Evaluation of the ShNeRF Render results

This Notebook is seperated from the actual Pipeline and has the purpose to measure the exact performance of the imodel

Prequesits to run this notebook

In this Notebook, the two "best" checkpoints `2024-07-28_174845_l1_pure_hook` and `2024-07-28_164939_l1_oSig_hook` were used. Therefore, these are required, as well as the binarized dataset

Step 1: Render images from the Model Checkpoint using dataset camera positions

Syntehtic test (hook):

```
ns-render dataset --load-config outputs\hook\alex-silhouette-model\2024-07-27_221252_l1_oSig_hook\config.yml --rendered-output-names bw --split val --data data\working\binarized_images_lowres\hook --output-path ..\evals-for-doc\2024-07-27_221252_l1_oSig_hook --colormap-options.colormap gray
```

```
ns-render dataset --load-config outputs\hook\alex-silhouette-model\2024-07-27_172756_l1_pure_hook\config.yml --rendered-output-names bw --split val --data data\working\binarized_images_lowres\hook --output-path ..\evals-for-doc\2024-07-27_172756_l1_pure_hook --colormap-options.colormap gray
```

Real World test (wall-e):

```
ns-render dataset --load-config outputs\wall-e\alex-silhouette-model\2024-08-07_165812-wall-e-oSig\config.yml --rendered-output-names bw --split val --data data\working\binarized_images_origres\wall-e --output-path ..\evals-for-doc\2024-08-07_165812-wall-e-oSig --colormap-options.colormap gray
```

```
ns-render dataset --load-config outputs\wall-e\alex-silhouette-model\2024-08-07_212527-wall-e-pure\config.yml --rendered-output-names bw --split val --data data\working\binarized_images_origres\wall-e --output-path ..\evals-for-doc\2024-08-07_212527-wall-e-pure --colormap-options.colormap gray
```

Step 2: Create IoU's

In [22]:

```
import os
import cv2
from sklearn.metrics import jaccard_score
import numpy as np

def compute_iou(image1, image2):
    # Flatten the images and compute the IoU
    image1_flat = image1.flatten()
    image2_flat = image2.flatten()
    iou = jaccard_score(image1_flat, image2_flat, average='macro')
    return iou

def binarize_image(image, threshold=50):
    _, binary_image = cv2.threshold(image, threshold, 255, cv2.THRESH_BINARY)
    return binary_image

def create_overlay(image1, image2):
    # Create an RGB image for visualization
    overlay = np.zeros((image1.shape[0], image1.shape[1], 3), dtype=np.uint8)

    # Intersection in green
    intersection = np.logical_and(image1, image2)
    overlay[intersection == 1] = [255, 255, 255]

    # Differences in red and blue
    only_image1 = np.logical_and(image1, np.logical_not(image2))
    only_image2 = np.logical_and(image2, np.logical_not(image1))

    overlay[only_image1 == 1] = [0, 0, 255]  # The predicted image
    overlay[only_image2 == 1] = [255, 0, 0]  # The ground truth image

    return overlay

def compare_folders(folder1, folder2, output_folder):
    if not os.path.exists(output_folder):
        os.makedirs(output_folder)

    folder1_images = sorted(os.listdir(folder1))
    folder2_images = sorted(os.listdir(folder2))

    # Filter folder 1, since ground truth path not alway just contaisn val data (fr
    folder2_images_set = {os.path.splitext(image)[0] for image in folder2_images} #
    filtered_folder1_images = [
        image for image in folder1_images if os.path.splitext(image)[0] in folder2_
    ]
    folder1_images = filtered_folder1_images

    total_iou = 0
    n_images = len(folder1_images)

    all_ious = []
```

```
    for img_name1, img_name2 in zip(folder1_images, folder2_images):
        img1_path = os.path.join(folder1, img_name1)
        img2_path = os.path.join(folder2, img_name2)

        img1 = cv2.imread(img1_path, cv2.IMREAD_GRAYSCALE)
        img2 = cv2.imread(img2_path, cv2.IMREAD_GRAYSCALE)

        if img1.shape != img2.shape:
            raise ValueError(f"Image sizes do not match: {img_name1} and {img_name2

        img1_binary = binarize_image(img1)
        img2_binary = binarize_image(img2)

        iou = compute_iou(img1_binary, img2_binary)
        total_iou += iou

        overlay = create_overlay(img1_binary, img2_binary)
        overlay_path = os.path.join(output_folder, f"{img_name1}_overlay.png")
        cv2.imwrite(overlay_path, overlay)

        all_ious.append(iou)

    print("saved all IoU Images to " + output_folder)
    average_iou = total_iou / n_images

    with open(os.path.join(output_folder, 'average_iou.txt'), 'w') as f:
        f.write(f"Average IoU for all images: {average_iou:.4f}")

    print(f"Average IoU for all images: {average_iou:.4f}")

    return all_ious
```

Result Evaluation / Visualization

In [15]:

```
import matplotlib.pyplot as plt

def plot_overlays(output_folder, title):
    # Get the list of overlay images in the output folder
    overlay_images = sorted([img for img in os.listdir(output_folder) if img.endswi

    # Ensure there are at least 6 images to plot
    if len(overlay_images) < 4:
        raise ValueError('Not enough overlay images to plot. At least 6 required.')

    # Create a figure with 2 rows and 3 columns
    fig, axes = plt.subplots(2, 2, figsize=(8, 8))
    fig.suptitle(title, fontsize=15)

    for i, ax in enumerate(axes.flat):
        # Read the image
        img_path = os.path.join(output_folder, overlay_images[i])
        img = cv2.imread(img_path)
        img_rgb = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)  # Convert from BGR to RGB

        # Display the image
```

```
        ax.imshow(img_rgb)
        ax.set_title(overlay_images[i])
        ax.axis('off')

    plt.tight_layout()
    plt.show()


def scatter_both_models(pure_ious, osig_ious):
    # Create a box plot
    plt.figure(figsize=(6, 5))

    data = [pure_ious, osig_ious]

    plt.boxplot(data,
                labels=['L1 Pure', 'L1 oSig'],
                patch_artist=True,
                boxprops=dict(facecolor='orange',
                    color='black',
                    alpha=0.5),
                whiskerprops=dict(color='black', alpha=1.0),
                medianprops=dict(color='black', alpha=0.0)) # dont show

    mean_pure = np.mean(pure_ious)
    mean_osig = np.mean(osig_ious)

    # Overlay individual data points
    for i, dataset in enumerate(data):
        plt.scatter([i + 1] * len(dataset), dataset, color='black', label='All IoUs

    #and mean
    plt.scatter([1], [mean_pure], color='green', edgecolor='black', s=100, zorder=5
    plt.scatter([2], [mean_osig], color='purple', edgecolor='black', s=100, zorder=

    plt.xlim(0.5, 2.5)

    plt.title('IoU Values of L1 Pure and L1 oSig')
    plt.xlabel('Class')
    plt.ylabel('Value')
    handles, labels = plt.gca().get_legend_handles_labels()
    plt.legend(handles=handles, labels=labels, loc='best')


    # Render the plot
    plt.show()
```

Run for Syntehtic Datatset / Checkpoint

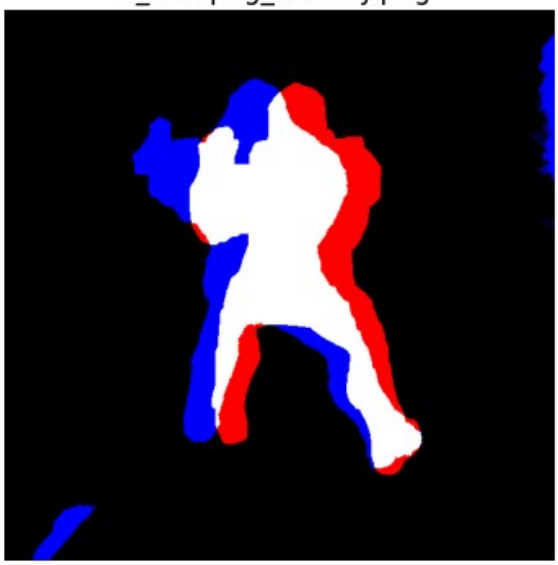
In [4]:
```
# Replace these paths with your local paths
images_gt_path = 'C:/dev/TU/htcv-project/nerf-shape-from-silhouette/data/working/bi

images_pred_path_l1_pure = 'C:/dev/TU/htcv-project/evals-for-doc/2024-07-27_172756_
images_pred_path_l1_oSig = 'C:/dev/TU/htcv-project/evals-for-doc/2024-07-27_221252_

# For the IoU visualization
```

```
output_folder_pure = 'C:/dev/TU/htcv-project/evals-for-doc/2024-07-27_172756_l1_pur
output_folder_oSig = 'C:/dev/TU/htcv-project/evals-for-doc/2024-07-27_221252_l1_oSi

# RUN
print("L1 pure: ")
ious_l1_pure = compare_folders(images_gt_path, images_pred_path_l1_pure, output_fol
print("-")
print("L1 oSig: ")
ious_l1_osig = compare_folders(images_gt_path, images_pred_path_l1_oSig, output_fol

# Show IoU Images
plot_overlays(output_folder_pure, 'IoU Images of ShNeRF L1 Pure')
plot_overlays(output_folder_oSig, 'IoU Images of ShNeRF L1 oSig')

# Show a Scatter Plot of all individual IoU values for oSig and Pure
scatter_both_models(ious_l1_pure, ious_l1_osig)
```

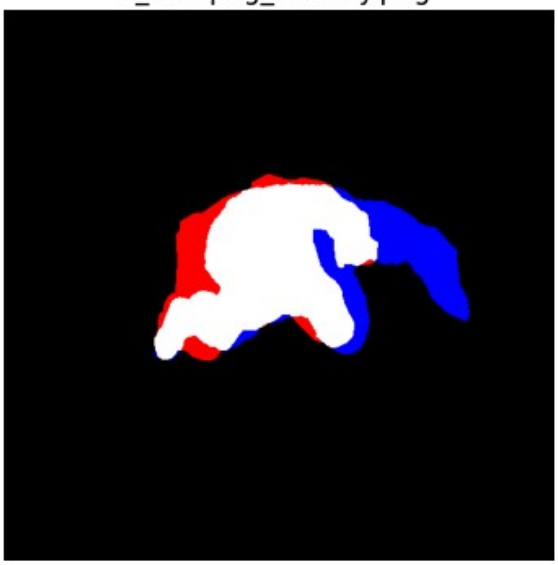
```
L1 pure:
saved all IoU Images to C:/dev/TU/htcv-project/evals-for-doc/2024-07-27_172756_l1_pu
re_hook/val/iou
Average IoU for all images: 0.8271
-
L1 oSig:
saved all IoU Images to C:/dev/TU/htcv-project/evals-for-doc/2024-07-27_221252_l1_oS
ig_hook/val/iou
Average IoU for all images: 0.8386
```

IoU Images of ShNeRF L1 Pure

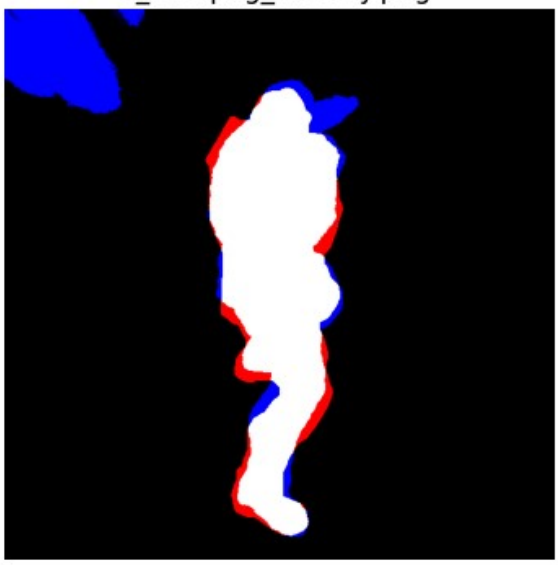
r_000.png_overlay.png



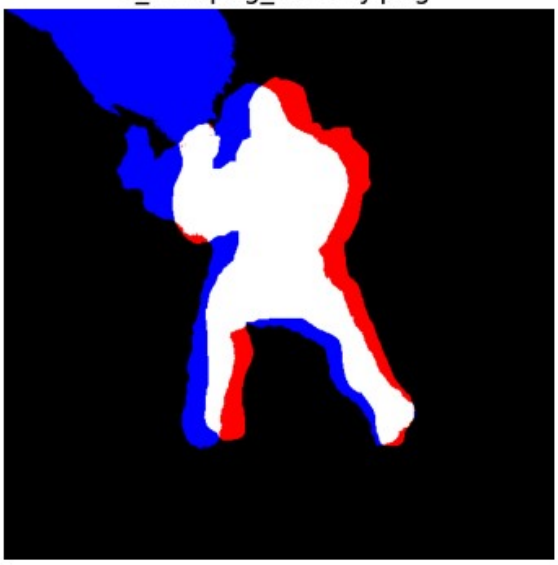
r_001.png_overlay.png



r_002.png_overlay.png

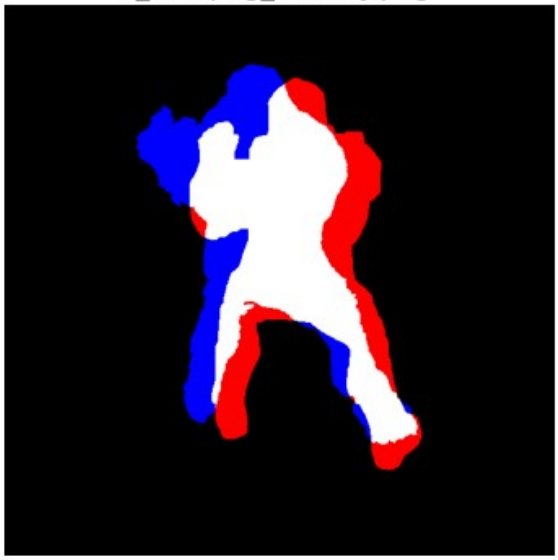


r_003.png_overlay.png



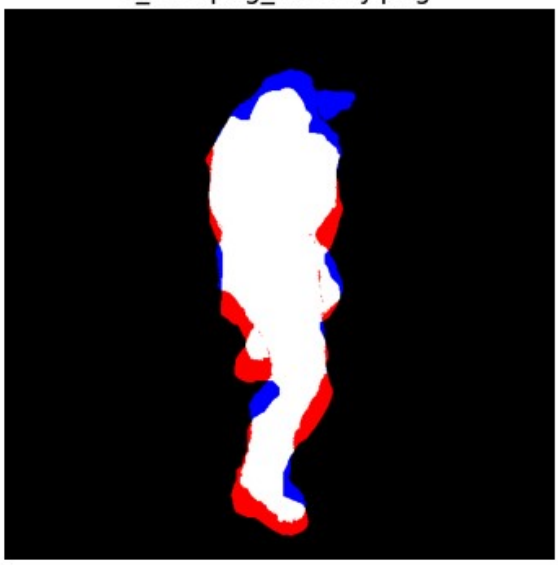
IoU Images of ShNeRF L1 oSig

r_000.png_overlay.png

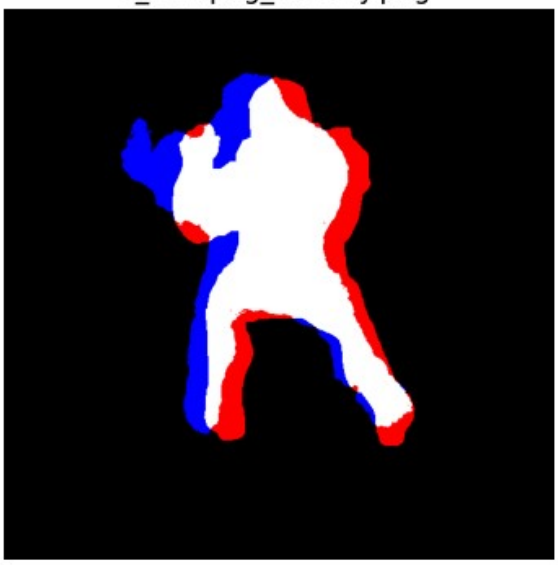


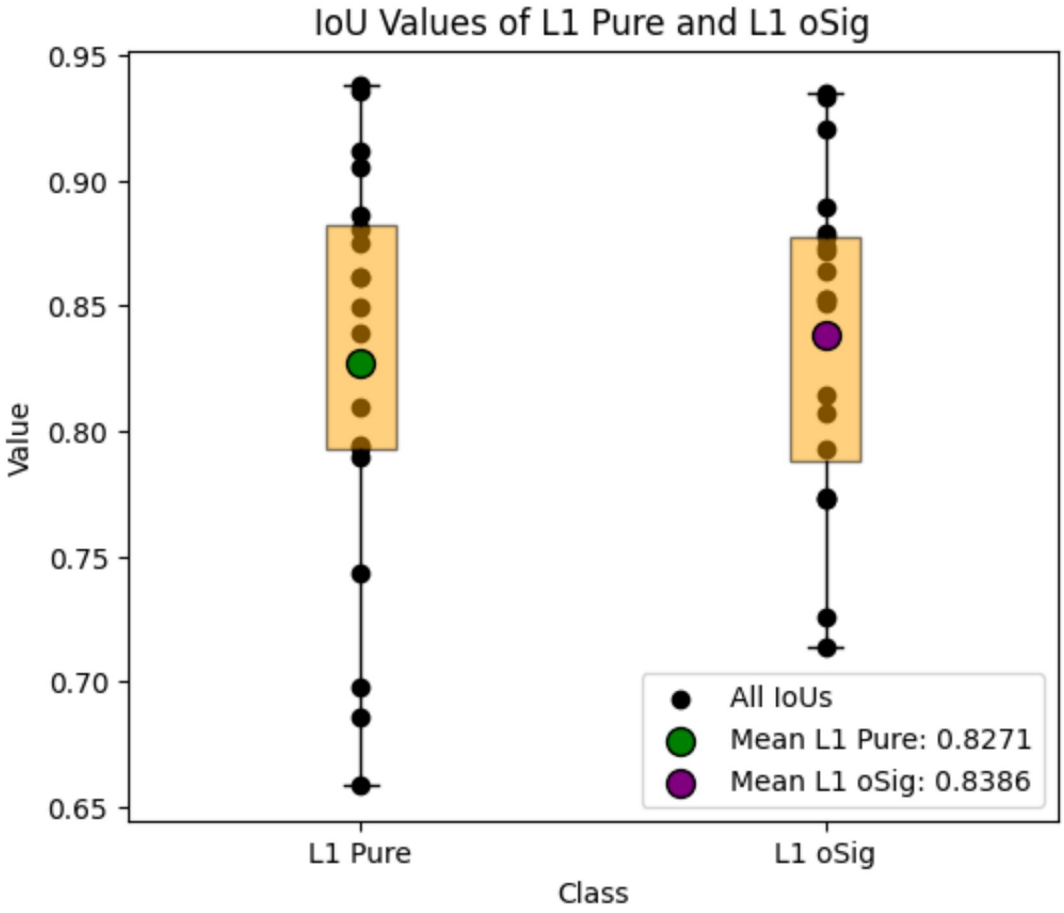
r_001.png_overlay.png

r_002.png_overlay.png



r_003.png_overlay.png





Run for self created real world dataset / checkpoint

In [26]:

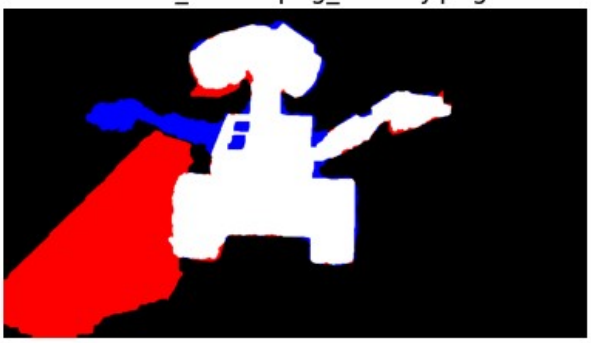
```
# Replace these paths with your local paths
images_gt_path = 'C:/dev/TU/htcv-project/nerf-shape-from-silhouette/data/working/bi

images_pred_path_l1_pure = 'C:/dev/TU/htcv-project/evals-for-doc/2024-08-07_212527-
images_pred_path_l1_oSig = 'C:/dev/TU/htcv-project/evals-for-doc/2024-08-07_165812-

# For the IoU visualization
output_folder_pure = 'C:/dev/TU/htcv-project/evals-for-doc/2024-08-07_212527-wall-e
output_folder_oSig = 'C:/dev/TU/htcv-project/evals-for-doc/2024-08-07_165812-wall-e

# RUN
print("L1 pure: ")
ious_l1_pure = compare_folders(images_gt_path, images_pred_path_l1_pure, output_fol
print("-")
print("L1 oSig: ")
ious_l1_osig = compare_folders(images_gt_path, images_pred_path_l1_oSig, output_fol

# Show IoU Images
plot_overlays(output_folder_pure, 'IoU Images of ShNeRF L1 pure')
plot_overlays(output_folder_oSig, 'IoU Images of ShNeRF L1 oSig')

# Show a Scatter Plot of all individual IoU values for oSig and Pure
scatter_both_models(ious_l1_pure, ious_l1_osig)
```

L1 pure:
saved all IoU Images to C:/dev/TU/htcv-project/evals-for-doc/2024-08-07_212527-wall-e-pure/val/iou
Average IoU for all images: 0.8866
-
L1 oSig:
saved all IoU Images to C:/dev/TU/htcv-project/evals-for-doc/2024-08-07_165812-wall-e-oSig/val/iou
Average IoU for all images: 0.8791

IoU Images of ShNeRF L1 pure

frame_00011.png_overlay.png

frame_00021.png_overlay.png

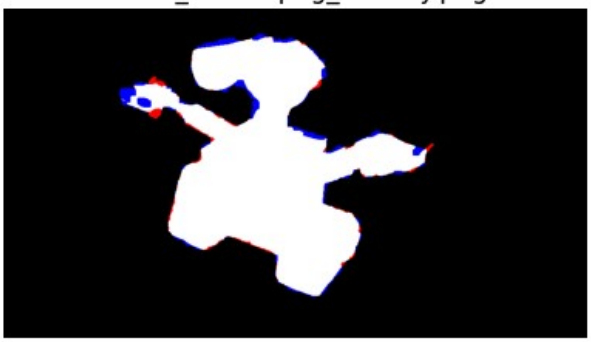


frame_00031.png_overlay.png

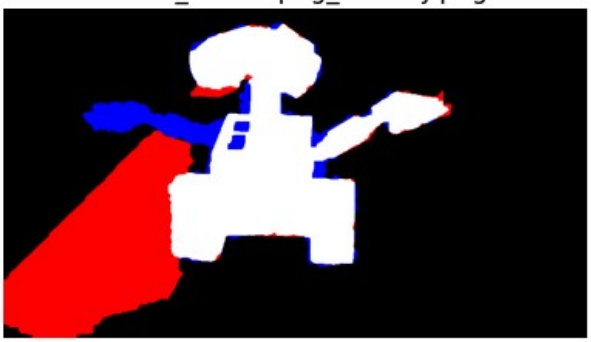
frame_00041.png_overlay.png

IoU Images of ShNeRF L1 oSig

frame_00011.png_overlay.png

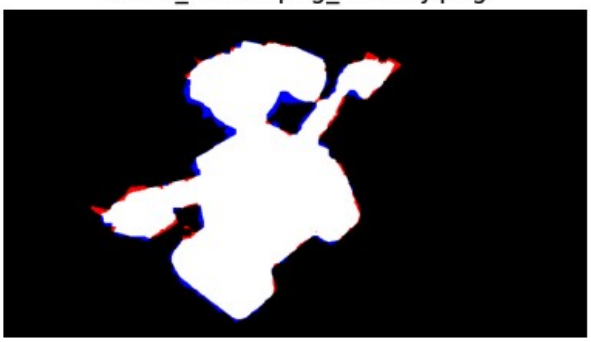


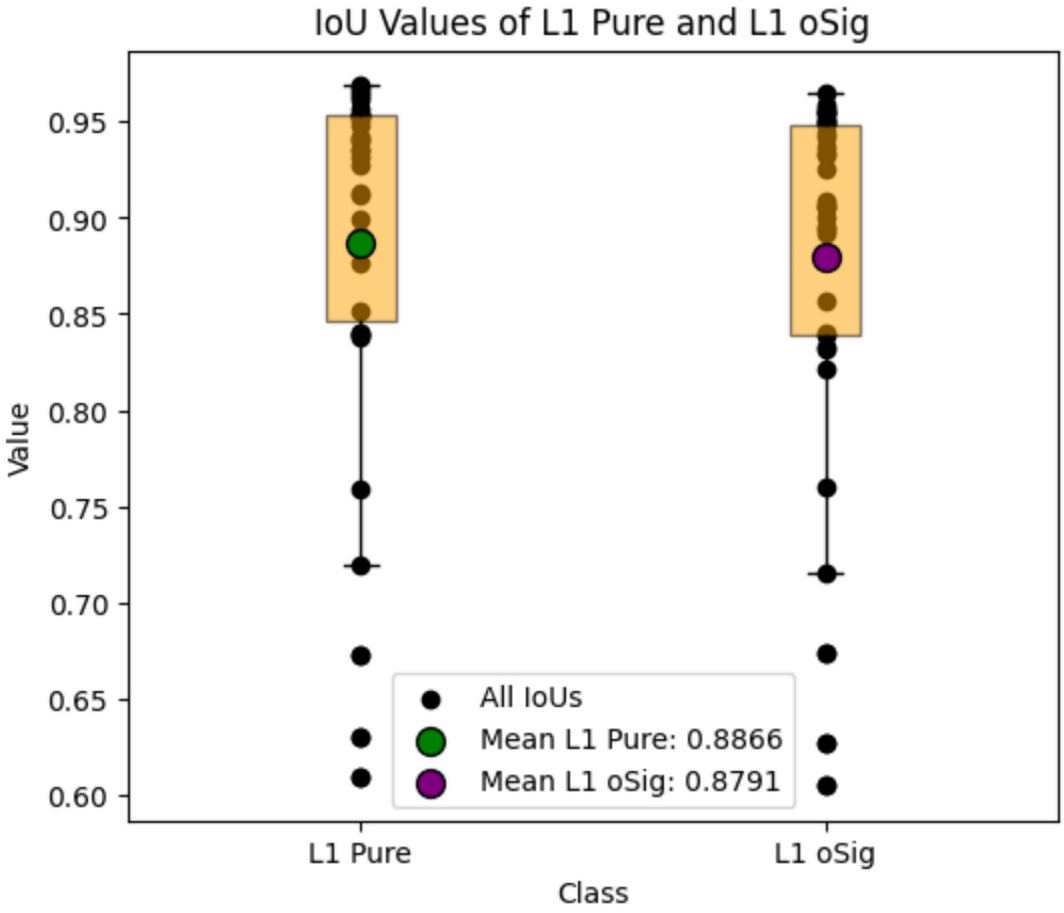
frame_00021.png_overlay.png



frame_00031.png_overlay.png

frame_00041.png_overlay.png




IoU Values of L1 Pure and L1 oSig
Value
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
All IoUs
Mean L1 Pure: 0.8866
Mean L1 oSig: 0.8791
L1 Pure
L1 oSig
Class

In [ ]: