

3D CoMPaT: Composition of Materials on Parts of 3D Things (ECCV 2022 Oral)

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Visit our project page with dataset and
code: <https://3dcompat-dataset.org/>

1. Introduction



We introduce a richly annotated large-scale dataset, dubbed as **3D CoMPaT**, Compositions of Materials on Parts of 3D Things. The dataset contains more than **7.19 million** rendered model styles from **8 views**, covers **43 shape categories**, **235 unique and distinguishable part names**, and **167 unique and distinguishable material classes** from **10 types** of materials that can be applied to parts of 3D objects. Then Number of Shapes is 7262.

2. Dataset



Fig. 1 Left: Examples of a stylized cabinet.

Fig. 1 Middle: 3D object is rendered in four canonical and randomized views.

Fig. 1 Right: Part segmentation masks examples of our dataset.

3. Dataset Preparation

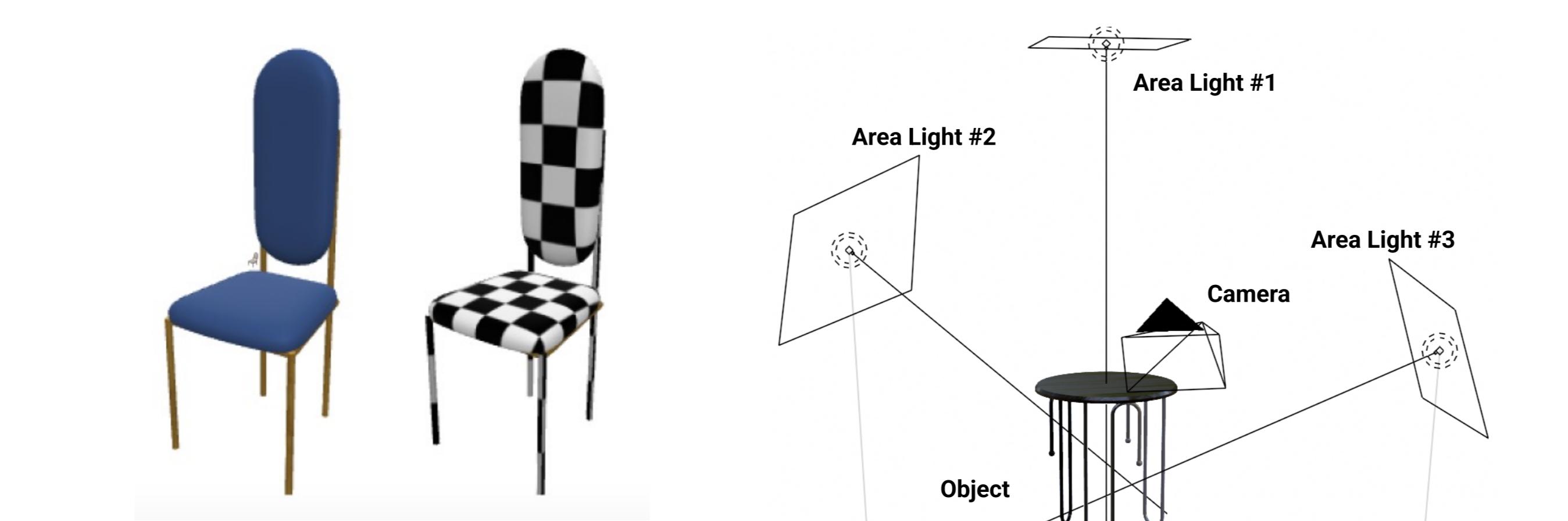


Fig. 2: Texture coordinate quality check. Fig. 3 : Rendering environment.

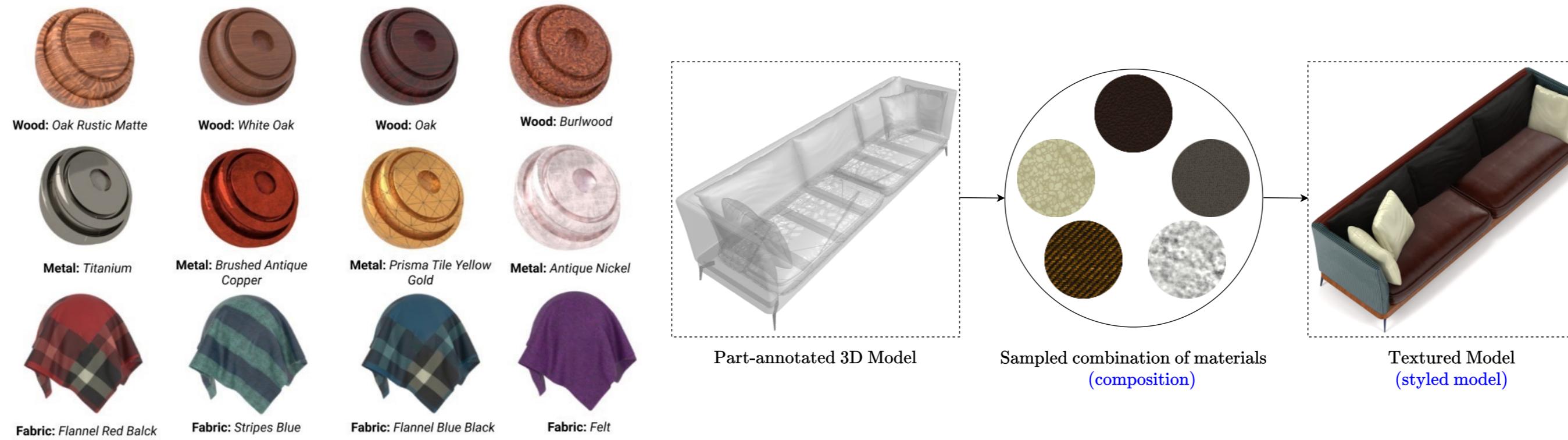


Fig. 4 Examples of materials.

Fig. 5 Pipeline of textured models

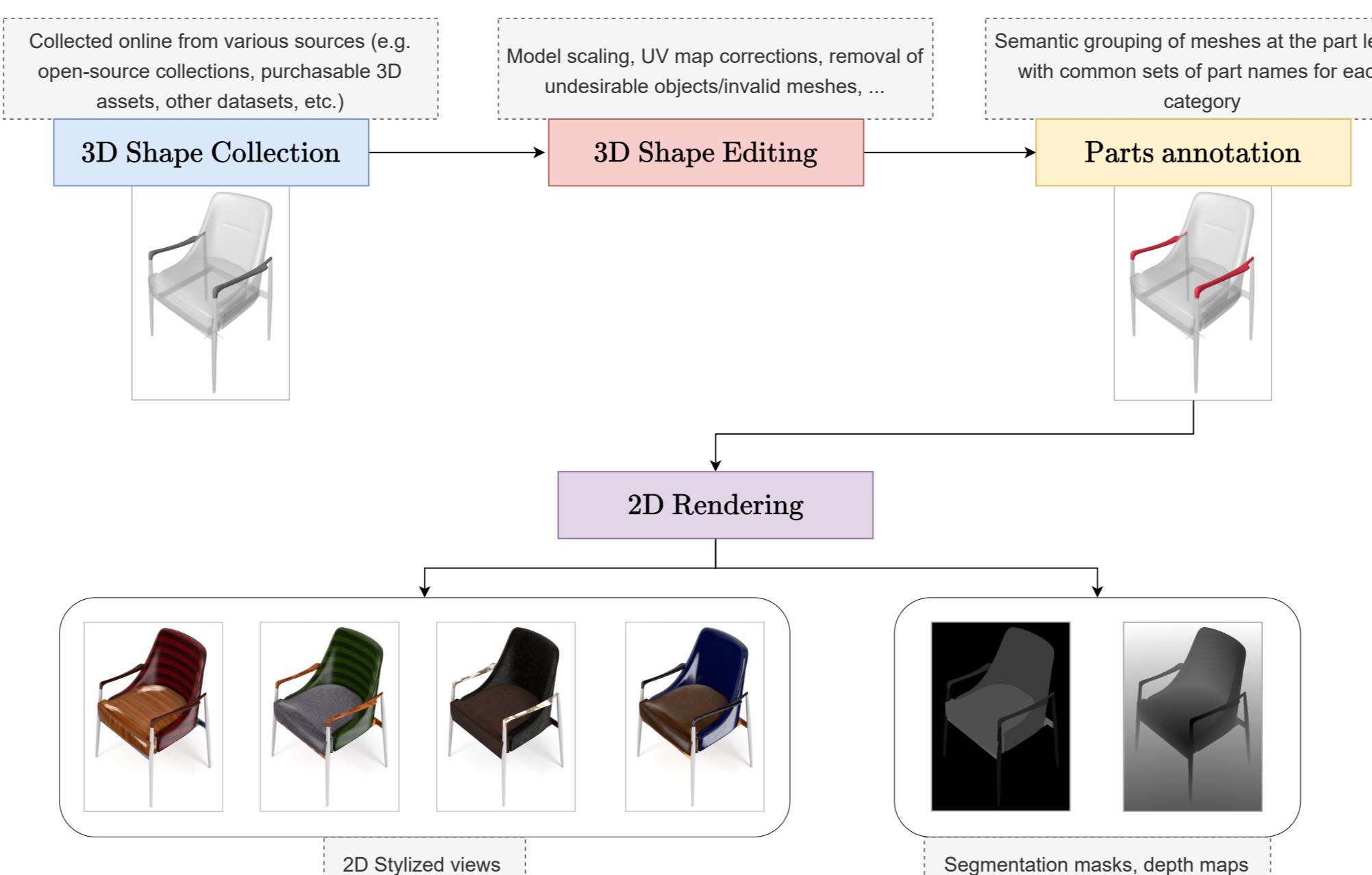


Fig. 6 Pipeline of data preparation

4. Dataset Statistics and Validation Experiments

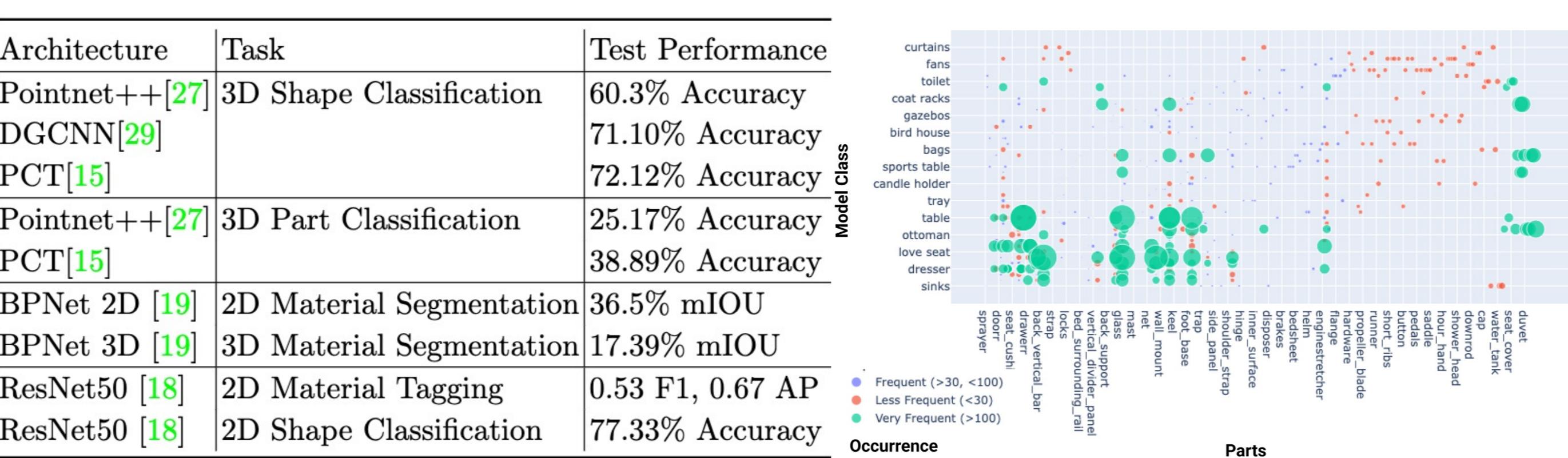


Fig. 7 Non-compositional experiments Fig. 8 Frequency of occurrence of part&model pair

5. 2D/3D Grounded CoMPaT Recognition (GCR) Task

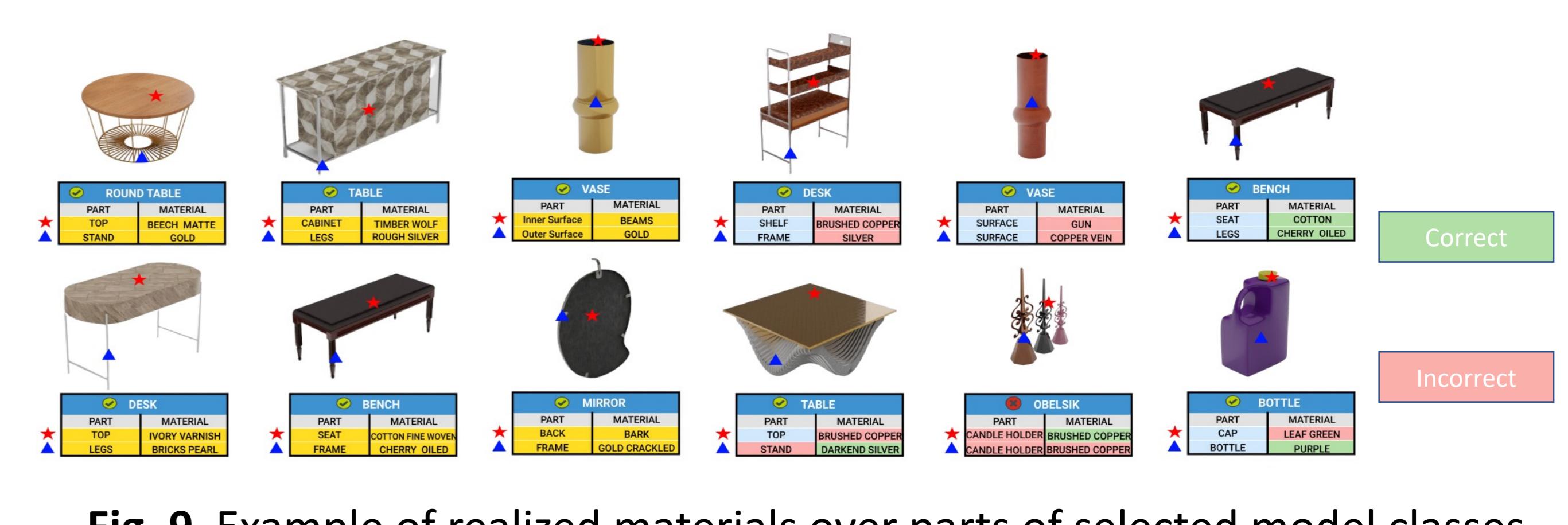
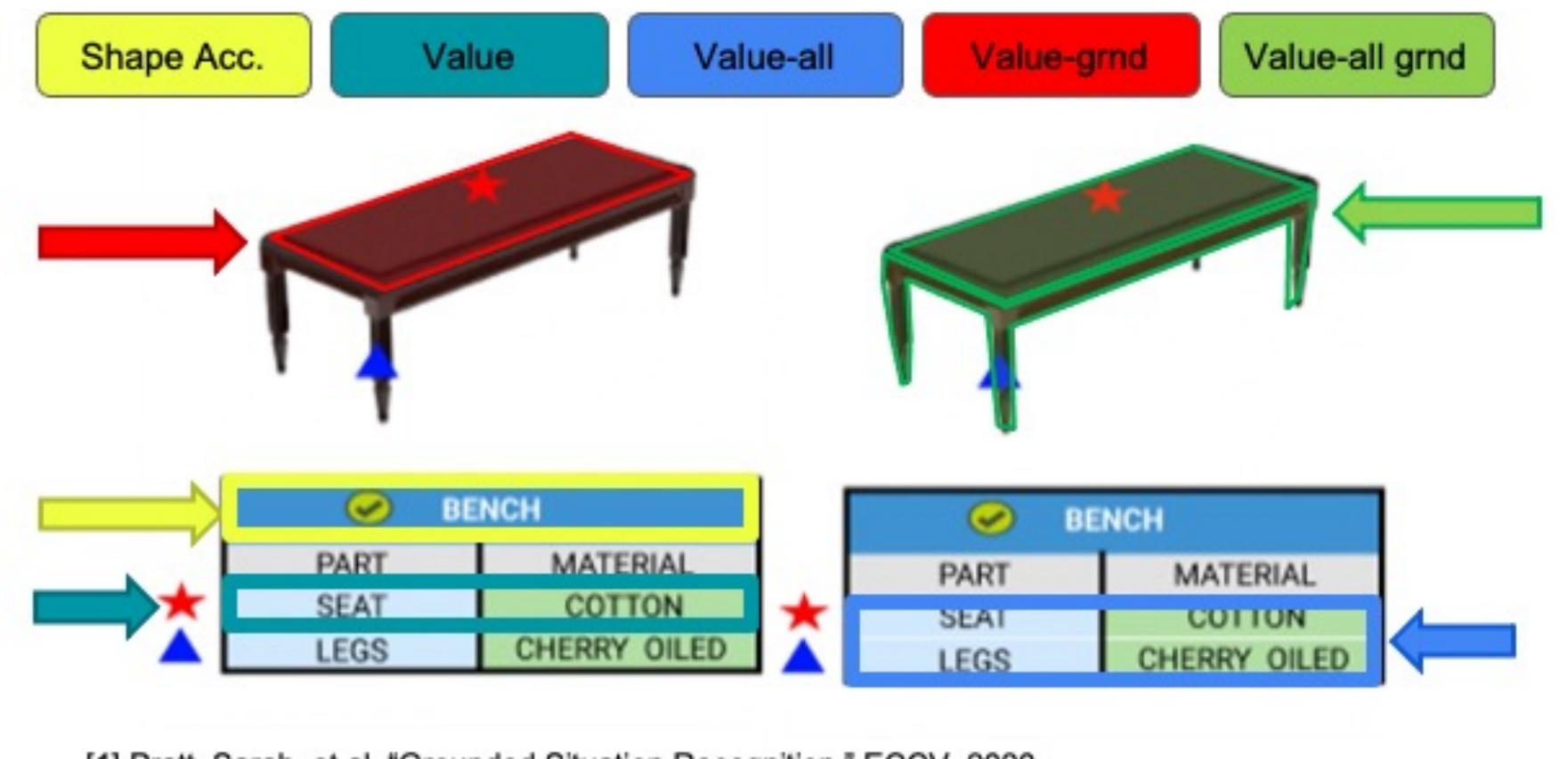


Fig. 9 Example of realized materials over parts of selected model classes



[1] Pratt, Sarah, et al. "Grounded Situation Recognition." ECCV, 2020

Fig. 10 Compositional Metrics of GCR-SEG Task

6. Baselines and Results

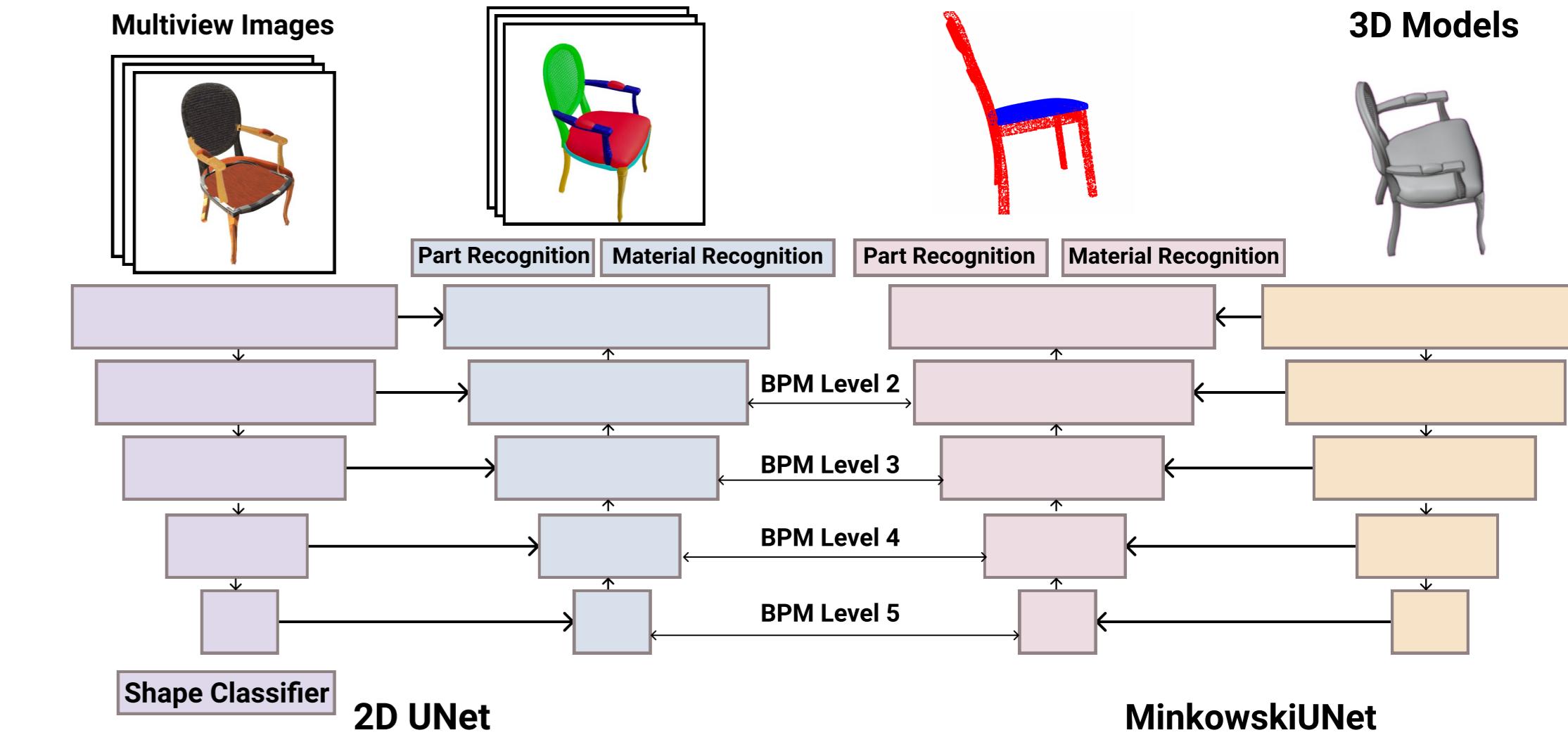


Fig. 10 2D/3D GCR-SEG: Modified 2D/3D BPNet segmentation architecture with 2D UNet and 3D MinkowskiUNet with same number of pyramid levels

Table 1: 2D/3D Grounded CoMPaT recognition (GCR) Results of 10 Compositions.

| Exp | Top-1 predicted shape | | | | | Top-5 predicted shape | | | | | Ground Truth Shape | | | | |
|--|-----------------------|-------|-----------|------------|----------------|-----------------------|-------|-----------|------------|----------------|--------------------|-----------|------------|----------------|--|
| | Shape Acc. | Value | Value-all | Value-grid | Value-all grid | Shape Acc. | Value | Value-all | Value-grid | Value-all grid | Value | Value-all | Value-grid | Value-all grid | |
| Standard | 36.91 | 6.81 | 3.54 | 3.29 | 0.07 | 39.07 | 7.29 | 3.74 | 3.48 | 0.07 | 65.07 | 27.72 | 36.15 | 2.89 | |
| GT Material | 36.91 | 7.10 | 3.54 | 4.30 | 0.60 | 39.07 | 7.59 | 3.74 | 4.51 | 0.60 | 69.54 | 27.72 | 40.46 | 4.80 | |
| GT Part | 36.91 | 7.52 | 5.77 | 4.94 | 0.94 | 39.07 | 8.07 | 6.28 | 5.37 | 1.49 | 86.84 | 71.73 | 71.83 | 44.80 | |
| 2D GCR-SEG (BPNet) + Separate 2D Shape Classifier | | | | | | | | | | | | | | | |
| Standard | 67.86 | 40.39 | 16.57 | 23.23 | 1.78 | 77.60 | 49.28 | 20.46 | 27.50 | 1.89 | 65.07 | 27.72 | 36.15 | 2.89 | |
| GT Material | 67.86 | 42.96 | 16.57 | 26.40 | 3.46 | 77.60 | 52.32 | 30.67 | 31.18 | 3.64 | 69.54 | 27.72 | 40.46 | 4.80 | |
| GT Part | 67.86 | 55.12 | 46.58 | 46.62 | 30.08 | 77.60 | 64.89 | 57.36 | 55.81 | 37.30 | 86.84 | 71.73 | 71.83 | 44.80 | |
| 3D GCR-SEG (BPNet) + Separate 3D Shape Classifier | | | | | | | | | | | | | | | |
| Standard | 36.91 | 5.39 | 2.02 | 0.65 | 0.03 | 39.07 | 5.68 | 2.07 | 0.70 | 0.03 | 44.59 | 12.52 | 4.92 | 0.47 | |
| GT Material | 36.91 | 6.10 | 2.02 | 1.34 | 0.15 | 39.07 | 6.43 | 2.07 | 1.40 | 0.15 | 50.71 | 12.52 | 8.23 | 0.66 | |
| GT Part | 36.91 | 6.30 | 4.13 | 2.05 | 0.82 | 39.07 | 6.72 | 4.40 | 2.29 | 0.92 | 77.27 | 65.30 | 44.83 | 36.57 | |
| 3D GCR-SEG (BPNet) + Separate 3D Shape Classifier | | | | | | | | | | | | | | | |
| Standard | 67.53 | 29.83 | 8.12 | 3.25 | 0.46 | 87.23 | 38.34 | 11.07 | 4.30 | 0.47 | 44.59 | 12.52 | 4.92 | 0.47 | |
| GT Material | 67.53 | 33.72 | 8.12 | 6.07 | 0.63 | 87.23 | 43.15 | 11.07 | 7.38 | 0.66 | 50.71 | 12.52 | 8.23 | 0.66 | |
| GT Part | 67.53 | 50.08 | 42.42 | 27.86 | 22.65 | 87.23 | 63.53 | 54.06 | 36.44 | 29.31 | 77.27 | 65.30 | 44.83 | 36.57 | |

Fig. 10 2D/3D Grounded CoMPaT recognition Results