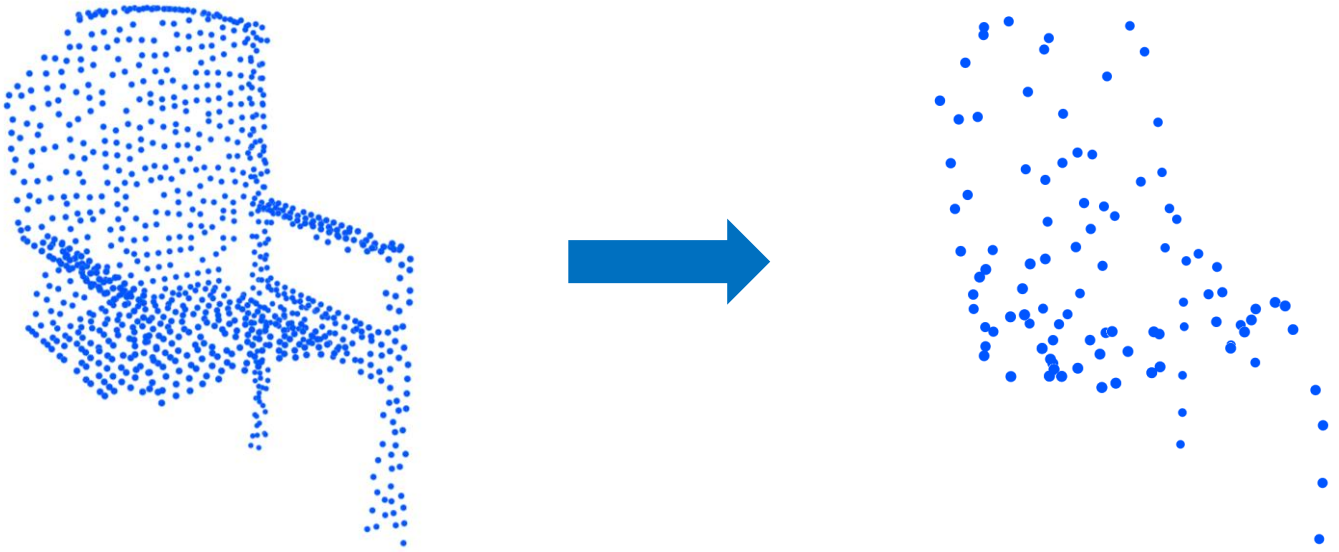


Steps of Point2skeleton

Proposed Network Architecture

- Skeleton Generation

Based on **Point2Skeleton**, we can generate skeleton points from its original point cloud. This transformation architecture consists of one PointNet++ encoder and MLPs.



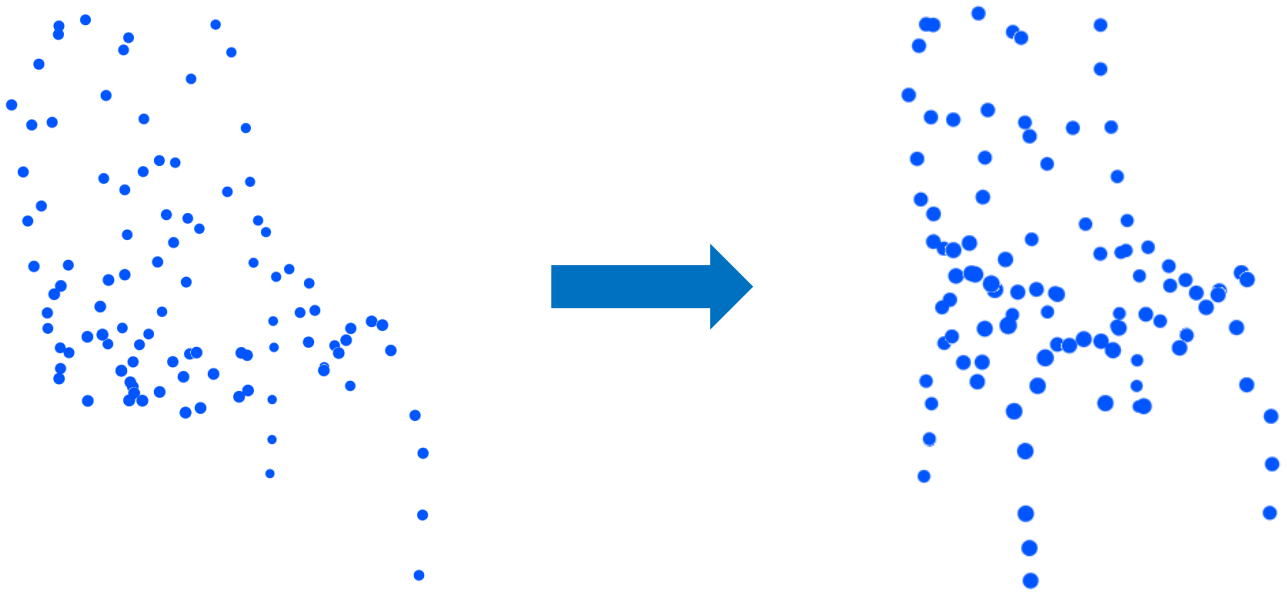
Point cloud

Skeleton points

Proposed Network Architecture

- Skeleton Completion

Build a sub-network which takes the partial skeleton as input and predicts the complete skeleton given the ground truth. **PU-Net[3]** will be the basic framwork.



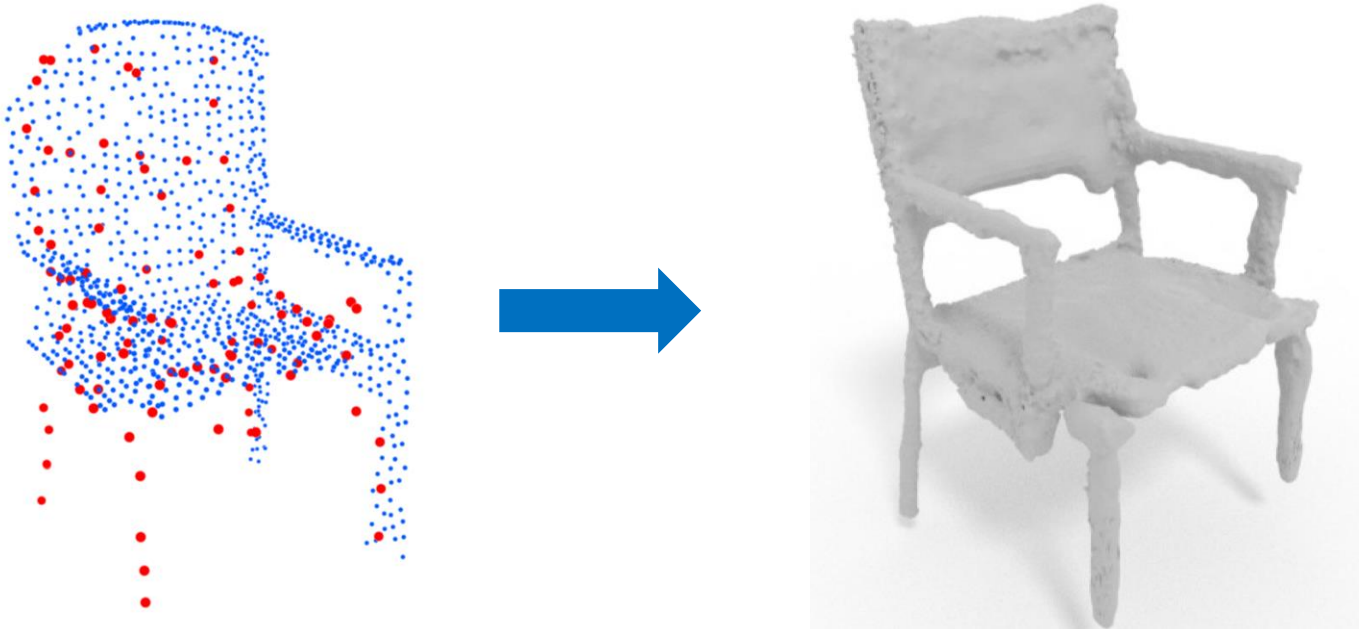
Partial skeleton points

Complete Skeleton points

Proposed Network Architecture

- Skeleton2surface

By combining the full skeleton and partial point cloud, we will refer to **P2P-NET[4]** and the completion part of **SK-PCN** to generate our final result, a 3D Mesh.

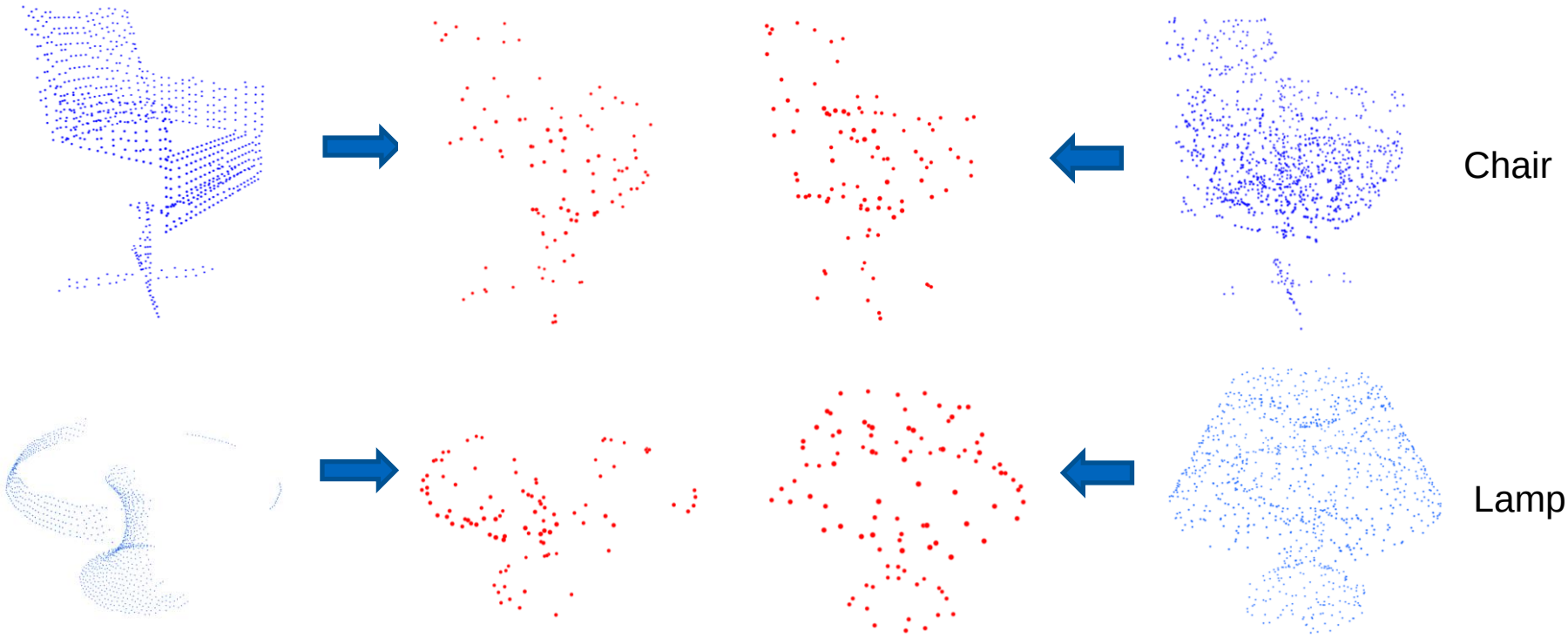


Complete skeleton points + partial point clouds

3D Mesh

Our Progress

We have studied the source code of **Point2Skeleton** and achieved the first part of our network: skeleton generation from point cloud based on Point2Skeleton for both partial skeleton and complete ground truth skeleton.



Challenge

- The skeletons generated from partial point cloud are not ideal, somtimes they can’t capture the features from point cloud.
- Possible Solutions: increase the number of skeleton points

- Need more training data
- It is not clear whether PU-net as an upsampling method will be helpful for our task

What we do next…

References

1. Yinyu Nie, Yiqun Lin, Xiaoguang Han, Shihui Guo, Jian Chang, Shuguang Cui, and Jian Jun Zhang. Skeleton-bridged point completion: From global inference to local adjustment*. arXiv preprint arXiv:2010.07428, 2020.*
2. Cheng Lin, Changjian Li, Yuan Liu, Nenglun Chen, Yi-King Choi, and Wenping Wang. Point2skeleton: Learning skeletal representations from point clouds. *arXiv preprint arXiv:2012.00230, 2020.*
3. Lequan Yu, Xianzhi Li, Chi-Wing Fu, Daniel Cohen-Or, and Pheng-Ann Heng. Pu-net: Point cloud upsampling network. In *Proceedings of IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2018.*
4. Kangxue Yin, Hui Huang, Daniel Cohen-Or, and Hao Zhang. P2p-net: Bidirectional point displacement net for shape transform. *ACM Transactions on Graphics(Special Issue of SIGGRAPH), 37(4):152:1–152:13, 2018.*

Thank You!

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