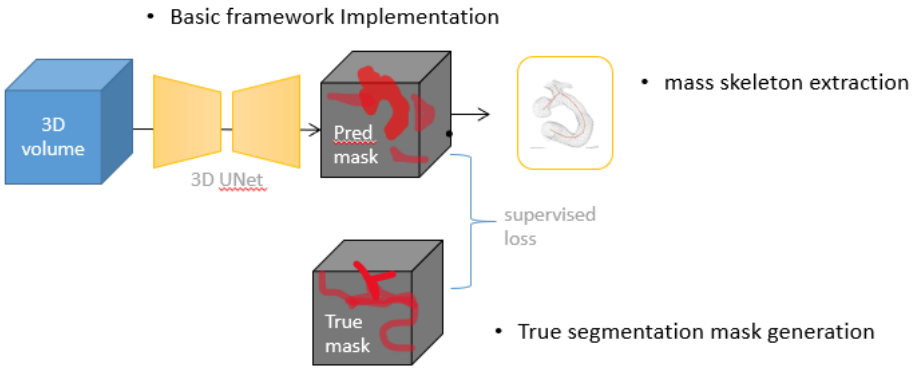
2021.7.9 Blood Vessel Segmentation

Progress so far



Future directions

1. Broken/unconnected parts of predicted mask could be repaired. Related work: http://www.lix.polytechnique.fr/~maks/papers/CVPR21_Phys_Gen_Networks.pdf.

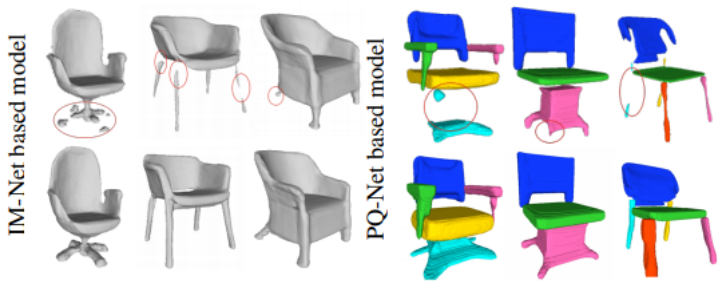
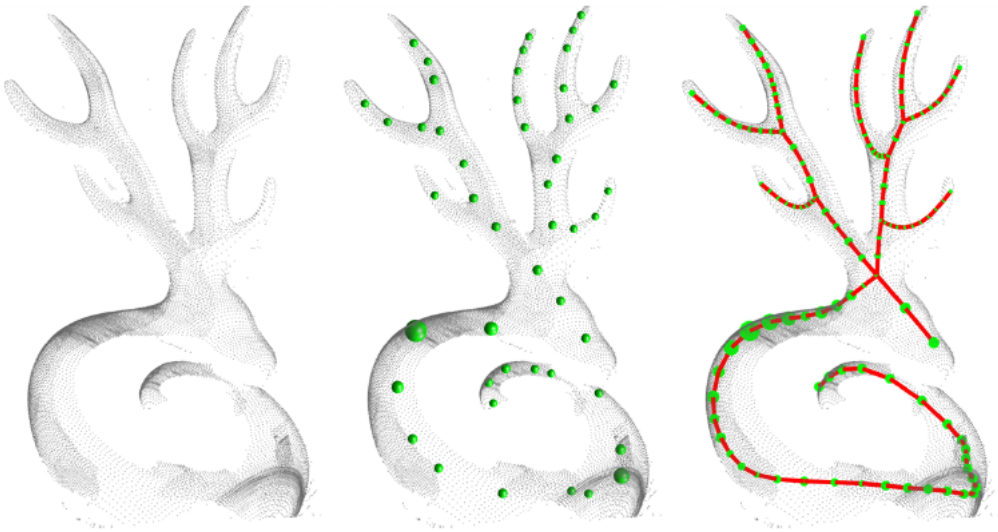


Figure 1: Visual results for 3D shape generation. We sample vectors from the latent space of IM-Net [15] and PQ-Net [71] that we decode using the corresponding baseline network (first row) and our generative network trained with the proposed physical losses (second row). Problematic regions are marked by red ovals. The resulting shapes become more connected and physically stable.

2. Geometric reconstruction from parameters (x, y, z, r), such as more accurate normal estimation, reconstruction for bifurcated vessel and multiple vessels touching each other.
3. Integrate skeleton energy into network, which means we need differentiable skeleton generation from signed distance function / segmentation mask. Related works:
   - Skeleton from point cloud: https://vcc.tech/research/2019/MassSkel



(a) Raw scan (b) Mass points (c) Mass skeleton

- OptNet: Differentiable Optimization: https://arxiv.org/abs/1703.00443

4. Unifed loss of parameter and volume, (parameter and volume are just different representation of vessel surface, so they should be consistent. Unified loss is an improved version of skeleton energy).
5. Combine 2D and 3D information for segmentation
6. Instance segmentation on vessel
7. Self-similarity. For small vessels (such as capillaries), zoom in and perhaps we could find some similar patterns and do further analysis. Related works:
   - SimGan: http://openaccess.thecvf.com/content_ICCV_2019/html/Shaham_SinGAN_Learning_a_Generative_Model_From_a
   - local implicit grid representation : https://openaccess.thecvf.com/content_CVPR_2020/papers/Jiang_Local_Implicit_Grid_Representations_for_3D_S _Local Implicit Grid (LIG) representation for 3Dscenes,waysto use LIG for 3D reconstruction from image(s).
8. Following self-similarity: Neural Cellular Automata can be used for simulation, generate a complex structure from a few cells and several basic rules. Related works:
   - https://arxiv.org/pdf/2103.08737.pdf
   - https://distill.pub/2020/growing-ca