Neural Mesh Models For 3D Part Detection

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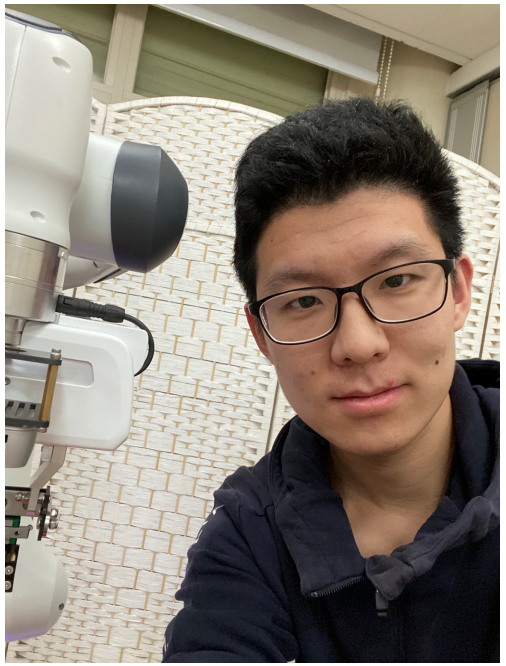
Self-introduction

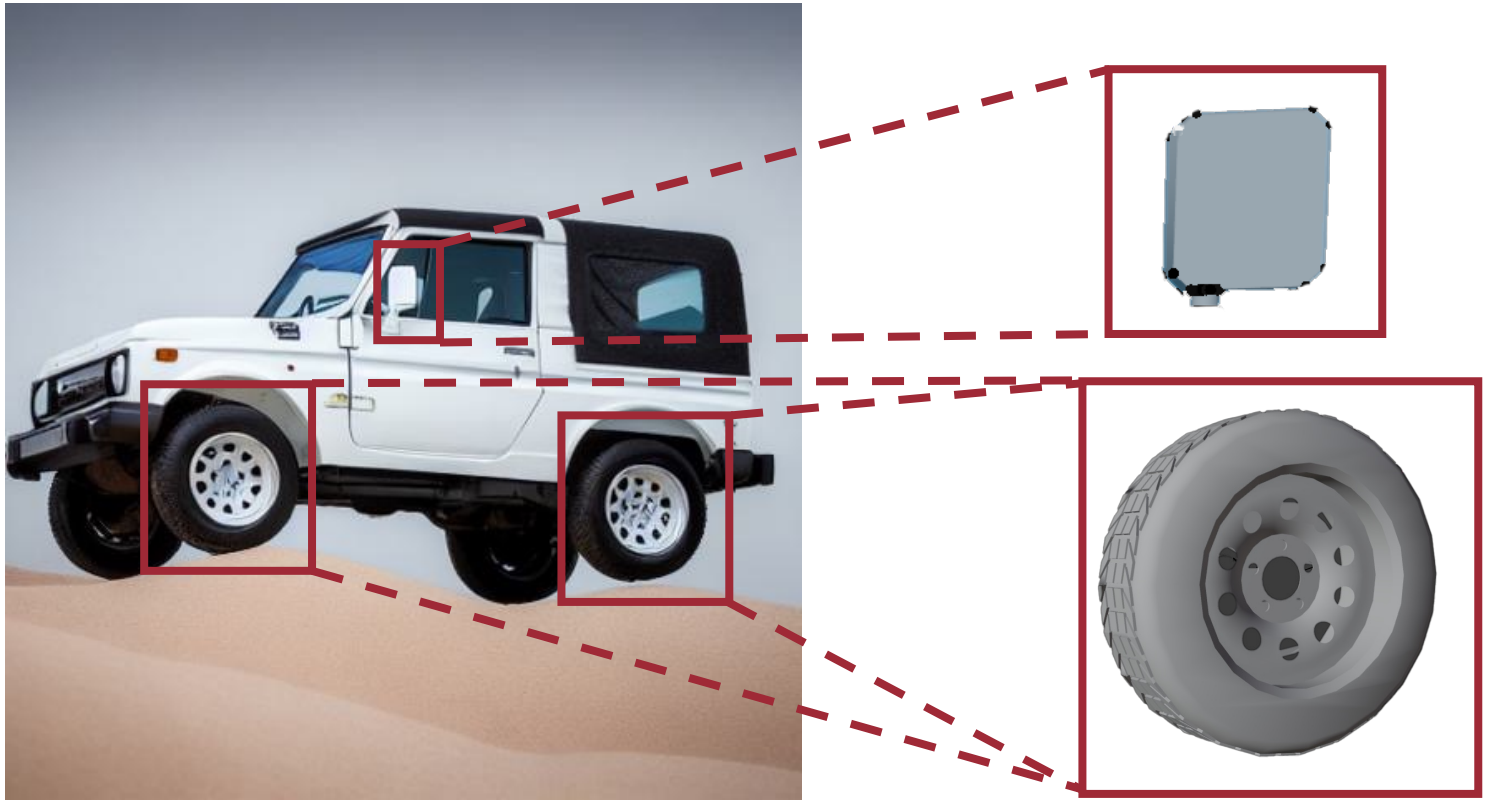
- Chuanruo Ning (宁川若)
  - Rising senior at Turing Class, Peking University
  - Non-CS interests: badminton, photography, music and reading



- Previous works
  - Deformable object manipulation. Accepted by ICCV 2023
  - Few-shot learning on articulated object manipulation. Under review of NeurIPS

What is 3D Part Detection?

- Detect precise 3D parts from a single image



Unseen single image

Precise 3D parts

Extend Render-and-compare Method to Part Detection

- NeMo's perspective
  - Current NeMo features are optimized for pose estimation
  - Part-level features enable NeMo to capture **precise geometric information**
- 3D Part detection
  - Recognizing parts are crucial for 3D understanding
  - Render-and-compare method provides 3D **global prior** for detection

How to Perform 3D Part Detection with Render-and-compare?

- Locate ---- Orient ---- Deform

Input image

3D part from
a different instance

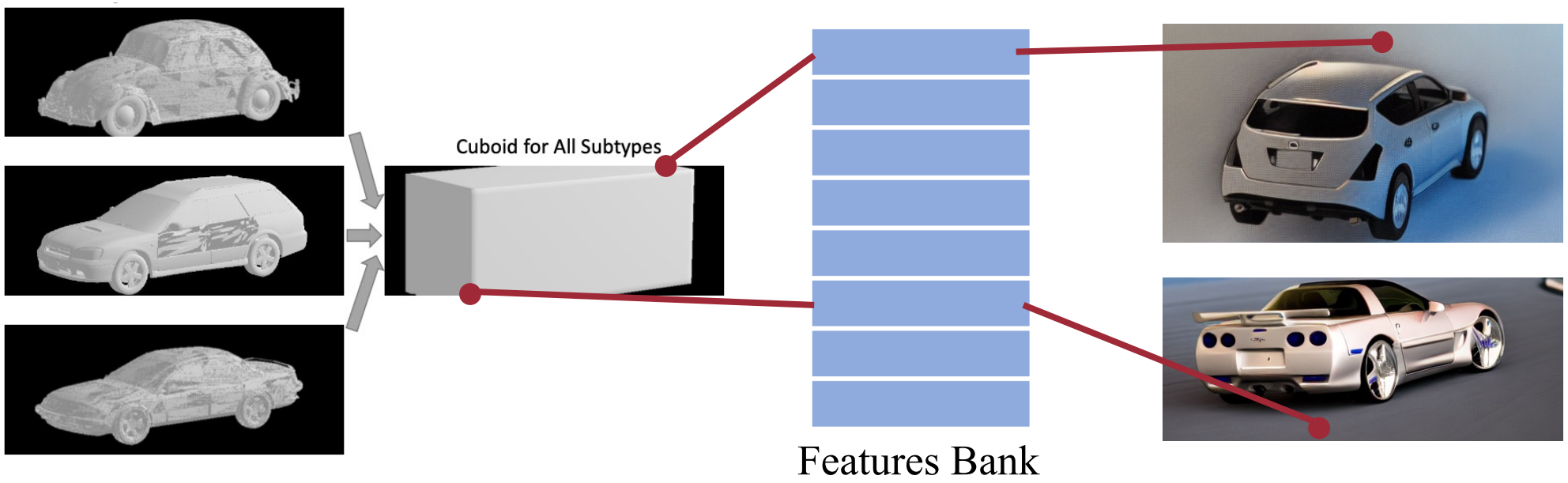
Locate

Orient

Deform

More Precisely Aligned NeMo

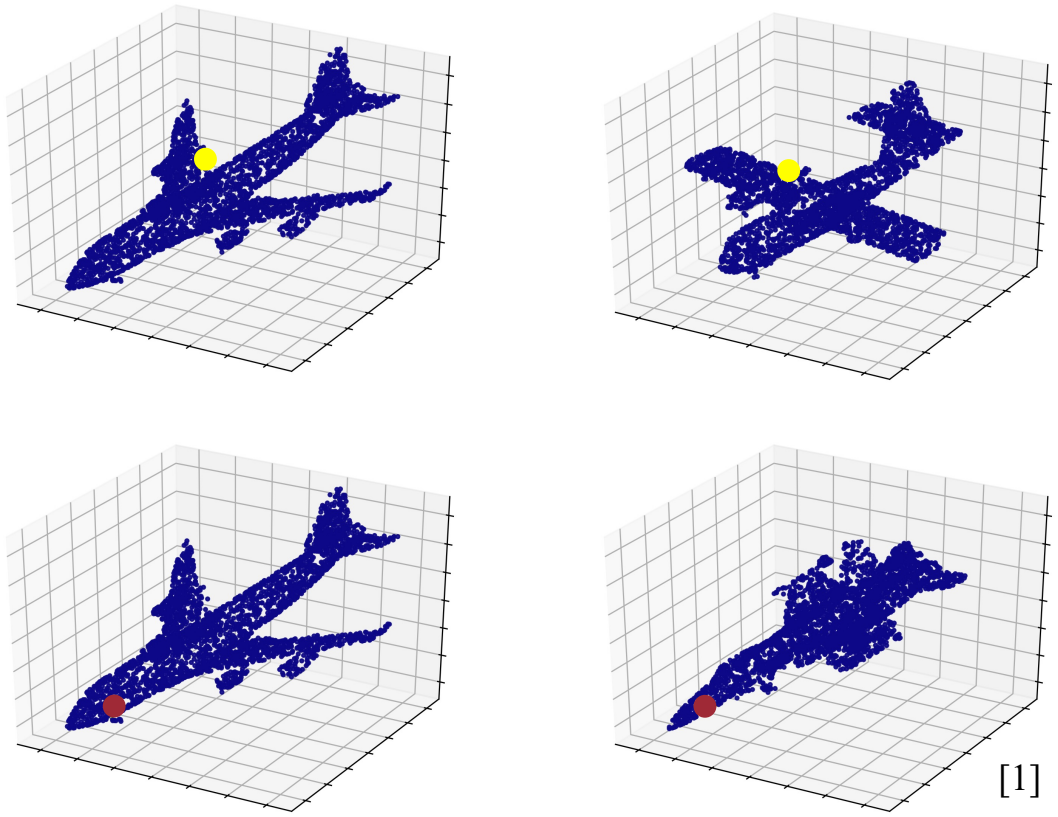
- NeMo leverages coarse alignment to perform robust pose estimation



- We need a more precise alignment between vertex features and 2D images

More Precisely Aligned NeMo

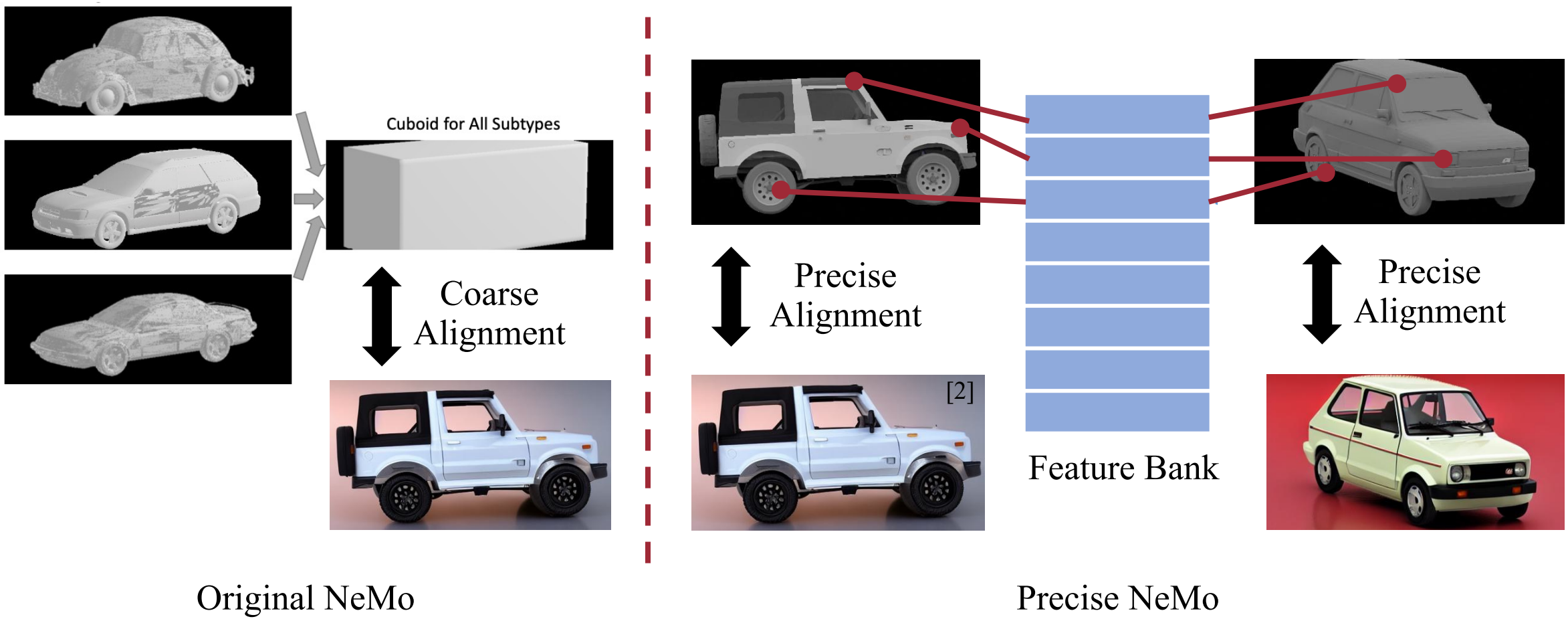
- Correspondence across instances



[1] Canonical Capsules: Self-Supervised Capsules in Canonical Pose

More Precisely Aligned NeMo

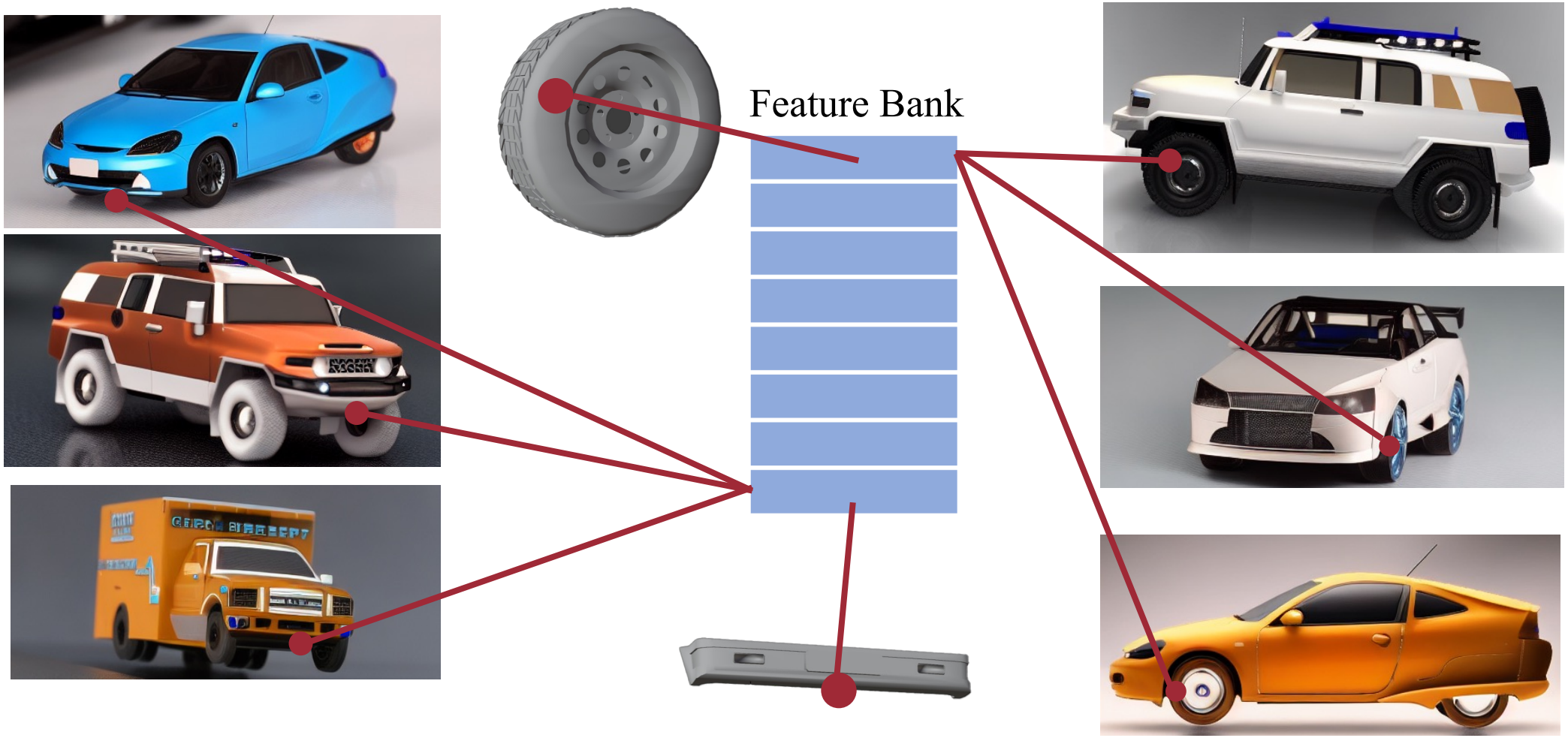
- Use correspondence to share features among precise shapes



[2] Adding 3D Geometry Control to Diffusion Models. *arXiv preprint arXiv:2306.08103*.

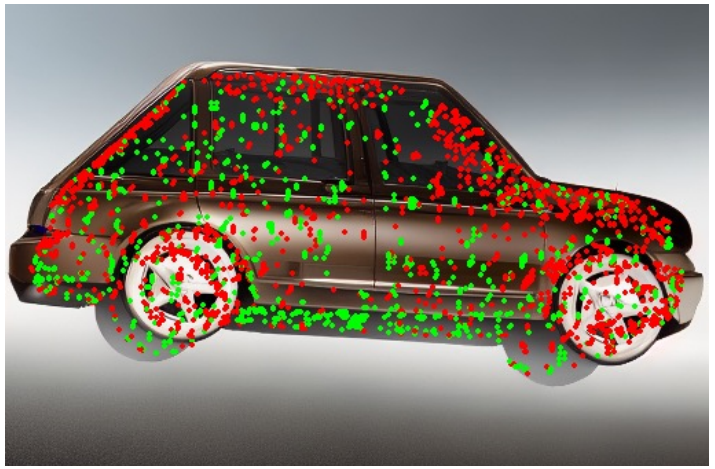
Locate & Orient with Precise NeMo

- Results

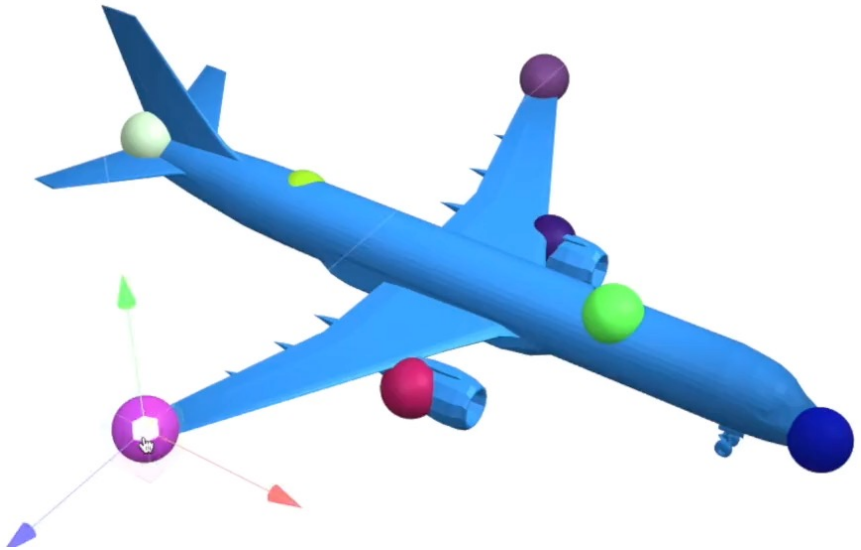


Deform by Changing The Position of Aligned Points

- Through gradient decent process



Points with aligned features



Deform using key points [2]

- Need some constraints (to be explored)

[2] KeypointDeformer: Unsupervised 3D Keypoint Discovery for Shape Control

Neural Mesh Models For 3D Part Recognition

Questions are welcomed

Thank you for Listening!