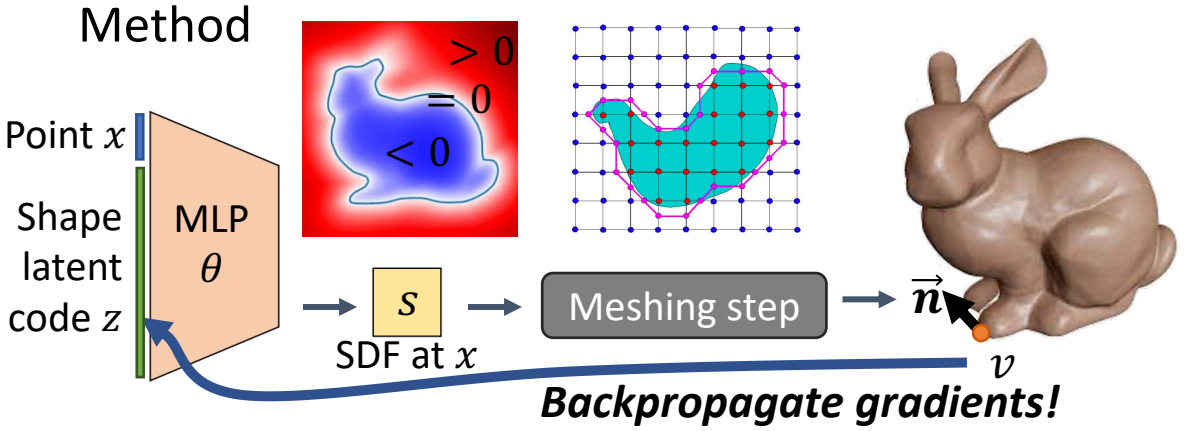
Deep Learning for Shape Reconstruction and Optimization

Benoit Guillard, Zhen Wei, Nicolas Talabot, Pascal Fua

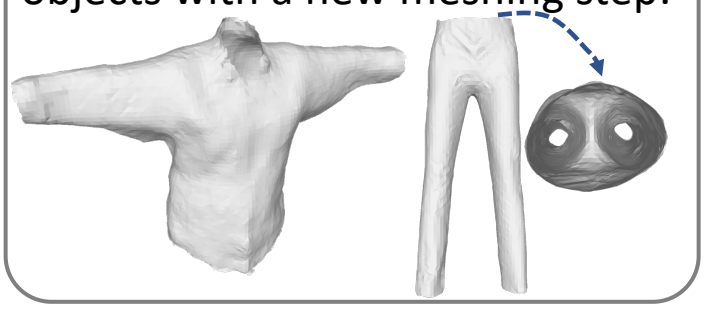
Differentiable 3D Mesh Parameterization with Neural Networks

Method



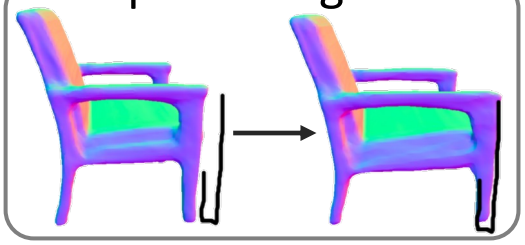
Open surfaces

Generalized to non-watertight objects with a new meshing step:

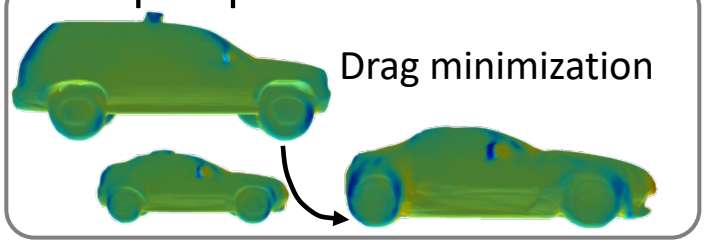


Shape recovery

Shape editing



Shape optimization



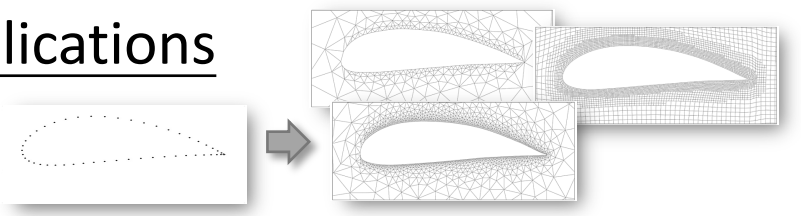
Mesh Representation for Aerodynamic Applications

Challenges in aerodynamic applications

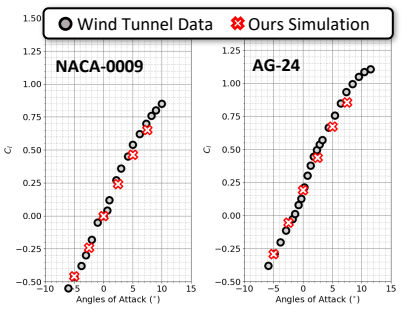
- Creating computational meshes quickly, with high quality for simulation.
- Automating & eliminating heavy handcrafts.

We propose an auto-decoder model

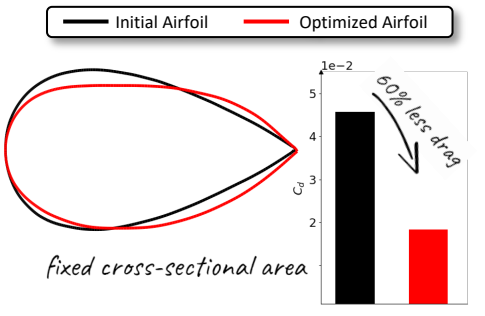
- Encoding and fitting the target shape by deforming a fixed template mesh.
- Solving an elastic energy problem to refine the mesh quality.



Application #1: Encode airfoils and create Computational Fluid Dynamics (CFD) meshes



Application #2: Simulate with auto mesh generation

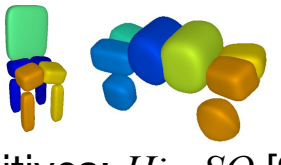


Application #3: Minimize airfoil's drag

Leveraging Geometric Primitives

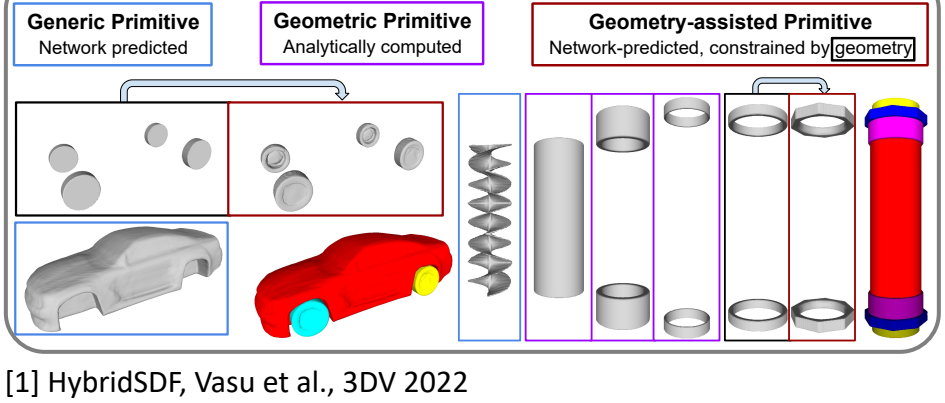
Implicit: *DeepSDF* [2]

VS.



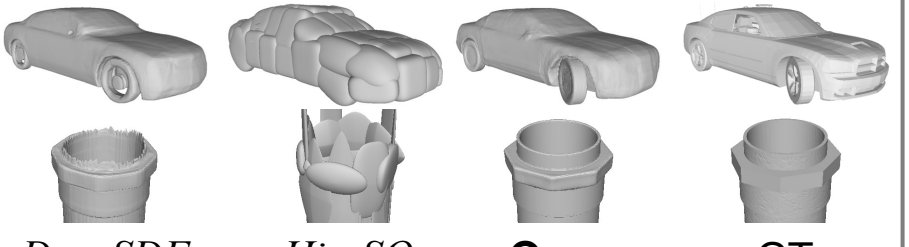
Primitives: *HierSQ* [3]

HybridSDF [1]: Combination of Both

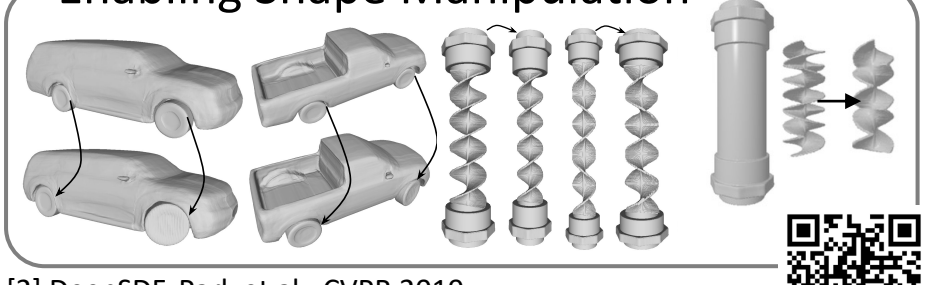


[1] HybridSDF, Vasu et al., 3DV 2022

Improving Local Quality and Realism



Enabling Shape Manipulation



[2] DeepSDF, Park et al., CVPR 2019

[3] HierSQ, Paschalidou et al., CVPR 2020