Stony Brook University

Learning Probabilistic Topological Representations Using Discrete Morse Theory

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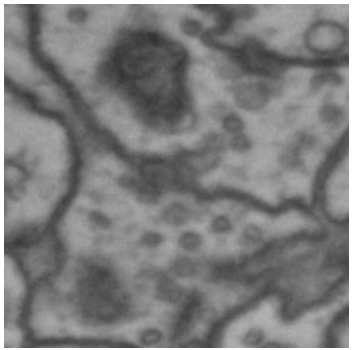
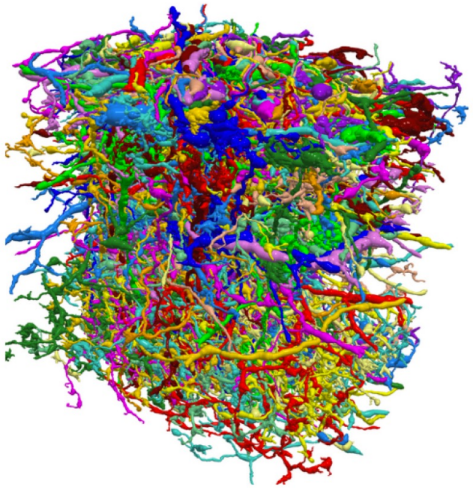
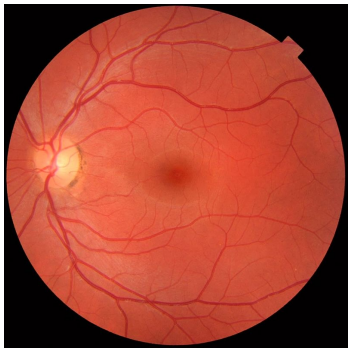
Topology: powerful structural information of complex data

- Explicit modeling of complex structures from data
  - Advanced math theory: algebraic topology
  - Seamless combination with deep learning


Probabilistic structural representation

- Structure-level uncertainty estimation
  - ➢ Focus on structure instead of pixel level
  - ➢ Easy to correct

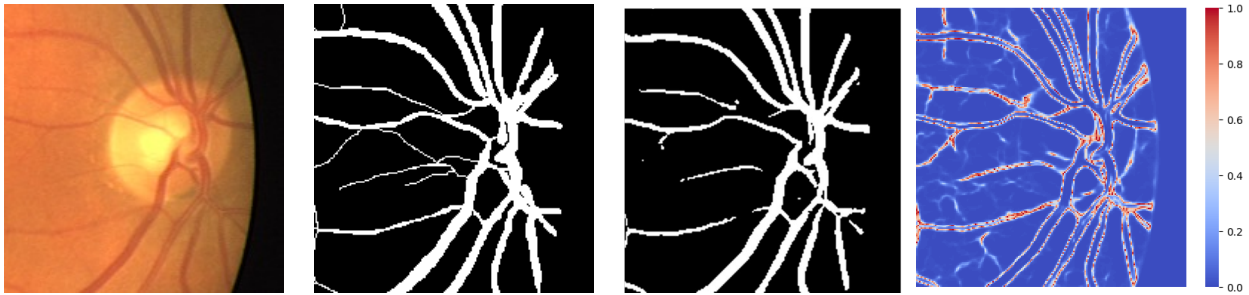
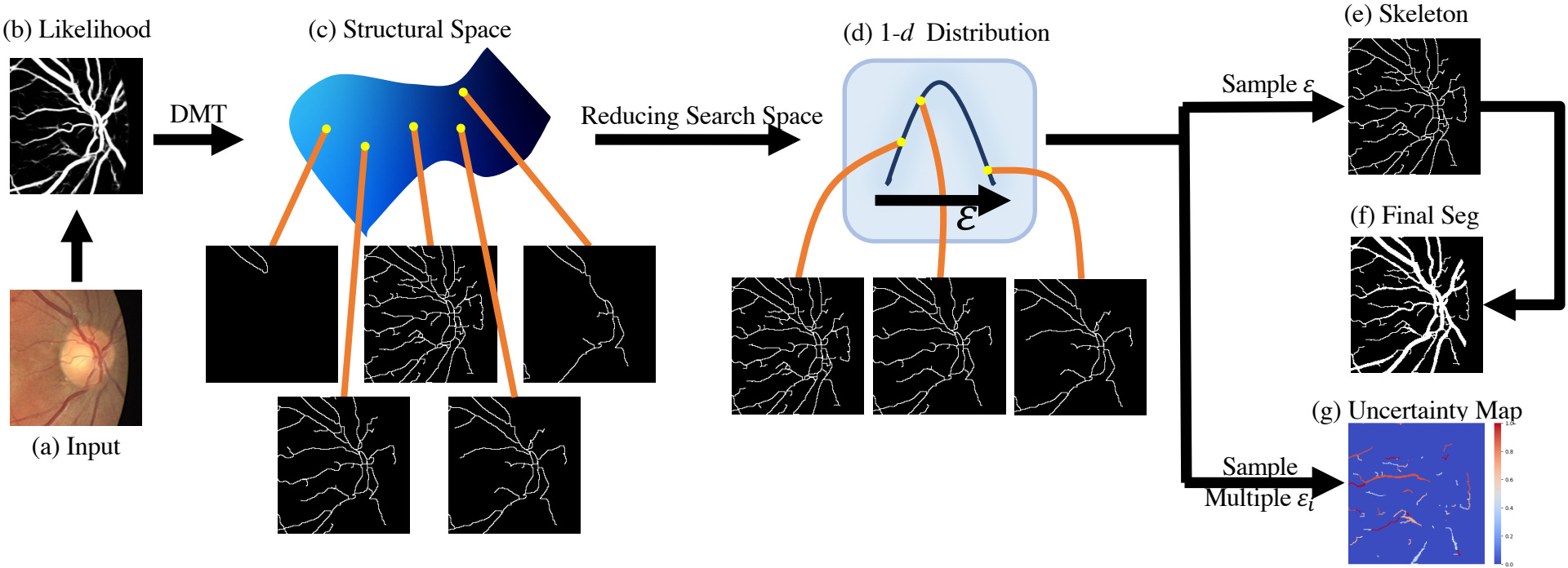
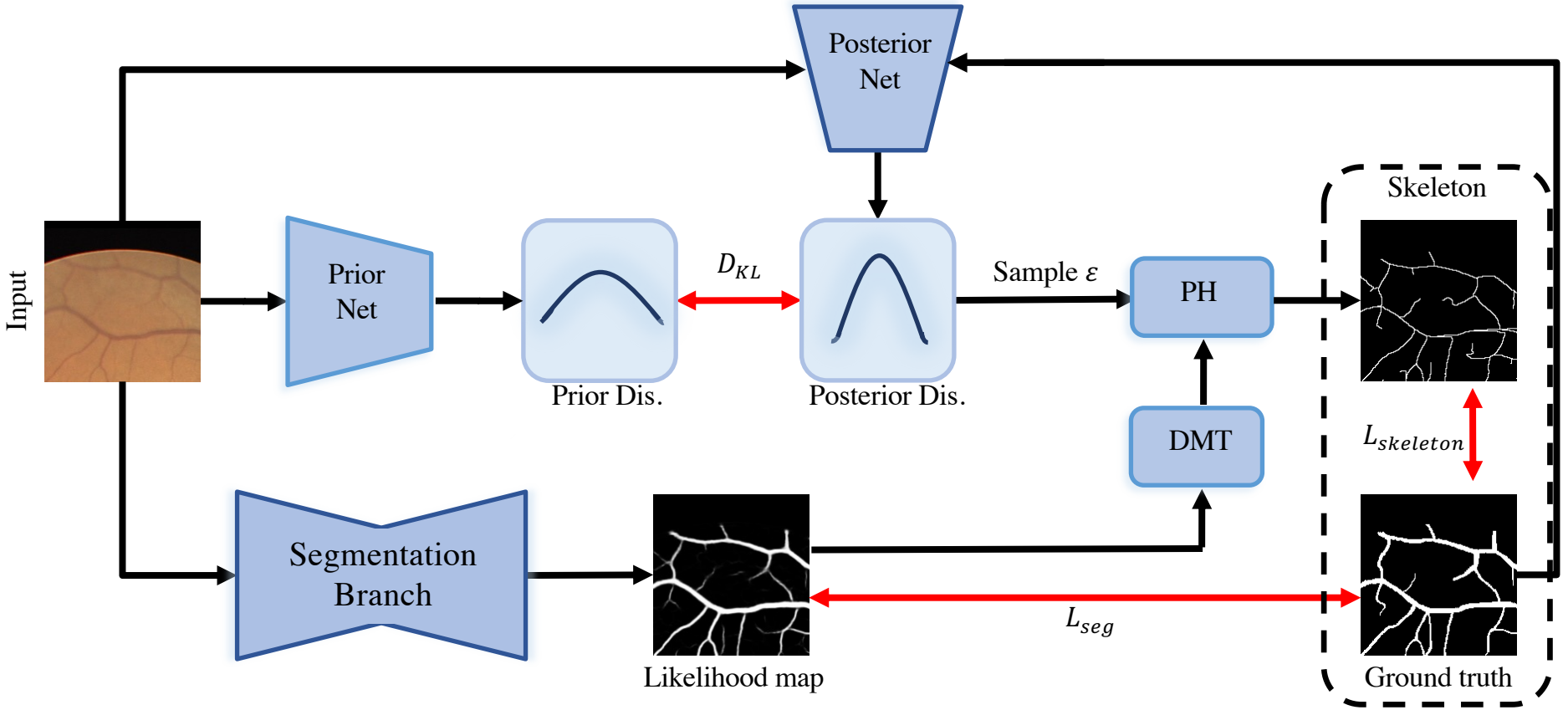


Image **GT** **Prob. UNet** **Pixel Uncer.** **Ours** **Stru. Uncer.**

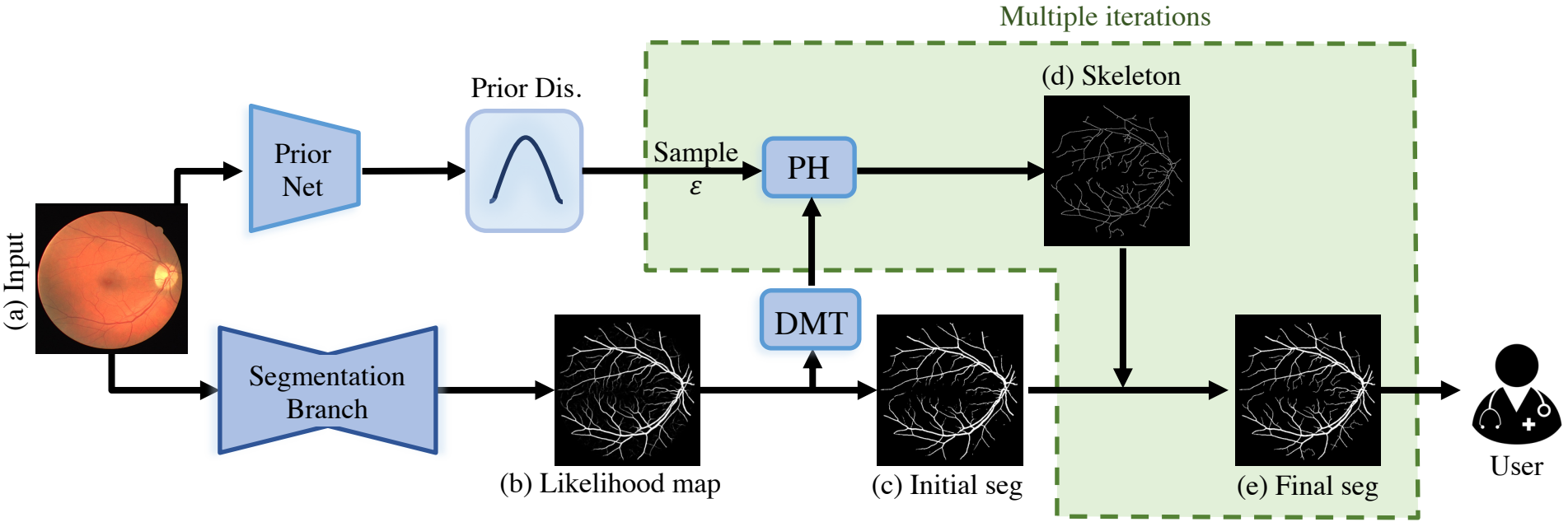
Overview


(b) Likelihood
(c) Structural Space
(d) 1-d Distribution
(e) Skeleton
DMT
Reducing Search Space
Sample ε
ε
(f) Final Seg
(g) Uncertainty Map
Sample
Multiple ε_i
(a) Input

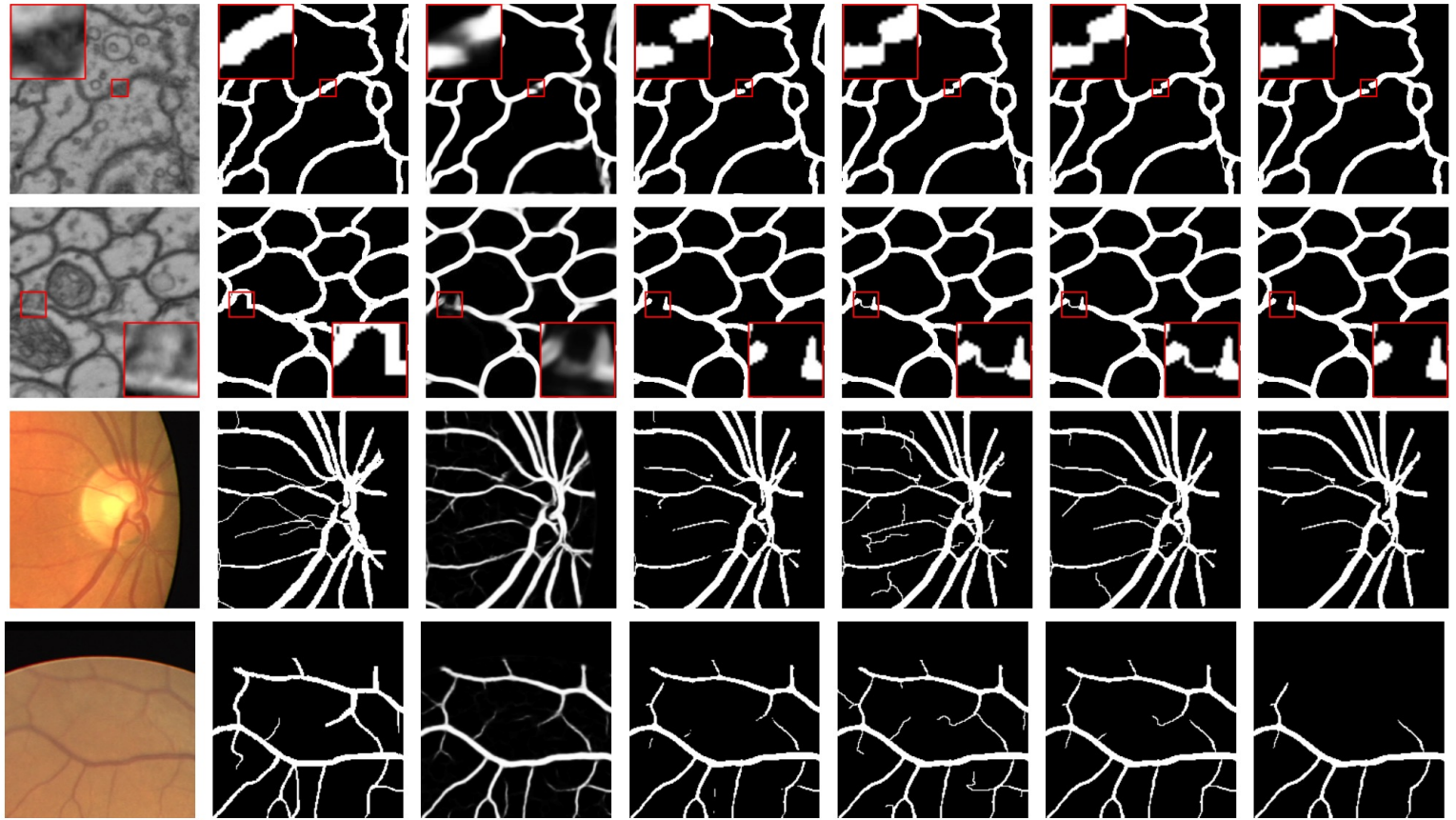
Probabilistic model



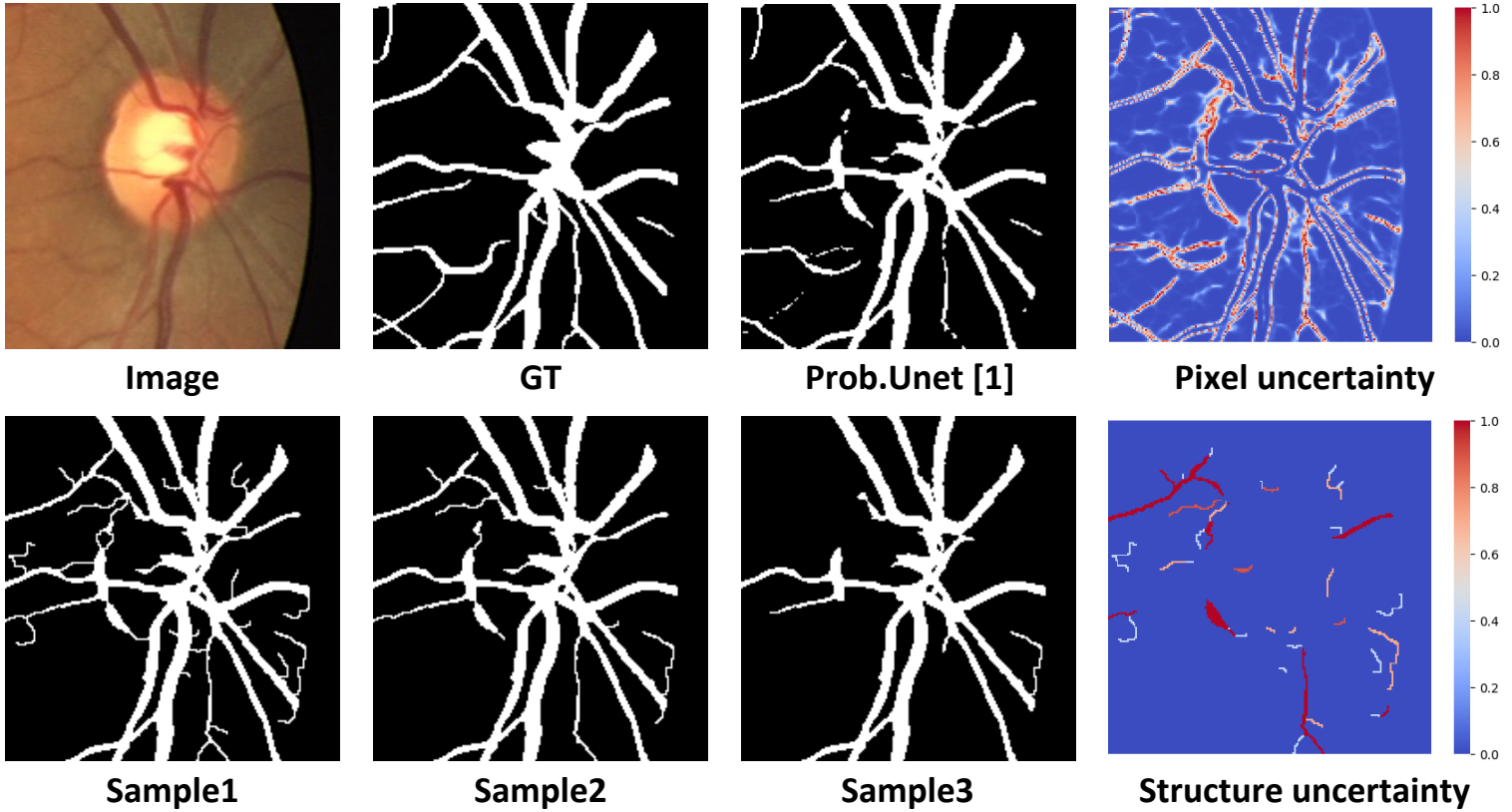
Inference and efficient annotation pipeline



Qualitative results



Uncertainty illustration



[1] Kohl, Simon, et al. "A probabilistic u-net for segmentation of ambiguous images." ***NeurIPS*** (2018).

Thank you for your attention!

Q&A