UIDs: 117975895, 117935585, 118386225, 117809114

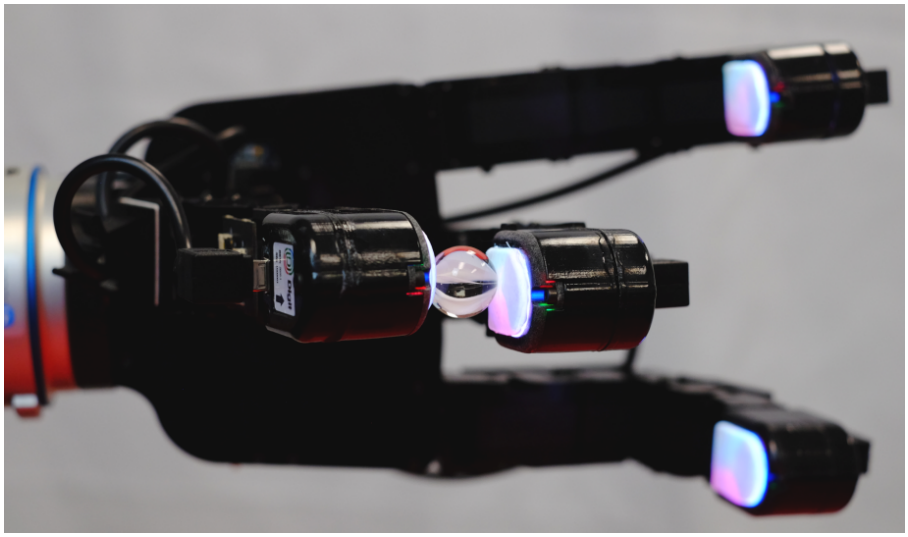
CMSC426 Final Project: Depth and Contact Prediction

Objective

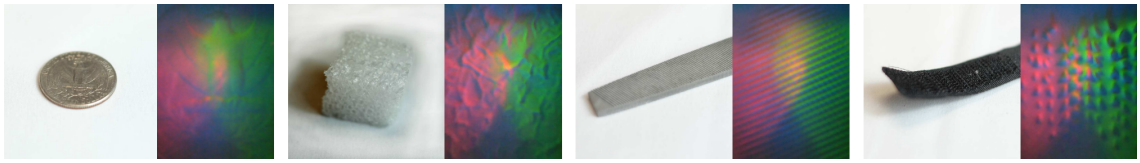
In this project we want to use deep neural networks to predict 3D contact geometry from monocular images of a vision-based tactile sensor.

Background

- **Tactile sensors** are devices designed to measure information arising from the physical interaction of robots with their environment. These sensors excel in detecting stimuli resulting from mechanical stimulation, temperature variations, and even pain-like responses.



However, recent sensor developments in this field, often inspired by the biological sense of cutaneous touch, have predominantly concentrated on capturing the 3D geometry of contact. In this project, we aim to extend this focus to predicting such interactions, particularly for GelSight tactile sensors. The figure below illustrates the resolution of tactile sensors when they come into contact with various objects



The papers below contain crucial information on how these sensors work, which could be helpful for success in this project

GelSight Wedge: Measuring High-Resolution 3D Contact Geometry with a Compact Robot Finger
DIGIT: A Novel Design for a Low-Cost Compact High-Resolution Tactile Sensor with Application to In-Hand Manipulation

- **Depth Prediction** is the task of measuring the distance of each pixel relative to the camera. Depth is extracted from either monocular (single) or stereo (multiple views of a scene) images. Traditional methods use multi-view geometry to find the relationship between the images. Newer methods can directly estimate depth by minimizing the regression loss, or by learning to generate a novel view from a sequence. *You can also watch one of the recent works in PRG on reconstructing objects with tactile sensors on YouTube*.

- **Contact Prediction** is closely akin to Depth Prediction but represents a somewhat simpler task. This is because the output solely consists of a binary mask indicating the areas where the depth is positive.

Objective

In this project, we aim to acquire the inverse sensor model to reconstruct local 3D geometry from a tactile image. The task involves training the model in a supervised manner to predict local heightmaps and contact areas from tactile images. While one potential strategy involves integrating depth and contact prediction within a stacked neural network, such as outlined in Depth Map Prediction from a Single Image using a Multi-Scale Deep Network, we encourage you to propose a novel approach tailored to the specific challenges of the problem. Nevertheless, we'll provide you with a project template to guide your implementation, building upon the principles covered during semester.

IN THIS PROJECT ALL FUNCTIONS/LIBRARIES ARE ALLOWED

Step 1: Dataloading

Create a custom dataset to read images from the provided dataset. You might need to preprocess the data as these are raw tactile readings from sensor without any normalization. For further guidance, refer to the PyTorch tutorial.

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inflating: mini_depth_dataset/long_cylinder/tactile/80.png
inflating: mini_depth_dataset/ring/tactile/88.png
inflating: mini_depth_dataset/long_cylinder/tactile/77.png
inflating: mini_depth_dataset/long_cylinder/tactile/78.png
inflating: mini_depth_dataset/ring/tactile/81.png
inflating: mini_depth_dataset/big_decagon/tactile/15.png
inflating: mini_depth_dataset/ring/tactile/82.png
inflating: mini_depth_dataset/long_cylinder/tactile/75.png
inflating: mini_depth_dataset/long_cylinder/tactile/72.png
inflating: mini_depth_dataset/ring/tactile/77.png
inflating: mini_depth_dataset/long_cylinder/tactile/76.png
inflating: mini_depth_dataset/ring/tactile/93.png
inflating: mini_depth_dataset/long_cylinder/tactile/69.png
inflating: mini_depth_dataset/long_cylinder/tactile/73.png
inflating: mini_depth_dataset/ring/tactile/91.png
inflating: mini_depth_dataset/long_cylinder/tactile/79.png
inflating: mini_depth_dataset/long_cylinder/tactile/74.png
inflating: mini_depth_dataset/big_decagon/tactile/29.png
inflating: mini_depth_dataset/ring/tactile/75.png
inflating: mini_depth_dataset/ring/tactile/80.png
inflating: mini_depth_dataset/long_cylinder/tactile/66.png
inflating: mini_depth_dataset/ring/tactile/73.png
inflating: mini_depth_dataset/long_cylinder/tactile/71.png
inflating: mini_depth_dataset/ring/tactile/76.png
inflating: mini_depth_dataset/ring/tactile/79.png
inflating: mini_depth_dataset/ring/tactile/78.png
inflating: mini_depth_dataset/ring/tactile/83.png
inflating: mini_depth_dataset/long_cylinder/tactile/92.png
inflating: mini_depth_dataset/ring/tactile/71.png
inflating: mini_depth_dataset/long_cylinder/tactile/70.png
inflating: mini_depth_dataset/ring/tactile/68.png
inflating: mini_depth_dataset/long_cylinder/tactile/64.png
inflating: mini_depth_dataset/ring/tactile/70.png
inflating: mini_depth_dataset/ring/tactile/67.png
inflating: mini_depth_dataset/long_cylinder/tactile/62.png
inflating: mini_depth_dataset/ring/tactile/69.png
inflating: mini_depth_dataset/long_cylinder/tactile/59.png
inflating: mini_depth_dataset/long_cylinder/tactile/67.png
inflating: mini_depth_dataset/long_cylinder/tactile/60.png
inflating: mini_depth_dataset/long_cylinder/tactile/58.png
```

```
inflating: mini_depth_dataset/ring/tactile/74.png
inflating: mini_depth_dataset/long_cylinder/tactile/61.png
inflating: mini_depth_dataset/ring/tactile/65.png
inflating: mini_depth_dataset/ring/tactile/92.png
inflating: mini_depth_dataset/long_cylinder/tactile/68.png
inflating: mini_depth_dataset/ring/tactile/62.png
inflating: mini_depth_dataset/ring/depth/115.png
inflating: mini_depth_dataset/long_cylinder/tactile/63.png
inflating: mini_depth_dataset/ring/tactile/66.png
inflating: mini_depth_dataset/ring/tactile/64.png
inflating: mini_depth_dataset/ring/tactile/72.png
inflating: mini_depth_dataset/long_cylinder/tactile/54.png
inflating: mini_depth_dataset/ring/tactile/102.png
inflating: mini_depth_dataset/ring/tactile/59.png
inflating: mini_depth_dataset/long_cylinder/tactile/65.png
inflating: mini_depth_dataset/long_cylinder/tactile/57.png
inflating: mini_depth_dataset/ring/tactile/60.png
inflating: mini_depth_dataset/ring/tactile/58.png
inflating: mini_depth_dataset/ring/tactile/63.png
inflating: mini_depth_dataset/long_cylinder/tactile/51.png
inflating: mini_depth_dataset/ring/depth/112.png
inflating: mini_depth_dataset/ring/depth/114.png
inflating: mini_depth_dataset/ring/tactile/57.png
inflating: mini_depth_dataset/long_cylinder/tactile/55.png
inflating: mini_depth_dataset/long_cylinder/depth/44.png
inflating: mini_depth_dataset/ring/tactile/56.png
inflating: mini_depth_dataset/ring/depth/109.png
inflating: mini_depth_dataset/long_cylinder/tactile/53.png
inflating: mini_depth_dataset/ring/depth/108.png
inflating: mini_depth_dataset/long_cylinder/tactile/49.png
inflating: mini_depth_dataset/long_cylinder/tactile/50.png
inflating: mini_depth_dataset/ring/depth/113.png
inflating: mini_depth_dataset/ring/depth/110.png
inflating: mini_depth_dataset/ring/tactile/55.png
inflating: mini_depth_dataset/ring/tactile/51.png
inflating: mini_depth_dataset/long_cylinder/tactile/48.png
inflating: mini_depth_dataset/ring/tactile/52.png
inflating: mini_depth_dataset/long_cylinder/tactile/52.png
inflating: mini_depth_dataset/ring/tactile/48.png
inflating: mini_depth_dataset/long_cylinder/tactile/43.png
inflating: mini_depth_dataset/long_cylinder/tactile/47.png
inflating: mini_depth_dataset/ring/tactile/47.png
inflating: mini_depth_dataset/ring/tactile/61.png
inflating: mini_depth_dataset/ring/depth/102.png
inflating: mini_depth_dataset/ring/tactile/50.png
inflating: mini_depth_dataset/long_cylinder/tactile/44.png
inflating: mini_depth_dataset/ring/tactile/49.png
inflating: mini_depth_dataset/ring/depth/111.png
inflating: mini_depth_dataset/ring/tactile/53.png
inflating: mini_depth_dataset/long_cylinder/tactile/45.png
inflating: mini_depth_dataset/ring/tactile/46.png
inflating: mini_depth_dataset/long_cylinder/tactile/41.png
inflating: mini_depth_dataset/ring/depth/103.png
inflating: mini_depth_dataset/big_decagon/depth/136.png
inflating: mini_depth_dataset/long_cylinder/tactile/56.png
inflating: mini_depth_dataset/long_cylinder/tactile/42.png
inflating: mini_depth_dataset/ring/depth/105.png
inflating: mini_depth_dataset/ring/tactile/42.png
inflating: mini_depth_dataset/ring/depth/100.png
inflating: mini_depth_dataset/ring/tactile/45.png
```

```
inflating: mini_depth_dataset/ring/depth/104.png
inflating: mini_depth_dataset/long_cylinder/tactile/46.png
inflating: mini_depth_dataset/long_cylinder/tactile/39.png
inflating: mini_depth_dataset/big_decagon/depth/139.png
inflating: mini_depth_dataset/big_decagon/depth/134.png
inflating: mini_depth_dataset/ring/tactile/43.png
inflating: mini_depth_dataset/big_decagon/depth/137.png
inflating: mini_depth_dataset/ring/depth/106.png
inflating: mini_depth_dataset/ring/depth/98.png
inflating: mini_depth_dataset/long_cylinder/tactile/40.png
inflating: mini_depth_dataset/ring/depth/107.png
inflating: mini_depth_dataset/ring/tactile/40.png
inflating: mini_depth_dataset/ring/depth/95.png
inflating: mini_depth_dataset/big_decagon/depth/133.png
inflating: mini_depth_dataset/ring/depth/101.png
inflating: mini_depth_dataset/long_cylinder/tactile/36.png
inflating: mini_depth_dataset/ring/tactile/54.png
inflating: mini_depth_dataset/ring/depth/97.png
inflating: mini_depth_dataset/ring/tactile/39.png
inflating: mini_depth_dataset/ring/depth/99.png
inflating: mini_depth_dataset/big_decagon/depth/132.png
inflating: mini_depth_dataset/big_decagon/depth/131.png
inflating: mini_depth_dataset/ring/tactile/41.png
inflating: mini_depth_dataset/big_decagon/depth/135.png
inflating: mini_depth_dataset/long_cylinder/tactile/35.png
inflating: mini_depth_dataset/ring/depth/96.png
inflating: mini_depth_dataset/long_cylinder/tactile/34.png
inflating: mini_depth_dataset/long_cylinder/tactile/38.png
inflating: mini_depth_dataset/long_cylinder/tactile/30.png
inflating: mini_depth_dataset/long_cylinder/tactile/31.png
inflating: mini_depth_dataset/long_cylinder/tactile/32.png
inflating: mini_depth_dataset/ring/tactile/34.png
inflating: mini_depth_dataset/ring/depth/92.png
inflating: mini_depth_dataset/long_cylinder/tactile/37.png
inflating: mini_depth_dataset/big_decagon/depth/126.png
inflating: mini_depth_dataset/big_decagon/depth/138.png
inflating: mini_depth_dataset/ring/tactile/36.png
inflating: mini_depth_dataset/ring/depth/88.png
inflating: mini_depth_dataset/ring/tactile/38.png
inflating: mini_depth_dataset/ring/tactile/32.png
inflating: mini_depth_dataset/ring/depth/91.png
inflating: mini_depth_dataset/long_cylinder/tactile/28.png
inflating: mini_depth_dataset/big_decagon/depth/128.png
inflating: mini_depth_dataset/big_decagon/depth/130.png
inflating: mini_depth_dataset/big_decagon/depth/129.png
inflating: mini_depth_dataset/ring/depth/89.png
inflating: mini_depth_dataset/long_cylinder/tactile/33.png
inflating: mini_depth_dataset/ring/tactile/31.png
inflating: mini_depth_dataset/ring/tactile/37.png
inflating: mini_depth_dataset/long_cylinder/tactile/29.png
inflating: mini_depth_dataset/ring/tactile/33.png
inflating: mini_depth_dataset/big_decagon/depth/125.png
inflating: mini_depth_dataset/ring/tactile/35.png
inflating: mini_depth_dataset/ring/depth/90.png
inflating: mini_depth_dataset/ring/tactile/44.png
inflating: mini_depth_dataset/big_decagon/tactile/90.png
inflating: mini_depth_dataset/ring/depth/86.png
inflating: mini_depth_dataset/long_cylinder/tactile/25.png
inflating: mini_depth_dataset/long_cylinder/tactile/24.png
inflating: mini_depth_dataset/long_cylinder/tactile/26.png
```

```
inflating: mini_depth_dataset/ring/depth/94.png
inflating: mini_depth_dataset/big_decagon/depth/127.png
inflating: mini_depth_dataset/big_decagon/depth/120.png
inflating: mini_depth_dataset/ring/depth/81.png
inflating: mini_depth_dataset/ring/depth/85.png
inflating: mini_depth_dataset/ring/depth/84.png
inflating: mini_depth_dataset/long_cylinder/tactile/22.png
inflating: mini_depth_dataset/ring/tactile/28.png
inflating: mini_depth_dataset/big_decagon/depth/122.png
inflating: mini_depth_dataset/long_cylinder/tactile/21.png
inflating: mini_depth_dataset/ring/tactile/27.png
inflating: mini_depth_dataset/big_decagon/tactile/76.png
inflating: mini_depth_dataset/ring/tactile/24.png
inflating: mini_depth_dataset/long_cylinder/tactile/23.png
inflating: mini_depth_dataset/big_decagon/depth/121.png
inflating: mini_depth_dataset/big_decagon/depth/124.png
inflating: mini_depth_dataset/big_decagon/depth/118.png
inflating: mini_depth_dataset/ring/depth/87.png
inflating: mini_depth_dataset/long_cylinder/tactile/20.png
inflating: mini_depth_dataset/long_cylinder/tactile/19.png
inflating: mini_depth_dataset/big_decagon/depth/117.png
inflating: mini_depth_dataset/ring/tactile/23.png
inflating: mini_depth_dataset/big_decagon/depth/119.png
inflating: mini_depth_dataset/long_cylinder/tactile/17.png
inflating: mini_depth_dataset/ring/tactile/22.png
inflating: mini_depth_dataset/long_cylinder/tactile/18.png
inflating: mini_depth_dataset/big_decagon/depth/123.png
inflating: mini_depth_dataset/ring/depth/80.png
inflating: mini_depth_dataset/long_cylinder/tactile/27.png
inflating: mini_depth_dataset/ring/tactile/26.png
inflating: mini_depth_dataset/long_cylinder/tactile/16.png
inflating: mini_depth_dataset/ring/depth/78.png
inflating: mini_depth_dataset/ring/depth/77.png
inflating: mini_depth_dataset/ring/tactile/21.png
inflating: mini_depth_dataset/ring/depth/74.png
inflating: mini_depth_dataset/ring/tactile/20.png
inflating: mini_depth_dataset/ring/tactile/29.png
inflating: mini_depth_dataset/ring/depth/83.png
inflating: mini_depth_dataset/big_decagon/depth/116.png
inflating: mini_depth_dataset/big_decagon/depth/113.png
inflating: mini_depth_dataset/ring/tactile/18.png
inflating: mini_depth_dataset/long_cylinder/tactile/15.png
inflating: mini_depth_dataset/ring/tactile/17.png
inflating: mini_depth_dataset/ring/tactile/15.png
inflating: mini_depth_dataset/ring/depth/75.png
inflating: mini_depth_dataset/ring/depth/76.png
inflating: mini_depth_dataset/long_cylinder/tactile/13.png
inflating: mini_depth_dataset/ring/depth/70.png
inflating: mini_depth_dataset/ring/depth/73.png
inflating: mini_depth_dataset/long_cylinder/tactile/12.png
inflating: mini_depth_dataset/ring/tactile/16.png
inflating: mini_depth_dataset/big_decagon/depth/111.png
inflating: mini_depth_dataset/big_decagon/depth/115.png
inflating: mini_depth_dataset/ring/tactile/14.png
inflating: mini_depth_dataset/big_decagon/depth/112.png
inflating: mini_depth_dataset/ring/depth/69.png
inflating: mini_depth_dataset/big_decagon/depth/108.png
inflating: mini_depth_dataset/long_cylinder/tactile/10.png
inflating: mini_depth_dataset/big_decagon/depth/109.png
inflating: mini_depth_dataset/ring/tactile/10.png
```

```
inflating: mini_depth_dataset/long_cylinder/tactile/9.png
inflating: mini_depth_dataset/long_cylinder/tactile/7.png
inflating: mini_depth_dataset/ring/depth/72.png
inflating: mini_depth_dataset/ring/depth/67.png
inflating: mini_depth_dataset/ring/tactile/13.png
inflating: mini_depth_dataset/ring/depth/66.png
inflating: mini_depth_dataset/long_cylinder/tactile/6.png
inflating: mini_depth_dataset/ring/tactile/11.png
inflating: mini_depth_dataset/big_decagon/depth/110.png
inflating: mini_depth_dataset/big_decagon/depth/106.png
inflating: mini_depth_dataset/long_cylinder/tactile/8.png
inflating: mini_depth_dataset/ring/depth/64.png
inflating: mini_depth_dataset/big_decagon/depth/107.png
inflating: mini_depth_dataset/ring/tactile/12.png
inflating: mini_depth_dataset/big_decagon/depth/114.png
inflating: mini_depth_dataset/ring/depth/63.png
inflating: mini_depth_dataset/ring/tactile/8.png
inflating: mini_depth_dataset/ring/depth/62.png
inflating: mini_depth_dataset/ring/depth/65.png
inflating: mini_depth_dataset/ring/depth/61.png
inflating: mini_depth_dataset/ring/tactile/6.png
inflating: mini_depth_dataset/big_decagon/depth/105.png
inflating: mini_depth_dataset/ring/depth/60.png
inflating: mini_depth_dataset/big_decagon/depth/101.png
inflating: mini_depth_dataset/ring/depth/71.png
inflating: mini_depth_dataset/big_decagon/depth/98.png
inflating: mini_depth_dataset/ring/tactile/9.png
inflating: mini_depth_dataset/big_decagon/depth/99.png
inflating: mini_depth_dataset/big_decagon/depth/102.png
inflating: mini_depth_dataset/big_decagon/depth/100.png
inflating: mini_depth_dataset/long_cylinder/tactile/4.png
inflating: mini_depth_dataset/ring/depth/59.png
inflating: mini_depth_dataset/big_decagon/depth/104.png
inflating: mini_depth_dataset/big_decagon/depth/96.png
inflating: mini_depth_dataset/ring/depth/56.png
inflating: mini_depth_dataset/big_decagon/depth/103.png
inflating: mini_depth_dataset/hafez/tactile/129.png
inflating: mini_depth_dataset/hafez/tactile/128.png
inflating: mini_depth_dataset/hafez/tactile/130.png
inflating: mini_depth_dataset/med_decagon/tactile/123.png
inflating: mini_depth_dataset/med_decagon/tactile/122.png
inflating: mini_depth_dataset/ring/depth/58.png
inflating: mini_depth_dataset/big_decagon/depth/94.png
inflating: mini_depth_dataset/ring/depth/55.png
inflating: mini_depth_dataset/ring/tactile/7.png
inflating: mini_depth_dataset/ring/depth/68.png
inflating: mini_depth_dataset/ring/depth/82.png
inflating: mini_depth_dataset/ring/tactile/30.png
inflating: mini_depth_dataset/ring/tactile/25.png
inflating: mini_depth_dataset/ring/tactile/19.png
inflating: mini_depth_dataset/long_cylinder/tactile/14.png
inflating: mini_depth_dataset/ring/depth/79.png
inflating: mini_depth_dataset/long_cylinder/tactile/11.png
inflating: mini_depth_dataset/long_cylinder/tactile/5.png
inflating: mini_depth_dataset/med_decagon/tactile/121.png
inflating: mini_depth_dataset/ring/depth/53.png
inflating: mini_depth_dataset/med_decagon/tactile/124.png
inflating: mini_depth_dataset/hafez/tactile/126.png
inflating: mini_depth_dataset/ring/tactile/5.png
inflating: mini_depth_dataset/ring/depth/54.png
```

```
inflating: mini_depth_dataset/big_decagon/depth/97.png
inflating: mini_depth_dataset/med_decagon/depth/124.png
inflating: mini_depth_dataset/hafez/tactile/124.png
inflating: mini_depth_dataset/big_decagon/depth/95.png
inflating: mini_depth_dataset/big_decagon/depth/92.png
inflating: mini_depth_dataset/ring/tactile/3.png
inflating: mini_depth_dataset/long_cylinder/tactile/3.png
inflating: mini_depth_dataset/hafez/tactile/125.png
inflating: mini_depth_dataset/ring/depth/51.png
inflating: mini_depth_dataset/hafez/tactile/127.png
inflating: mini_depth_dataset/big_decagon/depth/87.png
inflating: mini_depth_dataset/med_decagon/depth/120.png
inflating: mini_depth_dataset/ring/depth/52.png
inflating: mini_depth_dataset/med_decagon/tactile/116.png
inflating: mini_depth_dataset/med_decagon/depth/122.png
inflating: mini_depth_dataset/big_decagon/depth/86.png
inflating: mini_depth_dataset/big_decagon/depth/88.png
inflating: mini_depth_dataset/med_decagon/tactile/119.png
inflating: mini_depth_dataset/med_decagon/tactile/118.png
inflating: mini_depth_dataset/big_decagon/depth/91.png
inflating: mini_depth_dataset/med_decagon/depth/119.png
inflating: mini_depth_dataset/med_decagon/tactile/114.png
inflating: mini_depth_dataset/big_decagon/depth/85.png
inflating: mini_depth_dataset/big_decagon/depth/90.png
inflating: mini_depth_dataset/hafez/tactile/123.png
inflating: mini_depth_dataset/med_decagon/tactile/120.png
inflating: mini_depth_dataset/big_decagon/depth/89.png
inflating: mini_depth_dataset/med_decagon/depth/121.png
inflating: mini_depth_dataset/med_decagon/depth/116.png
inflating: mini_depth_dataset/big_decagon/depth/83.png
inflating: mini_depth_dataset/ring/depth/49.png
inflating: mini_depth_dataset/med_decagon/depth/117.png
inflating: mini_depth_dataset/big_decagon/depth/84.png
inflating: mini_depth_dataset/hafez/tactile/118.png
inflating: mini_depth_dataset/ring/depth/50.png
inflating: mini_depth_dataset/med_decagon/tactile/117.png
inflating: mini_depth_dataset/hafez/tactile/121.png
inflating: mini_depth_dataset/ring/depth/48.png
inflating: mini_depth_dataset/med_decagon/depth/118.png
inflating: mini_depth_dataset/med_decagon/tactile/115.png
inflating: mini_depth_dataset/big_decagon/depth/82.png
inflating: mini_depth_dataset/hafez/tactile/122.png
inflating: mini_depth_dataset/hafez/tactile/117.png
inflating: mini_depth_dataset/med_decagon/depth/115.png
inflating: mini_depth_dataset/hafez/tactile/119.png
inflating: mini_depth_dataset/med_decagon/tactile/109.png
inflating: mini_depth_dataset/big_decagon/depth/81.png
inflating: mini_depth_dataset/med_decagon/tactile/111.png
inflating: mini_depth_dataset/med_decagon/tactile/110.png
inflating: mini_depth_dataset/hafez/tactile/120.png
inflating: mini_depth_dataset/ring/depth/47.png
inflating: mini_depth_dataset/med_decagon/depth/112.png
inflating: mini_depth_dataset/big_decagon/depth/80.png
inflating: mini_depth_dataset/med_decagon/depth/113.png
inflating: mini_depth_dataset/med_decagon/tactile/113.png
inflating: mini_depth_dataset/med_decagon/depth/114.png
inflating: mini_depth_dataset/ring/depth/44.png
inflating: mini_depth_dataset/med_decagon/depth/111.png
inflating: mini_depth_dataset/med_decagon/tactile/107.png
inflating: mini_depth_dataset/big_decagon/depth/78.png
```

```
inflating: mini_depth_dataset/hafez/tactile/114.png
inflating: mini_depth_dataset/big_decagon/depth/79.png
inflating: mini_depth_dataset/med_decagon/tactile/112.png
inflating: mini_depth_dataset/med_decagon/tactile/108.png
inflating: mini_depth_dataset/med_decagon/tactile/106.png
inflating: mini_depth_dataset/ring/depth/45.png
inflating: mini_depth_dataset/hafez/tactile/112.png
inflating: mini_depth_dataset/hafez/depth/130.png
inflating: mini_depth_dataset/big_decagon/depth/76.png
inflating: mini_depth_dataset/med_decagon/depth/109.png
inflating: mini_depth_dataset/ring/depth/41.png
inflating: mini_depth_dataset/big_decagon/depth/77.png
inflating: mini_depth_dataset/hafez/tactile/115.png
inflating: mini_depth_dataset/ring/depth/46.png
inflating: mini_depth_dataset/med_decagon/depth/110.png
inflating: mini_depth_dataset/med_decagon/depth/108.png
inflating: mini_depth_dataset/med_decagon/tactile/103.png
inflating: mini_depth_dataset/med_decagon/tactile/102.png
inflating: mini_depth_dataset/ring/depth/38.png
inflating: mini_depth_dataset/hafez/depth/128.png
inflating: mini_depth_dataset/med_decagon/depth/105.png
inflating: mini_depth_dataset/ring/depth/42.png
inflating: mini_depth_dataset/big_decagon/depth/73.png
inflating: mini_depth_dataset/hafez/depth/129.png
inflating: mini_depth_dataset/med_decagon/tactile/104.png
inflating: mini_depth_dataset/hafez/tactile/113.png
inflating: mini_depth_dataset/med_decagon/depth/106.png
inflating: mini_depth_dataset/big_decagon/depth/72.png
inflating: mini_depth_dataset/big_decagon/depth/74.png
inflating: mini_depth_dataset/ring/depth/39.png
inflating: mini_depth_dataset/ring/depth/40.png
inflating: mini_depth_dataset/hafez/depth/126.png
inflating: mini_depth_dataset/big_decagon/depth/71.png
inflating: mini_depth_dataset/big_decagon/depth/75.png
inflating: mini_depth_dataset/med_decagon/tactile/101.png
inflating: mini_depth_dataset/med_decagon/tactile/105.png
inflating: mini_depth_dataset/hafez/tactile/116.png
inflating: mini_depth_dataset/med_decagon/depth/123.png
inflating: mini_depth_dataset/ring/depth/36.png
inflating: mini_depth_dataset/hafez/depth/125.png
inflating: mini_depth_dataset/ring/depth/37.png
inflating: mini_depth_dataset/hafez/depth/124.png
inflating: mini_depth_dataset/med_decagon/depth/101.png
inflating: mini_depth_dataset/hafez/depth/127.png
inflating: mini_depth_dataset/hafez/depth/121.png
inflating: mini_depth_dataset/med_decagon/tactile/100.png
inflating: mini_depth_dataset/big_decagon/depth/69.png
inflating: mini_depth_dataset/big_decagon/depth/66.png
inflating: mini_depth_dataset/big_decagon/depth/93.png
inflating: mini_depth_dataset/ring/depth/33.png
inflating: mini_depth_dataset/med_decagon/depth/102.png
inflating: mini_depth_dataset/hafez/depth/120.png
inflating: mini_depth_dataset/med_decagon/depth/99.png
inflating: mini_depth_dataset/big_decagon/depth/70.png
inflating: mini_depth_dataset/ring/depth/43.png
inflating: mini_depth_dataset/med_decagon/depth/96.png
inflating: mini_depth_dataset/big_decagon/depth/65.png
inflating: mini_depth_dataset/med_decagon/depth/97.png
inflating: mini_depth_dataset/med_decagon/depth/95.png
inflating: mini_depth_dataset/med_decagon/tactile/98.png
```

```
inflating: mini_depth_dataset/med_decagon/depth/103.png
inflating: mini_depth_dataset/hafez/depth/122.png
inflating: mini_depth_dataset/hafez/depth/119.png
inflating: mini_depth_dataset/ring/depth/34.png
inflating: mini_depth_dataset/med_decagon/depth/100.png
inflating: mini_depth_dataset/med_decagon/depth/98.png
inflating: mini_depth_dataset/med_decagon/tactile/96.png
inflating: mini_depth_dataset/med_decagon/tactile/95.png
inflating: mini_depth_dataset/med_decagon/tactile/99.png
inflating: mini_depth_dataset/ring/depth/31.png
inflating: mini_depth_dataset/big_decagon/depth/63.png
inflating: mini_depth_dataset/big_decagon/depth/62.png
inflating: mini_depth_dataset/med_decagon/tactile/92.png
inflating: mini_depth_dataset/med_decagon/tactile/94.png
inflating: mini_depth_dataset/med_decagon/depth/92.png
inflating: mini_depth_dataset/med_decagon/tactile/97.png
inflating: mini_depth_dataset/ring/depth/30.png
inflating: mini_depth_dataset/hafez/depth/117.png
inflating: mini_depth_dataset/big_decagon/depth/59.png
inflating: mini_depth_dataset/med_decagon/depth/107.png
inflating: mini_depth_dataset/med_decagon/tactile/93.png
inflating: mini_depth_dataset/med_decagon/depth/93.png
inflating: mini_depth_dataset/hafez/depth/114.png
inflating: mini_depth_dataset/ring/depth/93.png
inflating: mini_depth_dataset/med_decagon/depth/91.png
inflating: mini_depth_dataset/hafez/depth/115.png
inflating: mini_depth_dataset/big_decagon/depth/61.png
inflating: mini_depth_dataset/ring/depth/35.png
inflating: mini_depth_dataset/med_decagon/depth/89.png
inflating: mini_depth_dataset/med_decagon/depth/90.png
inflating: mini_depth_dataset/hafez/depth/118.png
inflating: mini_depth_dataset/med_decagon/tactile/89.png
inflating: mini_depth_dataset/big_decagon/depth/60.png
inflating: mini_depth_dataset/big_decagon/depth/58.png
inflating: mini_depth_dataset/hafez/depth/112.png
inflating: mini_depth_dataset/big_decagon/depth/64.png
inflating: mini_depth_dataset/ring/depth/29.png
inflating: mini_depth_dataset/ring/depth/28.png
inflating: mini_depth_dataset/hafez/depth/113.png
inflating: mini_depth_dataset/med_decagon/tactile/88.png
inflating: mini_depth_dataset/med_decagon/depth/88.png
inflating: mini_depth_dataset/med_decagon/tactile/91.png
inflating: mini_depth_dataset/big_decagon/depth/56.png
inflating: mini_depth_dataset/big_decagon/depth/57.png
inflating: mini_depth_dataset/big_decagon/depth/55.png
inflating: mini_depth_dataset/med_decagon/depth/85.png
inflating: mini_depth_dataset/ring/depth/26.png
inflating: mini_depth_dataset/ring/tactile/4.png
inflating: mini_depth_dataset/hafez/tactile/111.png
inflating: mini_depth_dataset/med_decagon/tactile/86.png
inflating: mini_depth_dataset/med_decagon/tactile/84.png
inflating: mini_depth_dataset/hafez/depth/107.png
inflating: mini_depth_dataset/med_decagon/tactile/85.png
inflating: mini_depth_dataset/med_decagon/depth/94.png
inflating: mini_depth_dataset/med_decagon/depth/87.png
inflating: mini_depth_dataset/med_decagon/tactile/87.png
inflating: mini_depth_dataset/med_decagon/tactile/90.png
inflating: mini_depth_dataset/hafez/depth/110.png
inflating: mini_depth_dataset/ring/depth/27.png
inflating: mini_depth_dataset/big_decagon/depth/54.png
```

```
inflating: mini_depth_dataset/hafez/depth/111.png
inflating: mini_depth_dataset/hafez/tactile/106.png
inflating: mini_depth_dataset/big_decagon/depth/67.png
inflating: mini_depth_dataset/ring/depth/25.png
inflating: mini_depth_dataset/med_decagon/depth/104.png
inflating: mini_depth_dataset/big_decagon/depth/52.png
inflating: mini_depth_dataset/ring/depth/24.png
inflating: mini_depth_dataset/big_decagon/depth/53.png
inflating: mini_depth_dataset/med_decagon/depth/84.png
inflating: mini_depth_dataset/hafez/tactile/105.png
inflating: mini_depth_dataset/ring/depth/23.png
inflating: mini_depth_dataset/med_decagon/tactile/82.png
inflating: mini_depth_dataset/hafez/tactile/104.png
inflating: mini_depth_dataset/med_decagon/depth/82.png
inflating: mini_depth_dataset/med_decagon/depth/83.png
inflating: mini_depth_dataset/hafez/depth/105.png
inflating: mini_depth_dataset/hafez/depth/106.png
inflating: mini_depth_dataset/big_decagon/depth/51.png
inflating: mini_depth_dataset/hafez/depth/103.png
inflating: mini_depth_dataset/hafez/depth/116.png
inflating: mini_depth_dataset/med_decagon/depth/79.png
inflating: mini_depth_dataset/med_decagon/tactile/80.png
inflating: mini_depth_dataset/med_decagon/depth/78.png
inflating: mini_depth_dataset/med_decagon/tactile/78.png
inflating: mini_depth_dataset/hafez/depth/100.png
inflating: mini_depth_dataset/hafez/depth/99.png
inflating: mini_depth_dataset/med_decagon/tactile/81.png
inflating: mini_depth_dataset/med_decagon/tactile/83.png
inflating: mini_depth_dataset/hafez/tactile/103.png
inflating: mini_depth_dataset/med_decagon/depth/77.png
inflating: mini_depth_dataset/big_decagon/depth/49.png
inflating: mini_depth_dataset/hafez/depth/98.png
inflating: mini_depth_dataset/hafez/tactile/102.png
inflating: mini_depth_dataset/ring/depth/22.png
inflating: mini_depth_dataset/hafez/tactile/101.png
inflating: mini_depth_dataset/big_decagon/depth/50.png
inflating: mini_depth_dataset/big_decagon/depth/45.png
inflating: mini_depth_dataset/ring/depth/21.png
inflating: mini_depth_dataset/med_decagon/depth/76.png
inflating: mini_depth_dataset/hafez/depth/102.png
inflating: mini_depth_dataset/med_decagon/tactile/79.png
inflating: mini_depth_dataset/hafez/tactile/100.png
inflating: mini_depth_dataset/hafez/depth/104.png
inflating: mini_depth_dataset/med_decagon/tactile/77.png
inflating: mini_depth_dataset/hafez/tactile/110.png
inflating: mini_depth_dataset/big_decagon/depth/47.png
inflating: mini_depth_dataset/med_decagon/tactile/75.png
inflating: mini_depth_dataset/big_decagon/depth/48.png
inflating: mini_depth_dataset/big_decagon/depth/44.png
inflating: mini_depth_dataset/hafez/depth/101.png
inflating: mini_depth_dataset/hafez/depth/97.png
inflating: mini_depth_dataset/med_decagon/depth/74.png
inflating: mini_depth_dataset/ring/depth/18.png
inflating: mini_depth_dataset/big_decagon/depth/42.png
inflating: mini_depth_dataset/ring/depth/19.png
inflating: mini_depth_dataset/big_decagon/depth/41.png
inflating: mini_depth_dataset/med_decagon/tactile/74.png
inflating: mini_depth_dataset/med_decagon/depth/75.png
inflating: mini_depth_dataset/hafez/depth/94.png
inflating: mini_depth_dataset/hafez/depth/96.png
```

```
inflating: mini_depth_dataset/big_decagon/depth/40.png
inflating: mini_depth_dataset/med_decagon/tactile/72.png
inflating: mini_depth_dataset/hafez/tactile/96.png
inflating: mini_depth_dataset/med_decagon/depth/73.png
inflating: mini_depth_dataset/big_decagon/depth/39.png
inflating: mini_depth_dataset/ring/depth/15.png
inflating: mini_depth_dataset/med_decagon/depth/80.png
inflating: mini_depth_dataset/hafez/tactile/99.png
inflating: mini_depth_dataset/hafez/tactile/94.png
inflating: mini_depth_dataset/big_decagon/depth/38.png
inflating: mini_depth_dataset/med_decagon/depth/71.png
inflating: mini_depth_dataset/ring/depth/20.png
inflating: mini_depth_dataset/hafez/tactile/98.png
inflating: mini_depth_dataset/big_decagon/depth/68.png
inflating: mini_depth_dataset/hafez/tactile/95.png
inflating: mini_depth_dataset/ring/depth/13.png
inflating: mini_depth_dataset/hafez/depth/95.png
inflating: mini_depth_dataset/big_decagon/depth/46.png
inflating: mini_depth_dataset/med_decagon/tactile/70.png
inflating: mini_depth_dataset/med_decagon/tactile/71.png
inflating: mini_depth_dataset/big_decagon/depth/43.png
inflating: mini_depth_dataset/med_decagon/depth/70.png
inflating: mini_depth_dataset/big_decagon/depth/37.png
inflating: mini_depth_dataset/hafez/tactile/92.png
inflating: mini_depth_dataset/hafez/depth/90.png
inflating: mini_depth_dataset/ring/depth/16.png
inflating: mini_depth_dataset/big_decagon/depth/36.png
inflating: mini_depth_dataset/hafez/depth/93.png
inflating: mini_depth_dataset/ring/depth/12.png
inflating: mini_depth_dataset/hafez/tactile/91.png
inflating: mini_depth_dataset/med_decagon/tactile/68.png
inflating: mini_depth_dataset/hafez/tactile/93.png
inflating: mini_depth_dataset/med_decagon/tactile/73.png
inflating: mini_depth_dataset/med_decagon/tactile/69.png
inflating: mini_depth_dataset/med_decagon/depth/86.png
inflating: mini_depth_dataset/big_decagon/depth/33.png
inflating: mini_depth_dataset/ring/depth/17.png
inflating: mini_depth_dataset/ring/depth/14.png
inflating: mini_depth_dataset/big_decagon/depth/34.png
inflating: mini_depth_dataset/med_decagon/depth/68.png
inflating: mini_depth_dataset/med_decagon/depth/72.png
inflating: mini_depth_dataset/big_decagon/depth/35.png
inflating: mini_depth_dataset/ring/depth/57.png
inflating: mini_depth_dataset/med_decagon/depth/69.png
inflating: mini_depth_dataset/med_decagon/tactile/65.png
inflating: mini_depth_dataset/med_decagon/tactile/66.png
inflating: mini_depth_dataset/ring/depth/9.png
inflating: mini_depth_dataset/hafez/depth/87.png
inflating: mini_depth_dataset/hafez/tactile/88.png
inflating: mini_depth_dataset/ring/depth/10.png
inflating: mini_depth_dataset/ring/depth/11.png
inflating: mini_depth_dataset/hafez/tactile/90.png
inflating: mini_depth_dataset/med_decagon/tactile/67.png
inflating: mini_depth_dataset/med_decagon/depth/81.png
inflating: mini_depth_dataset/hafez/tactile/97.png
inflating: mini_depth_dataset/hafez/depth/89.png
inflating: mini_depth_dataset/med_decagon/depth/66.png
inflating: mini_depth_dataset/hafez/depth/88.png
inflating: mini_depth_dataset/med_decagon/depth/65.png
inflating: mini_depth_dataset/hafez/depth/86.png
```

```
inflating: mini_depth_dataset/big_decagon/depth/31.png
inflating: mini_depth_dataset/hafez/depth/91.png
inflating: mini_depth_dataset/med_decagon/depth/67.png
inflating: mini_depth_dataset/med_decagon/tactile/64.png
inflating: mini_depth_dataset/hafez/tactile/87.png
inflating: mini_depth_dataset/big_decagon/depth/30.png
inflating: mini_depth_dataset/hafez/tactile/86.png
inflating: mini_depth_dataset/med_decagon/depth/64.png
inflating: mini_depth_dataset/ring/depth/7.png
inflating: mini_depth_dataset/med_decagon/depth/63.png
inflating: mini_depth_dataset/med_decagon/tactile/60.png
inflating: mini_depth_dataset/med_decagon/tactile/61.png
inflating: mini_depth_dataset/big_decagon/depth/28.png
inflating: mini_depth_dataset/hafez/depth/83.png
inflating: mini_depth_dataset/hafez/depth/84.png
inflating: mini_depth_dataset/med_decagon/depth/62.png
inflating: mini_depth_dataset/big_decagon/depth/32.png
inflating: mini_depth_dataset/ring/depth/6.png
inflating: mini_depth_dataset/ring/depth/8.png
inflating: mini_depth_dataset/ring/depth/5.png
inflating: mini_depth_dataset/hafez/tactile/89.png
inflating: mini_depth_dataset/big_decagon/depth/29.png
inflating: mini_depth_dataset/big_decagon/depth/27.png
inflating: mini_depth_dataset/hafez/tactile/84.png
inflating: mini_depth_dataset/hafez/depth/82.png
inflating: mini_depth_dataset/med_decagon/depth/60.png
inflating: mini_depth_dataset/hafez/depth/81.png
inflating: mini_depth_dataset/med_decagon/tactile/62.png
inflating: mini_depth_dataset/big_decagon/depth/26.png
inflating: mini_depth_dataset/ring/depth/4.png
inflating: mini_depth_dataset/med_decagon/tactile/57.png
inflating: mini_depth_dataset/hafez/tactile/82.png
inflating: mini_depth_dataset/big_decagon/depth/25.png
inflating: mini_depth_dataset/big_decagon/depth/24.png
inflating: mini_depth_dataset/med_decagon/depth/59.png
inflating: mini_depth_dataset/hafez/tactile/81.png
inflating: mini_depth_dataset/med_decagon/depth/58.png
inflating: mini_depth_dataset/hafez/depth/85.png
inflating: mini_depth_dataset/hafez/tactile/85.png
inflating: mini_depth_dataset/hafez/tactile/80.png
inflating: mini_depth_dataset/big_decagon/depth/23.png
inflating: mini_depth_dataset/hafez/depth/77.png
inflating: mini_depth_dataset/med_decagon/tactile/58.png
inflating: mini_depth_dataset/med_decagon/tactile/55.png
inflating: mini_depth_dataset/ring/depth/3.png
inflating: mini_depth_dataset/med_decagon/tactile/56.png
inflating: mini_depth_dataset/med_decagon/tactile/63.png
inflating: mini_depth_dataset/hafez/tactile/79.png
inflating: mini_depth_dataset/med_decagon/tactile/59.png
inflating: mini_depth_dataset/hafez/tactile/78.png
inflating: mini_depth_dataset/hafez/depth/92.png
inflating: mini_depth_dataset/big_decagon/depth/19.png
inflating: mini_depth_dataset/hafez/tactile/77.png
inflating: mini_depth_dataset/big_decagon/depth/21.png
inflating: mini_depth_dataset/big_decagon/depth/18.png
inflating: mini_depth_dataset/med_decagon/tactile/52.png
inflating: mini_depth_dataset/med_decagon/tactile/51.png
inflating: mini_depth_dataset/med_decagon/tactile/54.png
inflating: mini_depth_dataset/hafez/depth/75.png
inflating: mini_depth_dataset/big_decagon/depth/16.png
```

```
inflating: mini_depth_dataset/big_decagon/depth/20.png
inflating: mini_depth_dataset/hafez/depth/76.png
inflating: mini_depth_dataset/big_decagon/depth/22.png
inflating: mini_depth_dataset/hafez/tactile/76.png
inflating: mini_depth_dataset/hafez/tactile/83.png
inflating: mini_depth_dataset/med_decagon/tactile/49.png
inflating: mini_depth_dataset/med_decagon/tactile/50.png
inflating: mini_depth_dataset/med_decagon/depth/54.png
inflating: mini_depth_dataset/med_decagon/tactile/53.png
inflating: mini_depth_dataset/big_decagon/depth/14.png
inflating: mini_depth_dataset/hafez/depth/74.png
inflating: mini_depth_dataset/hafez/depth/78.png
inflating: mini_depth_dataset/hafez/depth/72.png
inflating: mini_depth_dataset/hafez/depth/79.png
inflating: mini_depth_dataset/med_decagon/depth/56.png
inflating: mini_depth_dataset/hafez/depth/71.png
inflating: mini_depth_dataset/med_decagon/depth/57.png
inflating: mini_depth_dataset/med_decagon/depth/51.png
inflating: mini_depth_dataset/hafez/depth/70.png
inflating: mini_depth_dataset/big_decagon/depth/15.png
inflating: mini_depth_dataset/hafez/tactile/75.png
inflating: mini_depth_dataset/big_decagon/depth/12.png
inflating: mini_depth_dataset/hafez/tactile/73.png
inflating: mini_depth_dataset/hafez/depth/80.png
inflating: mini_depth_dataset/big_decagon/depth/17.png
inflating: mini_depth_dataset/med_decagon/tactile/47.png
inflating: mini_depth_dataset/med_decagon/depth/55.png
inflating: mini_depth_dataset/med_decagon/depth/52.png
inflating: mini_depth_dataset/hafez/depth/73.png
inflating: mini_depth_dataset/med_decagon/depth/53.png
inflating: mini_depth_dataset/hafez/depth/69.png
inflating: mini_depth_dataset/med_decagon/tactile/46.png
inflating: mini_depth_dataset/med_decagon/depth/50.png
inflating: mini_depth_dataset/hafez/depth/67.png
inflating: mini_depth_dataset/hafez/depth/68.png
inflating: mini_depth_dataset/med_decagon/tactile/45.png
inflating: mini_depth_dataset/big_decagon/depth/10.png
inflating: mini_depth_dataset/med_decagon/depth/49.png
inflating: mini_depth_dataset/med_decagon/tactile/42.png
inflating: mini_depth_dataset/med_decagon/depth/48.png
inflating: mini_depth_dataset/big_decagon/depth/7.png
inflating: mini_depth_dataset/hafez/tactile/72.png
inflating: mini_depth_dataset/big_decagon/depth/11.png
inflating: mini_depth_dataset/med_decagon/tactile/43.png
inflating: mini_depth_dataset/big_decagon/depth/9.png
inflating: mini_depth_dataset/hafez/depth/66.png
inflating: mini_depth_dataset/hafez/tactile/68.png
inflating: mini_depth_dataset/hafez/tactile/69.png
inflating: mini_depth_dataset/med_decagon/depth/45.png
inflating: mini_depth_dataset/med_decagon/depth/47.png
inflating: mini_depth_dataset/med_decagon/tactile/48.png
inflating: mini_depth_dataset/med_decagon/depth/61.png
inflating: mini_depth_dataset/med_decagon/tactile/38.png
inflating: mini_depth_dataset/hafez/depth/65.png
inflating: mini_depth_dataset/med_decagon/tactile/39.png
inflating: mini_depth_dataset/med_decagon/tactile/41.png
inflating: mini_depth_dataset/hafez/depth/62.png
inflating: mini_depth_dataset/med_decagon/tactile/44.png
inflating: mini_depth_dataset/hafez/tactile/66.png
inflating: mini_depth_dataset/hafez/tactile/65.png
```

```
inflating: mini_depth_dataset/hafez/tactile/67.png
inflating: mini_depth_dataset/med_decagon/depth/46.png
inflating: mini_depth_dataset/hafez/tactile/71.png
inflating: mini_depth_dataset/big_decagon/depth/8.png
inflating: mini_depth_dataset/hafez/tactile/74.png
inflating: mini_depth_dataset/big_decagon/depth/13.png
inflating: mini_depth_dataset/hafez/depth/63.png
inflating: mini_depth_dataset/med_decagon/tactile/40.png
inflating: mini_depth_dataset/med_decagon/depth/43.png
inflating: mini_depth_dataset/med_decagon/depth/44.png
inflating: mini_depth_dataset/big_decagon/depth/4.png
inflating: mini_depth_dataset/big_decagon/depth/6.png
inflating: mini_depth_dataset/med_decagon/tactile/37.png
inflating: mini_depth_dataset/hafez/tactile/63.png
inflating: mini_depth_dataset/big_decagon/depth/5.png
inflating: mini_depth_dataset/med_decagon/tactile/36.png
inflating: mini_depth_dataset/hafez/depth/60.png
inflating: mini_depth_dataset/hafez/depth/64.png
inflating: mini_depth_dataset/med_decagon/depth/41.png
inflating: mini_depth_dataset/med_decagon/depth/42.png
inflating: mini_depth_dataset/med_decagon/depth/40.png
inflating: mini_depth_dataset/hafez/depth/58.png
inflating: mini_depth_dataset/hafez/tactile/60.png
inflating: mini_depth_dataset/hafez/depth/57.png
inflating: mini_depth_dataset/med_decagon/tactile/32.png
inflating: mini_depth_dataset/hafez/depth/123.png
inflating: mini_depth_dataset/hafez/depth/61.png
inflating: mini_depth_dataset/med_decagon/tactile/34.png
inflating: mini_depth_dataset/hafez/tactile/62.png
inflating: mini_depth_dataset/hafez/tactile/58.png
inflating: mini_depth_dataset/hafez/tactile/64.png
inflating: mini_depth_dataset/med_decagon/tactile/29.png
inflating: mini_depth_dataset/med_decagon/depth/38.png
inflating: mini_depth_dataset/hafez/depth/55.png
inflating: mini_depth_dataset/hafez/tactile/70.png
inflating: mini_depth_dataset/hafez/depth/56.png
inflating: mini_depth_dataset/hafez/tactile/61.png
inflating: mini_depth_dataset/med_decagon/depth/37.png
inflating: mini_depth_dataset/hafez/depth/53.png
inflating: mini_depth_dataset/med_decagon/tactile/28.png
inflating: mini_depth_dataset/hafez/tactile/54.png
inflating: mini_depth_dataset/hafez/tactile/55.png
inflating: mini_depth_dataset/med_decagon/tactile/31.png
inflating: mini_depth_dataset/hafez/tactile/56.png
inflating: mini_depth_dataset/med_decagon/tactile/33.png
inflating: mini_depth_dataset/cube/depth/131.png
inflating: mini_depth_dataset/hafez/tactile/57.png
inflating: mini_depth_dataset/hafez/depth/51.png
inflating: mini_depth_dataset/hafez/depth/54.png
inflating: mini_depth_dataset/hafez/depth/52.png
inflating: mini_depth_dataset/med_decagon/depth/36.png
inflating: mini_depth_dataset/med_decagon/tactile/30.png
inflating: mini_depth_dataset/med_decagon/depth/35.png
inflating: mini_depth_dataset/hafez/depth/59.png
inflating: mini_depth_dataset/cube/depth/133.png
inflating: mini_depth_dataset/hafez/tactile/52.png
inflating: mini_depth_dataset/cube/depth/130.png
inflating: mini_depth_dataset/cube/depth/132.png
inflating: mini_depth_dataset/hafez/tactile/53.png
inflating: mini_depth_dataset/med_decagon/tactile/25.png
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inflating: mini_depth_dataset/hafez/tactile/59.png
inflating: mini_depth_dataset/hafez/tactile/51.png
inflating: mini_depth_dataset/hafez/tactile/48.png
inflating: mini_depth_dataset/hafez/depth/50.png
inflating: mini_depth_dataset/cube/depth/128.png
inflating: mini_depth_dataset/cube/depth/134.png
inflating: mini_depth_dataset/cube/depth/126.png
inflating: mini_depth_dataset/med_decagon/depth/34.png
inflating: mini_depth_dataset/hafez/depth/49.png
inflating: mini_depth_dataset/cube/depth/127.png
inflating: mini_depth_dataset/hafez/tactile/50.png
inflating: mini_depth_dataset/hafez/tactile/49.png
inflating: mini_depth_dataset/med_decagon/tactile/23.png
inflating: mini_depth_dataset/hafez/depth/48.png
inflating: mini_depth_dataset/med_decagon/tactile/24.png
inflating: mini_depth_dataset/hafez/depth/46.png
inflating: mini_depth_dataset/hafez/depth/47.png
inflating: mini_depth_dataset/cube/depth/123.png
inflating: mini_depth_dataset/med_decagon/tactile/20.png
inflating: mini_depth_dataset/med_decagon/depth/32.png
inflating: mini_depth_dataset/cube/depth/122.png
inflating: mini_depth_dataset/med_decagon/tactile/35.png
inflating: mini_depth_dataset/med_decagon/depth/31.png
inflating: mini_depth_dataset/med_decagon/depth/29.png
inflating: mini_depth_dataset/cube/depth/124.png
inflating: mini_depth_dataset/med_decagon/depth/30.png
inflating: mini_depth_dataset/cube/depth/129.png
inflating: mini_depth_dataset/med_decagon/tactile/26.png
inflating: mini_depth_dataset/med_decagon/tactile/27.png
inflating: mini_depth_dataset/hafez/depth/44.png
inflating: mini_depth_dataset/med_decagon/tactile/21.png
inflating: mini_depth_dataset/med_decagon/tactile/22.png
inflating: mini_depth_dataset/hafez/tactile/46.png
inflating: mini_depth_dataset/med_decagon/depth/28.png
inflating: mini_depth_dataset/cube/depth/125.png
inflating: mini_depth_dataset/med_decagon/tactile/19.png
inflating: mini_depth_dataset/med_decagon/tactile/18.png
inflating: mini_depth_dataset/hafez/tactile/47.png
inflating: mini_depth_dataset/med_decagon/depth/33.png
inflating: mini_depth_dataset/med_decagon/depth/27.png
inflating: mini_depth_dataset/cube/depth/120.png
inflating: mini_depth_dataset/hafez/tactile/43.png
inflating: mini_depth_dataset/cube/depth/119.png
inflating: mini_depth_dataset/med_decagon/tactile/17.png
inflating: mini_depth_dataset/hafez/tactile/44.png
inflating: mini_depth_dataset/hafez/depth/43.png
inflating: mini_depth_dataset/med_decagon/depth/26.png
inflating: mini_depth_dataset/hafez/tactile/40.png
inflating: mini_depth_dataset/hafez/depth/42.png
inflating: mini_depth_dataset/hafez/tactile/39.png
inflating: mini_depth_dataset/med_decagon/depth/25.png
inflating: mini_depth_dataset/cube/depth/121.png
inflating: mini_depth_dataset/med_decagon/tactile/16.png
inflating: mini_depth_dataset/hafez/depth/38.png
inflating: mini_depth_dataset/hafez/tactile/42.png
inflating: mini_depth_dataset/cube/depth/116.png
inflating: mini_depth_dataset/hafez/tactile/38.png
inflating: mini_depth_dataset/hafez/tactile/37.png
inflating: mini_depth_dataset/hafez/tactile/45.png
inflating: mini_depth_dataset/cube/depth/113.png
```

```
inflating: mini_depth_dataset/cube/depth/115.png
inflating: mini_depth_dataset/med_decagon/tactile/15.png
inflating: mini_depth_dataset/hafez/tactile/41.png
inflating: mini_depth_dataset/hafez/depth/41.png
inflating: mini_depth_dataset/med_decagon/tactile/14.png
inflating: mini_depth_dataset/hafez/depth/40.png
inflating: mini_depth_dataset/med_decagon/tactile/11.png
inflating: mini_depth_dataset/med_decagon/depth/23.png
inflating: mini_depth_dataset/med_decagon/depth/24.png
inflating: mini_depth_dataset/cube/depth/114.png
inflating: mini_depth_dataset/med_decagon/depth/22.png
inflating: mini_depth_dataset/hafez/tactile/34.png
inflating: mini_depth_dataset/hafez/tactile/35.png
inflating: mini_depth_dataset/med_decagon/depth/21.png
inflating: mini_depth_dataset/med_decagon/tactile/10.png
inflating: mini_depth_dataset/cube/depth/112.png
inflating: mini_depth_dataset/hafez/tactile/33.png
inflating: mini_depth_dataset/cube/depth/107.png
inflating: mini_depth_dataset/cube/depth/118.png
inflating: mini_depth_dataset/hafez/tactile/36.png
inflating: mini_depth_dataset/med_decagon/tactile/8.png
inflating: mini_depth_dataset/cube/depth/110.png
inflating: mini_depth_dataset/hafez/depth/39.png
inflating: mini_depth_dataset/med_decagon/depth/20.png
inflating: mini_depth_dataset/med_decagon/tactile/9.png
inflating: mini_depth_dataset/hafez/tactile/31.png
inflating: mini_depth_dataset/cube/depth/106.png
inflating: mini_depth_dataset/hafez/depth/37.png
inflating: mini_depth_dataset/cube/depth/111.png
inflating: mini_depth_dataset/cube/depth/109.png
inflating: mini_depth_dataset/med_decagon/tactile/12.png
inflating: mini_depth_dataset/cube/depth/117.png
inflating: mini_depth_dataset/hafez/tactile/32.png
inflating: mini_depth_dataset/hafez/depth/34.png
inflating: mini_depth_dataset/med_decagon/depth/19.png
inflating: mini_depth_dataset/hafez/depth/32.png
inflating: mini_depth_dataset/hafez/depth/33.png
inflating: mini_depth_dataset/hafez/tactile/29.png
inflating: mini_depth_dataset/hafez/depth/35.png
inflating: mini_depth_dataset/cube/depth/104.png
inflating: mini_depth_dataset/med_decagon/tactile/6.png
inflating: mini_depth_dataset/hafez/tactile/27.png
inflating: mini_depth_dataset/cube/depth/108.png
inflating: mini_depth_dataset/ring/depth/32.png
inflating: mini_depth_dataset/med_decagon/tactile/3.png
inflating: mini_depth_dataset/cube/depth/102.png
inflating: mini_depth_dataset/med_decagon/tactile/5.png
inflating: mini_depth_dataset/hafez/tactile/28.png
inflating: mini_depth_dataset/hafez/tactile/30.png
inflating: mini_depth_dataset/hafez/depth/36.png
inflating: mini_depth_dataset/med_decagon/depth/18.png
inflating: mini_depth_dataset/hafez/depth/29.png
inflating: mini_depth_dataset/med_decagon/depth/39.png
inflating: mini_depth_dataset/med_decagon/depth/16.png
inflating: mini_depth_dataset/hafez/tactile/26.png
inflating: mini_depth_dataset/cube/depth/100.png
inflating: mini_depth_dataset/med_decagon/depth/14.png
inflating: mini_depth_dataset/cube/depth/101.png
inflating: mini_depth_dataset/cube/depth/103.png
inflating: mini_depth_dataset/cube/depth/96.png
```

```
inflating: mini_depth_dataset/hafez/depth/28.png
inflating: mini_depth_dataset/med_decagon/depth/13.png
inflating: mini_depth_dataset/cube/depth/99.png
inflating: mini_depth_dataset/hafez/tactile/23.png
inflating: mini_depth_dataset/med_decagon/depth/11.png
inflating: mini_depth_dataset/cube/depth/97.png
inflating: mini_depth_dataset/med_decagon/depth/17.png
inflating: mini_depth_dataset/hafez/tactile/25.png
inflating: mini_depth_dataset/med_decagon/tactile/7.png
inflating: mini_depth_dataset/hafez/depth/26.png
inflating: mini_depth_dataset/hafez/tactile/21.png
inflating: mini_depth_dataset/hafez/tactile/22.png
inflating: mini_depth_dataset/hafez/depth/25.png
inflating: mini_depth_dataset/hafez/tactile/20.png
inflating: mini_depth_dataset/hafez/depth/45.png
inflating: mini_depth_dataset/med_decagon/depth/9.png
inflating: mini_depth_dataset/cube/depth/92.png
inflating: mini_depth_dataset/med_decagon/depth/12.png
inflating: mini_depth_dataset/med_decagon/depth/10.png
inflating: mini_depth_dataset/hafez/depth/24.png
inflating: mini_depth_dataset/hafez/depth/27.png
inflating: mini_depth_dataset/cube/depth/98.png
inflating: mini_depth_dataset/med_decagon/tactile/4.png
inflating: mini_depth_dataset/cube/depth/93.png
inflating: mini_depth_dataset/hafez/depth/23.png
inflating: mini_depth_dataset/cube/depth/90.png
inflating: mini_depth_dataset/hafez/tactile/19.png
inflating: mini_depth_dataset/med_decagon/depth/15.png
inflating: mini_depth_dataset/cube/depth/89.png
inflating: mini_depth_dataset/med_decagon/depth/7.png
inflating: mini_depth_dataset/hafez/tactile/18.png
inflating: mini_depth_dataset/cube/depth/91.png
inflating: mini_depth_dataset/med_decagon/depth/6.png
inflating: mini_depth_dataset/hafez/tactile/17.png
inflating: mini_depth_dataset/cube/depth/95.png
inflating: mini_depth_dataset/hafez/tactile/14.png
inflating: mini_depth_dataset/hafez/tactile/16.png
inflating: mini_depth_dataset/cube/depth/87.png
inflating: mini_depth_dataset/hafez/depth/21.png
inflating: mini_depth_dataset/hafez/depth/22.png
inflating: mini_depth_dataset/med_decagon/depth/3.png
inflating: mini_depth_dataset/hafez/tactile/13.png
inflating: mini_depth_dataset/med_decagon/depth/5.png
inflating: mini_depth_dataset/hafez/depth/19.png
inflating: mini_depth_dataset/cube/depth/105.png
inflating: mini_depth_dataset/hafez/depth/20.png
inflating: mini_depth_dataset/hafez/tactile/24.png
inflating: mini_depth_dataset/hafez/tactile/10.png
inflating: mini_depth_dataset/cube/depth/84.png
inflating: mini_depth_dataset/cube/depth/83.png
inflating: mini_depth_dataset/cube/depth/82.png
inflating: mini_depth_dataset/hafez/tactile/9.png
inflating: mini_depth_dataset/hafez/tactile/15.png
inflating: mini_depth_dataset/hafez/depth/16.png
inflating: mini_depth_dataset/hafez/tactile/12.png
inflating: mini_depth_dataset/cube/depth/80.png
inflating: mini_depth_dataset/cube/depth/88.png
inflating: mini_depth_dataset/hafez/tactile/8.png
inflating: mini_depth_dataset/med_decagon/depth/8.png
inflating: mini_depth_dataset/hafez/depth/14.png
```

```
inflating: mini_depth_dataset/cube/depth/81.png
inflating: mini_depth_dataset/hafez/tactile/6.png
inflating: mini_depth_dataset/hafez/depth/17.png
inflating: mini_depth_dataset/hafez/tactile/7.png
inflating: mini_depth_dataset/cube/depth/94.png
inflating: mini_depth_dataset/cube/depth/86.png
inflating: mini_depth_dataset/hafez/depth/15.png
inflating: mini_depth_dataset/cube/depth/76.png
inflating: mini_depth_dataset/hafez/depth/10.png
inflating: mini_depth_dataset/hafez/depth/13.png
inflating: mini_depth_dataset/hafez/depth/11.png
inflating: mini_depth_dataset/hafez/tactile/4.png
inflating: mini_depth_dataset/hafez/tactile/11.png
inflating: mini_depth_dataset/cube/depth/72.png
inflating: mini_depth_dataset/hafez/tactile/3.png
inflating: mini_depth_dataset/cube/depth/74.png
inflating: mini_depth_dataset/hafez/depth/8.png
inflating: mini_depth_dataset/med_decagon/tactile/76.png
inflating: mini_depth_dataset/hafez/depth/12.png
inflating: mini_depth_dataset/cube/depth/79.png
inflating: mini_depth_dataset/cube/depth/85.png
inflating: mini_depth_dataset/hafez/depth/6.png
inflating: mini_depth_dataset/cube/depth/73.png
inflating: mini_depth_dataset/cube/depth/77.png
inflating: mini_depth_dataset/cube/depth/71.png
inflating: mini_depth_dataset/hafez/depth/4.png
inflating: mini_depth_dataset/cube/depth/68.png
inflating: mini_depth_dataset/hafez/depth/18.png
inflating: mini_depth_dataset/cube/depth/64.png
inflating: mini_depth_dataset/cube/depth/61.png
inflating: mini_depth_dataset/hafez/depth/7.png
inflating: mini_depth_dataset/cube/depth/60.png
inflating: mini_depth_dataset/cube/depth/70.png
inflating: mini_depth_dataset/cube/depth/65.png
inflating: mini_depth_dataset/hafez/depth/3.png
inflating: mini_depth_dataset/hafez/depth/9.png
inflating: mini_depth_dataset/cube/depth/50.png
inflating: mini_depth_dataset/cube/depth/57.png
inflating: mini_depth_dataset/cube/depth/55.png
inflating: mini_depth_dataset/hafez/tactile/5.png
inflating: mini_depth_dataset/cube/depth/51.png
inflating: mini_depth_dataset/hafez/depth/5.png
inflating: mini_depth_dataset/cube/depth/46.png
inflating: mini_depth_dataset/cube/depth/67.png
inflating: mini_depth_dataset/cube/depth/59.png
inflating: mini_depth_dataset/cube/depth/58.png
inflating: mini_depth_dataset/cube/depth/53.png
inflating: mini_depth_dataset/cube/depth/43.png
inflating: mini_depth_dataset/cube/depth/63.png
inflating: mini_depth_dataset/cube/depth/39.png
inflating: mini_depth_dataset/cube/depth/45.png
inflating: mini_depth_dataset/cube/depth/52.png
inflating: mini_depth_dataset/cube/depth/66.png
inflating: mini_depth_dataset/cube/depth/62.png
inflating: mini_depth_dataset/cube/depth/69.png
inflating: mini_depth_dataset/cube/depth/56.png
inflating: mini_depth_dataset/cube/depth/37.png
inflating: mini_depth_dataset/cube/depth/54.png
inflating: mini_depth_dataset/cube/depth/38.png
inflating: mini_depth_dataset/cube/depth/42.png
```

```
inflating: mini_depth_dataset/cube/depth/47.png
inflating: mini_depth_dataset/cube/depth/75.png
inflating: mini_depth_dataset/cube/depth/31.png
inflating: mini_depth_dataset/cube/depth/49.png
inflating: mini_depth_dataset/cube/depth/30.png
inflating: mini_depth_dataset/cube/depth/36.png
inflating: mini_depth_dataset/cube/depth/41.png
inflating: mini_depth_dataset/cube/depth/34.png
inflating: mini_depth_dataset/cube/depth/25.png
inflating: mini_depth_dataset/cube/depth/44.png
inflating: mini_depth_dataset/cube/depth/20.png
inflating: mini_depth_dataset/cube/depth/21.png
inflating: mini_depth_dataset/cube/depth/22.png
inflating: mini_depth_dataset/cube/depth/33.png
inflating: mini_depth_dataset/cube/depth/32.png
inflating: mini_depth_dataset/cube/depth/23.png
inflating: mini_depth_dataset/cube/depth/19.png
inflating: mini_depth_dataset/med_decagon/tactile/13.png
inflating: mini_depth_dataset/cube/depth/15.png
inflating: mini_depth_dataset/hafez/depth/31.png
inflating: mini_depth_dataset/cube/depth/40.png
inflating: mini_depth_dataset/cube/depth/8.png
inflating: mini_depth_dataset/cube/depth/27.png
inflating: mini_depth_dataset/cube/depth/48.png
inflating: mini_depth_dataset/cube/depth/3.png
inflating: mini_depth_dataset/cube/depth/16.png
inflating: mini_depth_dataset/cube/tactile/133.png
inflating: mini_depth_dataset/cube/depth/28.png
inflating: mini_depth_dataset/cube/depth/11.png
inflating: mini_depth_dataset/cube/depth/13.png
inflating: mini_depth_dataset/cube/tactile/134.png
inflating: mini_depth_dataset/cube/depth/9.png
inflating: mini_depth_dataset/cube/depth/29.png
inflating: mini_depth_dataset/cube/depth/5.png
inflating: mini_depth_dataset/cube/depth/14.png
inflating: mini_depth_dataset/cube/depth/17.png
inflating: mini_depth_dataset/cube/depth/24.png
inflating: mini_depth_dataset/hafez/depth/30.png
inflating: mini_depth_dataset/cube/depth/18.png
inflating: mini_depth_dataset/cube/depth/26.png
inflating: mini_depth_dataset/cube/depth/12.png
inflating: mini_depth_dataset/cube/tactile/128.png
inflating: mini_depth_dataset/cube/depth/6.png
inflating: mini_depth_dataset/cube/tactile/132.png
inflating: mini_depth_dataset/cube/depth/78.png
inflating: mini_depth_dataset/cube/depth/35.png
inflating: mini_depth_dataset/cube/tactile/119.png
inflating: mini_depth_dataset/cube/tactile/112.png
inflating: mini_depth_dataset/cube/tactile/107.png
inflating: mini_depth_dataset/cube/depth/7.png
inflating: mini_depth_dataset/cube/tactile/131.png
inflating: mini_depth_dataset/cube/tactile/129.png
inflating: mini_depth_dataset/cube/depth/4.png
inflating: mini_depth_dataset/cube/tactile/123.png
inflating: mini_depth_dataset/cube/tactile/111.png
inflating: mini_depth_dataset/cube/tactile/118.png
inflating: mini_depth_dataset/cube/depth/10.png
inflating: mini_depth_dataset/cube/tactile/114.png
inflating: mini_depth_dataset/cube/tactile/104.png
inflating: mini_depth_dataset/cube/tactile/113.png
```

```
inflating: mini_depth_dataset/cube/tactile/127.png
inflating: mini_depth_dataset/cube/tactile/130.png
inflating: mini_depth_dataset/cube/tactile/122.png
inflating: mini_depth_dataset/cube/tactile/106.png
inflating: mini_depth_dataset/cube/tactile/105.png
inflating: mini_depth_dataset/cube/tactile/102.png
inflating: mini_depth_dataset/cube/tactile/115.png
inflating: mini_depth_dataset/cube/tactile/110.png
inflating: mini_depth_dataset/cube/tactile/120.png
inflating: mini_depth_dataset/cube/tactile/108.png
inflating: mini_depth_dataset/cube/tactile/96.png
inflating: mini_depth_dataset/cube/tactile/93.png
inflating: mini_depth_dataset/cube/tactile/124.png
inflating: mini_depth_dataset/cube/tactile/109.png
inflating: mini_depth_dataset/cube/tactile/121.png
inflating: mini_depth_dataset/cube/tactile/101.png
inflating: mini_depth_dataset/cube/tactile/100.png
inflating: mini_depth_dataset/cube/tactile/116.png
inflating: mini_depth_dataset/cube/tactile/125.png
inflating: mini_depth_dataset/cube/tactile/90.png
inflating: mini_depth_dataset/cube/tactile/103.png
inflating: mini_depth_dataset/cube/tactile/94.png
inflating: mini_depth_dataset/cube/tactile/92.png
inflating: mini_depth_dataset/cube/tactile/97.png
inflating: mini_depth_dataset/cube/tactile/117.png
inflating: mini_depth_dataset/cube/tactile/82.png
inflating: mini_depth_dataset/cube/tactile/83.png
inflating: mini_depth_dataset/cube/tactile/91.png
inflating: mini_depth_dataset/cube/tactile/87.png
inflating: mini_depth_dataset/cube/tactile/76.png
inflating: mini_depth_dataset/cube/tactile/99.png
inflating: mini_depth_dataset/cube/tactile/85.png
inflating: mini_depth_dataset/cube/tactile/86.png
inflating: mini_depth_dataset/cube/tactile/75.png
inflating: mini_depth_dataset/cube/tactile/84.png
inflating: mini_depth_dataset/cube/tactile/78.png
inflating: mini_depth_dataset/cube/tactile/72.png
inflating: mini_depth_dataset/cube/tactile/89.png
inflating: mini_depth_dataset/cube/tactile/81.png
inflating: mini_depth_dataset/cube/tactile/67.png
inflating: mini_depth_dataset/cube/tactile/126.png
inflating: mini_depth_dataset/cube/tactile/69.png
inflating: mini_depth_dataset/cube/tactile/73.png
inflating: mini_depth_dataset/cube/tactile/88.png
inflating: mini_depth_dataset/cube/tactile/77.png
inflating: mini_depth_dataset/cube/tactile/66.png
inflating: mini_depth_dataset/cube/tactile/79.png
inflating: mini_depth_dataset/cube/tactile/70.png
inflating: mini_depth_dataset/cube/tactile/64.png
inflating: mini_depth_dataset/cube/tactile/98.png
inflating: mini_depth_dataset/cube/tactile/74.png
inflating: mini_depth_dataset/cube/tactile/57.png
inflating: mini_depth_dataset/cube/tactile/51.png
inflating: mini_depth_dataset/cube/tactile/62.png
inflating: mini_depth_dataset/cube/tactile/71.png
inflating: mini_depth_dataset/cube/tactile/50.png
inflating: mini_depth_dataset/cube/tactile/68.png
inflating: mini_depth_dataset/cube/tactile/47.png
inflating: mini_depth_dataset/cube/tactile/80.png
inflating: mini_depth_dataset/cube/tactile/53.png
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```
inflating: mini_depth_dataset/cube/tactile/46.png
inflating: mini_depth_dataset/cube/tactile/43.png
inflating: mini_depth_dataset/cube/tactile/61.png
inflating: mini_depth_dataset/cube/tactile/65.png
inflating: mini_depth_dataset/cube/tactile/54.png
inflating: mini_depth_dataset/cube/tactile/48.png
inflating: mini_depth_dataset/cube/tactile/49.png
inflating: mini_depth_dataset/cube/tactile/52.png
inflating: mini_depth_dataset/cube/tactile/41.png
inflating: mini_depth_dataset/cube/tactile/44.png
inflating: mini_depth_dataset/cube/tactile/39.png
inflating: mini_depth_dataset/cube/tactile/63.png
inflating: mini_depth_dataset/cube/tactile/40.png
inflating: mini_depth_dataset/cube/tactile/56.png
inflating: mini_depth_dataset/cube/tactile/59.png
inflating: mini_depth_dataset/cube/tactile/28.png
inflating: mini_depth_dataset/cube/tactile/37.png
inflating: mini_depth_dataset/cube/tactile/26.png
inflating: mini_depth_dataset/cube/tactile/45.png
inflating: mini_depth_dataset/cube/tactile/55.png
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inflating: mini_depth_dataset/cube/tactile/30.png
inflating: mini_depth_dataset/cube/tactile/13.png
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inflating: mini_depth_dataset/cube/tactile/21.png
inflating: mini_depth_dataset/cube/tactile/35.png
inflating: mini_depth_dataset/cube/tactile/25.png
inflating: mini_depth_dataset/cube/tactile/34.png
inflating: mini_depth_dataset/cube/tactile/32.png
inflating: mini_depth_dataset/cube/tactile/16.png
inflating: mini_depth_dataset/cube/tactile/15.png
inflating: mini_depth_dataset/cube/tactile/42.png
inflating: mini_depth_dataset/cube/tactile/58.png
inflating: mini_depth_dataset/cube/tactile/95.png
inflating: mini_depth_dataset/cube/tactile/14.png
inflating: mini_depth_dataset/cube/tactile/18.png
inflating: mini_depth_dataset/cube/tactile/33.png
inflating: mini_depth_dataset/cube/tactile/19.png
inflating: mini_depth_dataset/cube/tactile/10.png
inflating: mini_depth_dataset/cube/tactile/8.png
inflating: mini_depth_dataset/cube/tactile/11.png
inflating: mini_depth_dataset/cube/tactile/5.png
inflating: mini_depth_dataset/cube/tactile/7.png
inflating: mini_depth_dataset/cube/tactile/24.png
inflating: mini_depth_dataset/cube/tactile/6.png
inflating: mini_depth_dataset/cube/tactile/12.png
inflating: mini_depth_dataset/cube/tactile/4.png
inflating: mini_depth_dataset/cables/tactile/131.png
inflating: mini_depth_dataset/cube/tactile/36.png
inflating: mini_depth_dataset/cables/tactile/133.png
inflating: mini_depth_dataset/cube/tactile/38.png
inflating: mini_depth_dataset/cube/tactile/23.png
inflating: mini_depth_dataset/cube/tactile/17.png
inflating: mini_depth_dataset/cube/tactile/3.png
inflating: mini_depth_dataset/cube/tactile/20.png
inflating: mini_depth_dataset/cube/tactile/27.png
inflating: mini_depth_dataset/cube/tactile/9.png
inflating: mini_depth_dataset/cables/tactile/121.png
inflating: mini_depth_dataset/cables/tactile/135.png
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inflating: mini_depth_dataset/cube/tactile/60.png
inflating: mini_depth_dataset/cables/tactile/123.png
inflating: mini_depth_dataset/cables/tactile/126.png
inflating: mini_depth_dataset/cables/tactile/125.png
inflating: mini_depth_dataset/cables/tactile/129.png
inflating: mini_depth_dataset/cables/tactile/136.png
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inflating: mini_depth_dataset/cables/tactile/108.png
inflating: mini_depth_dataset/cables/tactile/114.png
inflating: mini_depth_dataset/cables/tactile/134.png
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inflating: mini_depth_dataset/cables/tactile/63.png
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inflating: mini_depth_dataset/cables/tactile/18.png
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inflating: mini_depth_dataset/cables/depth/137.png
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inflating: mini_depth_dataset/cables/depth/96.png
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inflating: mini_depth_dataset/cables/depth/56.png
inflating: mini_depth_dataset/digit_mount/tactile/124.png
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inflating: mini_depth_dataset/digit_mount/depth/120.png
inflating: mini_depth_dataset/digit_mount/depth/117.png
inflating: mini_depth_dataset/digit_mount/tactile/58.png
inflating: mini_depth_dataset/digit_mount/tactile/56.png
inflating: mini_depth_dataset/digit_mount/depth/114.png
inflating: mini_depth_dataset/digit_mount/tactile/54.png
inflating: mini_depth_dataset/digit_mount/depth/107.png
inflating: mini_depth_dataset/digit_mount/depth/116.png
inflating: mini_depth_dataset/cables/depth/41.png
inflating: mini_depth_dataset/digit_mount/tactile/63.png
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inflating: mini_depth_dataset/digit_mount/depth/125.png
inflating: mini_depth_dataset/digit_mount/tactile/48.png
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inflating: mini_depth_dataset/digit_mount/depth/131.png
inflating: mini_depth_dataset/digit_mount/depth/99.png
inflating: mini_depth_dataset/digit_mount/depth/102.png
inflating: mini_depth_dataset/digit_mount/depth/100.png
inflating: mini_depth_dataset/digit_mount/tactile/49.png
inflating: mini_depth_dataset/digit_mount/depth/103.png
inflating: mini_depth_dataset/digit_mount/depth/95.png
inflating: mini_depth_dataset/digit_mount/depth/98.png
inflating: mini_depth_dataset/digit_mount/tactile/44.png
inflating: mini_depth_dataset/digit_mount/tactile/53.png
inflating: mini_depth_dataset/digit_mount/depth/93.png
inflating: mini_depth_dataset/digit_mount/depth/92.png
inflating: mini_depth_dataset/digit_mount/depth/104.png
inflating: mini_depth_dataset/digit_mount/depth/96.png
inflating: mini_depth_dataset/digit_mount/tactile/60.png
inflating: mini_depth_dataset/digit_mount/depth/89.png
inflating: mini_depth_dataset/digit_mount/depth/105.png
```

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inflating: mini_depth_dataset/digit_mount/depth/97.png
inflating: mini_depth_dataset/digit_mount/tactile/45.png
inflating: mini_depth_dataset/digit_mount/tactile/46.png
inflating: mini_depth_dataset/digit_mount/tactile/50.png
inflating: mini_depth_dataset/digit_mount/tactile/34.png
inflating: mini_depth_dataset/digit_mount/tactile/42.png
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inflating: mini_depth_dataset/digit_mount/depth/91.png
inflating: mini_depth_dataset/digit_mount/tactile/37.png
inflating: mini_depth_dataset/digit_mount/tactile/39.png
inflating: mini_depth_dataset/digit_mount/tactile/35.png
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inflating: mini_depth_dataset/digit_mount/depth/88.png
inflating: mini_depth_dataset/digit_mount/depth/86.png
inflating: mini_depth_dataset/digit_mount/depth/85.png
inflating: mini_depth_dataset/digit_mount/tactile/25.png
inflating: mini_depth_dataset/digit_mount/depth/84.png
inflating: mini_depth_dataset/digit_mount/depth/94.png
inflating: mini_depth_dataset/digit_mount/tactile/40.png
inflating: mini_depth_dataset/digit_mount/tactile/32.png
inflating: mini_depth_dataset/digit_mount/tactile/28.png
inflating: mini_depth_dataset/digit_mount/depth/82.png
inflating: mini_depth_dataset/digit_mount/depth/83.png
inflating: mini_depth_dataset/digit_mount/tactile/43.png
inflating: mini_depth_dataset/digit_mount/tactile/23.png
inflating: mini_depth_dataset/digit_mount/depth/79.png
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inflating: mini_depth_dataset/digit_mount/tactile/33.png
inflating: mini_depth_dataset/digit_mount/tactile/30.png
inflating: mini_depth_dataset/digit_mount/tactile/22.png
inflating: mini_depth_dataset/digit_mount/tactile/41.png
inflating: mini_depth_dataset/digit_mount/tactile/27.png
inflating: mini_depth_dataset/digit_mount/tactile/31.png
inflating: mini_depth_dataset/digit_mount/depth/74.png
inflating: mini_depth_dataset/digit_mount/tactile/29.png
inflating: mini_depth_dataset/digit_mount/depth/81.png
inflating: mini_depth_dataset/digit_mount/depth/75.png
inflating: mini_depth_dataset/digit_mount/tactile/26.png
inflating: mini_depth_dataset/digit_mount/depth/90.png
inflating: mini_depth_dataset/digit_mount/tactile/21.png
inflating: mini_depth_dataset/digit_mount/depth/76.png
inflating: mini_depth_dataset/digit_mount/depth/78.png
inflating: mini_depth_dataset/digit_mount/depth/68.png
inflating: mini_depth_dataset/digit_mount/depth/73.png
inflating: mini_depth_dataset/digit_mount/tactile/18.png
inflating: mini_depth_dataset/digit_mount/depth/66.png
inflating: mini_depth_dataset/digit_mount/tactile/12.png
inflating: mini_depth_dataset/digit_mount/depth/80.png
inflating: mini_depth_dataset/digit_mount/depth/70.png
inflating: mini_depth_dataset/digit_mount/depth/69.png
inflating: mini_depth_dataset/digit_mount/tactile/36.png
inflating: mini_depth_dataset/digit_mount/depth/72.png
inflating: mini_depth_dataset/digit_mount/tactile/16.png
inflating: mini_depth_dataset/digit_mount/tactile/11.png
inflating: mini_depth_dataset/digit_mount/tactile/13.png
inflating: mini_depth_dataset/digit_mount/depth/71.png
inflating: mini_depth_dataset/digit_mount/depth/62.png
inflating: mini_depth_dataset/digit_mount/tactile/15.png
```

```
inflating: mini_depth_dataset/digit_mount/depth/67.png
inflating: mini_depth_dataset/digit_mount/depth/63.png
inflating: mini_depth_dataset/digit_mount/depth/65.png
inflating: mini_depth_dataset/digit_mount/tactile/6.png
inflating: mini_depth_dataset/digit_mount/depth/60.png
inflating: mini_depth_dataset/digit_mount/tactile/19.png
inflating: mini_depth_dataset/digit_mount/tactile/9.png
inflating: mini_depth_dataset/digit_mount/tactile/4.png
inflating: mini_depth_dataset/digit_mount/depth/58.png
inflating: mini_depth_dataset/digit_mount/depth/53.png
inflating: mini_depth_dataset/digit_mount/depth/57.png
inflating: mini_depth_dataset/digit_mount/tactile/8.png
inflating: mini_depth_dataset/digit_mount/depth/54.png
inflating: mini_depth_dataset/digit_mount/tactile/3.png
inflating: mini_depth_dataset/digit_mount/tactile/7.png
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inflating: mini_depth_dataset/digit_mount/depth/56.png
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inflating: mini_depth_dataset/digit_mount/tactile/5.png
inflating: mini_depth_dataset/digit_mount/depth/46.png
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inflating: mini_depth_dataset/digit_mount/depth/36.png
inflating: mini_depth_dataset/digit_mount/depth/43.png
inflating: mini_depth_dataset/cables/depth/70.png
inflating: mini_depth_dataset/digit_mount/depth/28.png
inflating: mini_depth_dataset/digit_mount/depth/18.png
inflating: mini_depth_dataset/digit_mount/depth/20.png
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inflating: mini_depth_dataset/digit_mount/depth/13.png
inflating: mini_depth_dataset/digit_mount/depth/24.png
inflating: mini_depth_dataset/digit_mount/depth/6.png
inflating: mini_depth_dataset/digit_mount/depth/9.png
inflating: mini_depth_dataset/digit_mount/depth/14.png
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  inflating: mini_depth_dataset/digit_mount/depth/7.png
  inflating: mini_depth_dataset/digit_mount/depth/25.png
  inflating: mini_depth_dataset/digit_mount/depth/22.png
  inflating: mini_depth_dataset/digit_mount/depth/5.png
  inflating: mini_depth_dataset/digit_mount/depth/3.png
  inflating: mini_depth_dataset/digit_mount/depth/23.png
  inflating: mini_depth_dataset/digit_mount/depth/15.png
  inflating: mini_depth_dataset/digit_mount/depth/4.png
  inflating: mini_depth_dataset/digit_mount/tactile/20.png
  inflating: mini_depth_dataset/digit_mount/depth/8.png
  inflating: mini_depth_dataset/digit_mount/depth/29.png
  inflating: mini_depth_dataset/digit_mount/depth/26.png
  inflating: mini_depth_dataset/digit_mount/depth/41.png
  inflating: mini_depth_dataset/digit_mount/depth/10.png
  inflating: mini_depth_dataset/digit_mount/depth/127.png
  inflating: mini_depth_dataset/digit_mount/depth/30.png
  inflating: mini_depth_dataset/digit_mount/tactile/10.png
  inflating: mini_depth_dataset/digit_mount/depth/47.png
```

In [2]:

```python
import torch
import torch.nn as nn
import torchvision
from torchvision import transforms, utils
from skimage import transform
from torch.utils.data import Dataset, DataLoader
import numpy as np
import matplotlib.pyplot as plt
from IPython.core.pylabtools import figsize
import time
import os
import re
import tqdm
import random
from imageio import imread
from pathlib import Path
from PIL import Image, ImageFile
import shutil
from sklearn.model_selection import train_test_split
from torchvision.transforms import ToTensor, Compose

class TactileDataset(Dataset):
    def __init__(self, tactile_dir, depth_dir, transform=None):
        super(TactileDataset, self).__init__()
        self.tactile_dir = tactile_dir
        self.depth_dir = depth_dir
        self.transform = transform if transform is not None else Compose([ToTensor()])


    def __len__(self):
        return len(os.listdir(self.tactile_dir))

    def __get_file_name__(self, idx):
        tactile_image_path = os.path.join(self.tactile_dir, os.listdir(self.tactile_di
        split_path = tactile_image_path.split('/')  # Splitting by '/'
        return split_path[-1]  # Return the file name

    def __getitem__(self, idx):
        # read as PIL images
        tactile_image_path = os.path.join(self.tactile_dir, os.listdir(self.tactile_di
        tactile_sample = Image.open(tactile_image_path)
```

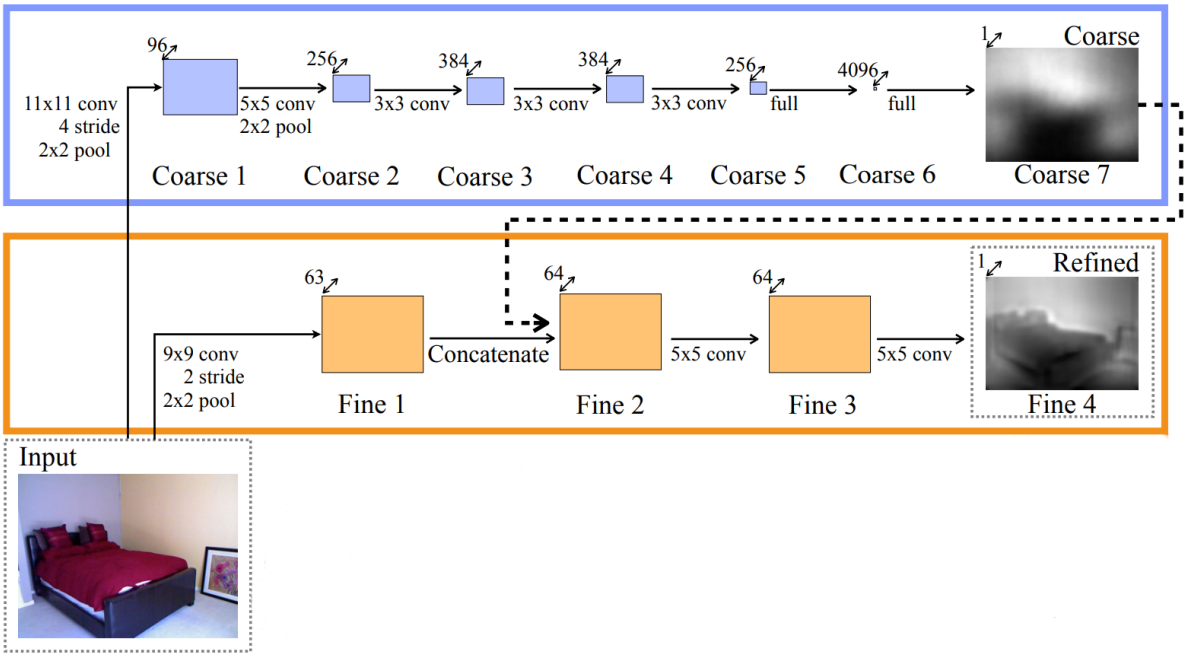
```
        if idx >= len(os.listdir(self.depth_dir)):
            depth_image_path = os.path.join(self.depth_dir, os.listdir(self.depth_dir)
        else:
            depth_image_path = os.path.join(self.depth_dir, os.listdir(self.depth_dir)
        depth_sample = Image.open(depth_image_path)

        depth_array = np.array(depth_sample)
        depth_threshold = 0
        contact_mask = depth_array > depth_threshold
        contact_sample = Image.fromarray(contact_mask.astype('uint8') * 255)     # cor

        # train transform
        seed = random.randint(0, 2 ** 32)
        if self.transform:
            random.seed(seed)
            tactile_sample = self.transform(tactile_sample)

            random.seed(seed)
            depth_sample = self.transform(depth_sample)

            random.seed(seed)
            contact_sample = self.transform(contact_sample)

        # resize depth image if needed
        # calculate contact mask based on depth


        # convert to torch tensor
        sample = {'tactile':tactile_sample, 'depth': depth_sample, 'contact': contact_

        return sample

# Add some transformation based on your choice that suits the diversity you expect to
# you can check https://pytorch.org/vision/stable/transforms.html for existing augment
trans_train = transforms.Compose([
    # transforms.ToPILImage(),
    transforms.Resize((320, 240)),
    transforms.ToTensor(),
])

trans_test = transforms.Compose([
    # transforms.ToPILImage(),
    transforms.Resize((320, 240)), # resize to training images shape
    transforms.ToTensor(),
])

# added
# Paths to your original dataset directories
base_dir = 'mini_depth_dataset/ring'
tactile_path = os.path.join(base_dir, 'tactile')
depth_path = os.path.join(base_dir, 'depth')

# Lists of all files
tactile_files = os.listdir(tactile_path)
depth_files = os.listdir(depth_path)

# Split the dataset into training and temporary (for validation and test) sets
tactile_train, tactile_temp, depth_train, depth_temp = train_test_split(
    tactile_files, depth_files, test_size=0.3, random_state=42)
```

```
# Split the temporary set into validation and test sets
tactile_val, tactile_test, depth_val, depth_test = train_test_split(
    tactile_temp, depth_temp, test_size=0.5, random_state=42)

# Function to move files to their respective directories
def move_files(file_list, src_dir, dest_dir):
    os.makedirs(dest_dir, exist_ok=True)
    for file in file_list:
        shutil.copy(os.path.join(src_dir, file), os.path.join(dest_dir, file))

# Creating directories and moving files
train_dir = os.path.join(base_dir, 'train')
validation_dir = os.path.join(base_dir, 'validation')
test_dir = os.path.join(base_dir, 'test')

move_files(tactile_train, tactile_path, os.path.join(train_dir, 'tactile'))
move_files(depth_train, depth_path, os.path.join(train_dir, 'depth'))
move_files(tactile_val, tactile_path, os.path.join(validation_dir, 'tactile'))
move_files(depth_val, depth_path, os.path.join(validation_dir, 'depth'))
move_files(tactile_test, tactile_path, os.path.join(test_dir, 'tactile'))
move_files(depth_test, depth_path, os.path.join(test_dir, 'depth'))

data_dir_train = Path(train_dir)
data_dir_valid = Path(validation_dir)
data_dir_test = Path(test_dir)
bs = 32

dataset_train = TactileDataset(data_dir_train / 'tactile', data_dir_train / 'depth', t
dataloader_train = DataLoader(dataset_train, batch_size=bs, shuffle=True)

dataset_valid = TactileDataset(data_dir_valid / 'tactile', data_dir_valid / 'depth', t
dataloader_valid = DataLoader(dataset_valid, batch_size=bs, shuffle=True)

dataset_test = TactileDataset(data_dir_test / 'tactile', data_dir_test / 'depth', trar
dataloader_test = DataLoader(dataset_test, batch_size=bs, shuffle=True)

datalen_train = len(dataset_train)
datalen_valid = len(dataset_valid)
datalen_test = len(dataset_test)

print(datalen_train, datalen_valid, datalen_test)
```

```
79 17 17
```

Step 2: Network Design

Design the neural network, incorporating various layers. Additionally, consider initializing the layer weights using predefined PyTorch initializers. Inpired by [1], you may use Coarse network for contact prediction and a Fine network for depth prediction, providing higher resolution.



In [3]:

```
import torch
import torch.nn as nn
import torch.nn.functional as F

class ContactNet(nn.Module):
    def __init__(self, init=True):
        super(ContactNet, self).__init__()
        # Define the network layers for contact prediction
        self.conv1 = nn.Conv2d(3, 96, kernel_size=11, stride=4, padding=2)
        self.bn1 = nn.BatchNorm2d(96)
        self.pool1 = nn.MaxPool2d(kernel_size=2, stride=2)

        self.conv2 = nn.Conv2d(96, 256, kernel_size=5, padding=2)
        self.bn2 = nn.BatchNorm2d(256)
        self.pool2 = nn.MaxPool2d(kernel_size=2, stride=2)

        self.conv3 = nn.Conv2d(256, 384, kernel_size=3, padding=1)
        self.bn3 = nn.BatchNorm2d(384)

        self.conv4 = nn.Conv2d(384, 384, kernel_size=3, padding=1)
        self.bn4 = nn.BatchNorm2d(384)

        self.conv5 = nn.Conv2d(384, 256, kernel_size=3, padding=1)
        self.bn5 = nn.BatchNorm2d(256)

        self.fc1 = nn.Linear(68096, 4096)  # Adjust the input features to match your f
        self.bn6 = nn.BatchNorm1d(4096)

        self.fc2 = nn.Linear(4096, 1 * 74 * 55)  # Output size needs to be adapted bas

        if init:
            self._initialize_weights()

    def _initialize_weights(self):
        for m in self.modules():
            if isinstance(m, nn.Conv2d):
                nn.init.kaiming_normal_(m.weight, mode='fan_in', nonlinearity='relu')
                if m.bias is not None:
```

```
                    nn.init.constant_(m.bias, 0)
            elif isinstance(m, nn.Linear):
                nn.init.kaiming_normal_(m.weight, mode='fan_in', nonlinearity='relu')
                nn.init.constant_(m.bias, 0)


    def forward(self, x):
        x = self.pool1(F.relu(self.bn1(self.conv1(x))))
        x = self.pool2(F.relu(self.bn2(self.conv2(x))))
        x = F.relu(self.bn3(self.conv3(x)))
        x = F.relu(self.bn4(self.conv4(x)))
        x = F.relu(self.bn5(self.conv5(x)))
        x = x.view(x.size(0), -1)  # Flatten the tensor for the fully connected layer

        x = F.relu(self.bn6(self.fc1(x)))
        c = self.fc2(x)
        c = c.view(-1, 1, 74, 55)
        return c


class TactileDepthNet(nn.Module):
    def __init__(self, init=True):
        super(TactileDepthNet, self).__init__()
        # Define the network layers for depth prediction
        self.fine1 = nn.Conv2d(3, 63, kernel_size=9, stride=2, padding=2)
        self.pool1 = nn.MaxPool2d(kernel_size=2, stride=2)
        # Assuming concatenation with a 256-channel feature map of size 55x74 from Con
        self.fine2 = nn.Conv2d(64, 64, kernel_size=5, padding=1)
        self.fine3 = nn.Conv2d(64, 64, kernel_size=5, padding=1)

        # Adjusting the final convolution to get the desired output size
        self.fine4 = nn.Conv2d(64, 1, kernel_size=5, padding=1)

        # Adding an adaptive pooling layer to ensure the output size
        self.adaptive_pool = nn.AdaptiveAvgPool2d((74, 55))

        if init:
            self._initialize_weights()

    def _initialize_weights(self):
        for m in self.modules():
            if isinstance(m, nn.Conv2d):
                nn.init.kaiming_normal_(m.weight, mode='fan_out', nonlinearity='relu')
                if m.bias is not None:
                    nn.init.constant_(m.bias, 0)
            elif isinstance(m, nn.Linear):
                nn.init.xavier_normal_(m.weight)
                nn.init.constant_(m.bias, 0)

    def forward(self, x, contact_output_batch):
        x = self.pool1(F.relu(self.fine1(x)))
        contact_output_batch_resized = F.interpolate(contact_output_batch, size=(x.siz
        # Concatenate with contact output feature map
        x = torch.cat((x, contact_output_batch_resized), 1)
        x = F.relu(self.fine2(x))
        x = F.relu(self.fine3(x))
        x = self.fine4(x)

        # Upsample to desired output size
        d = F.interpolate(x, size=(240, 320), mode='bilinear', align_corners=False)
```

```
        return d


# Assuming 'device' is defined (e.g., as 'cuda' or 'cpu')
device = torch.device('cuda' if torch.cuda.is_available() else 'cpu')

# Initialize models
contact_model = ContactNet(init=True).to(device)
tactile_depth_model = TactileDepthNet(init=True).to(device)


dummy_input = torch.randn(32, 3, 320, 240)

# Test ContactNet
contact_output = contact_model(dummy_input)
print("ContactNet Output Size:", contact_output.size())

# Test TactileDepthNet
# Assuming contact_output is correctly sized and batched
tactile_output = tactile_depth_model(dummy_input, contact_output)
print("TactileDepthNet Output Size:", tactile_output.size())
```

```
ContactNet Output Size: torch.Size([32, 1, 74, 55])
TactileDepthNet Output Size: torch.Size([32, 1, 240, 320])
```

Step 3: Loss Function

In [4]:
```
class MSE_Loss(nn.Module):
    def __init__(self):
        super(MSE_Loss, self).__init__()

    def forward(self, pred, target):
        # Mean Squared Error Loss
        return F.mse_loss(pred, target)

# Loss Functions
contact_criterion = MSE_Loss()
tactile_depth_criterion = MSE_Loss()

# optimizer
contact_optimizer = torch.optim.Adam(contact_model.parameters(), lr=0.0001)
tactile_depth_optimizer = torch.optim.Adam(tactile_depth_model.parameters(), lr=0.0005

# data parallel
contact_model = nn.DataParallel(contact_model)
tactile_depth_model = nn.DataParallel(tactile_depth_model)
```

In [5]:
```
def plot_losses(train_losses, valid_losses):
    plt.plot(train_losses, label='train losses')
    plt.plot(valid_losses, label='valid losses')

    plt.xlabel("Iterations")
    plt.ylabel("Losses")

    plt.legend()
    plt.title("Losses")
    plt.grid(True)
```

In [6]:
```
def plot_accuracy(train_acc, valid_acc):
    plt.plot(train_acc, label='train accuracy')
    plt.plot(valid_acc, label='valid accuracy')

    plt.xlabel("Iterations")
    plt.ylabel("Accuracy")

    plt.legend()
    plt.title("Accuracy")
    plt.grid(True)
```

In [7]:
```
def plot_mse(train_mse, valid_mse):
    plt.plot(train_mse, label='Train MSE')
    plt.plot(valid_mse, label='Validation MSE')
    plt.title('Mean Squared Error over Epochs')
    plt.xlabel('Epoch')
    plt.ylabel('MSE')
    plt.legend()
    plt.show()
```

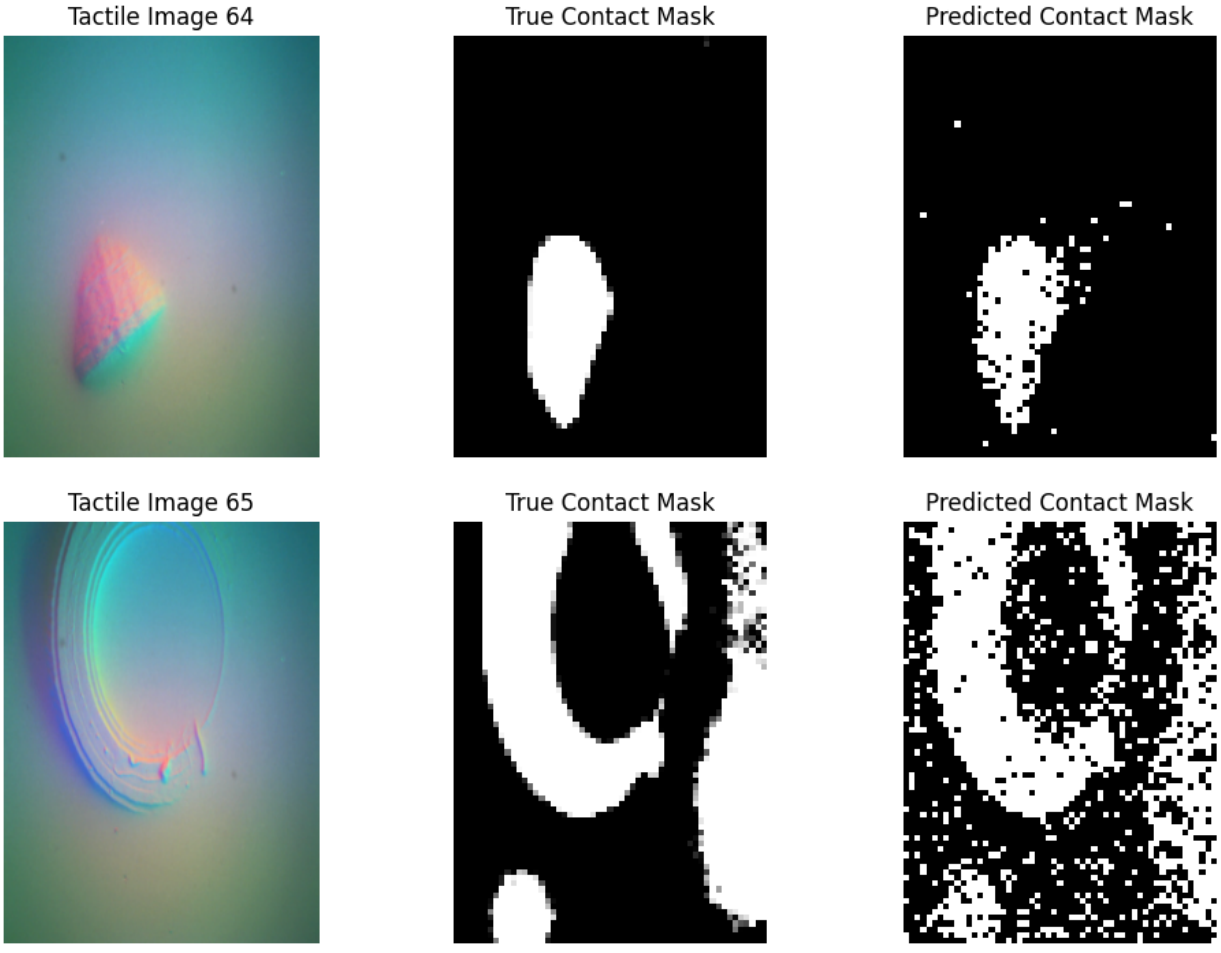
Step 4: Training Networks

In [8]:
```
## Contact Model
def dice_coefficient(output, target):
    smooth = 1.0  # Add smooth to avoid division by zero error
    iflat = output.view(-1)
    tflat = target.view(-1)
    intersection = (iflat * tflat).sum()
    return (2. * intersection + smooth) / (iflat.sum() + tflat.sum() + smooth)

contact_epochs = 15
train_losses = []
valid_losses = []
tl_b = []
train_dice_scores = []
valid_dice_scores = []
start = time.time()

for epoch in tqdm.tqdm(range(contact_epochs)):
    train_loss = 0
    train_dice = 0
    contact_model.train()

    for i, samples in enumerate(dataloader_train):
        tactiles = samples['tactile'].float().to(device)
        contacts = samples['contact'].float().to(device)
        contacts_resized = F.interpolate(contacts, size=(74, 55), mode='bilinear', ali

        # forward pass
        output = contact_model(tactiles)

        # compute contact loss
        loss = contact_criterion(output, contacts_resized)

        # compute dice score
        dice_score = dice_coefficient(output, contacts_resized)
        train_dice += dice_score.item()
```

```
        # backward pass
        contact_optimizer.zero_grad()
        loss.backward()

       # After loss.backward()
        # for name, param in contact_model.named_parameters():
        #     if param.requires_grad and "conv1.weight" in name:
        #         print(f"Gradients of {name}: {param.grad}")

        # optimization
        contact_optimizer.step()

        train_loss += loss.item()
        tl_b.append(loss.item())


    if epoch == contact_epochs - 1:
        for j in range(tactiles.size(0)):
            tactile_image = tactiles[j].cpu().permute(1, 2, 0)  # Change the order of
            true_contact = contacts_resized[j].cpu().squeeze()  # Remove unnecessary d
            predicted_contact = output[j].cpu().squeeze()

            # Apply threshold to predicted contact mask to make it binary
            predicted_contact_binary = predicted_contact > 0.5

            # Plot the images
            plt.figure(figsize=(12, 4))
            plt.subplot(1, 3, 1)
            plt.imshow(tactile_image.numpy(), cmap='gray')
            plt.title(f'Tactile Image {i * dataloader_valid.batch_size + j}')
            plt.axis('off')

            plt.subplot(1, 3, 2)
            plt.imshow(true_contact.numpy(), cmap='gray')
            plt.title('True Contact Mask')
            plt.axis('off')

            plt.subplot(1, 3, 3)
            plt.imshow(predicted_contact_binary.numpy(), cmap='gray')
            plt.title('Predicted Contact Mask')
            plt.axis('off')

            plt.show()

    train_losses.append(train_loss / datalen_train)
    train_dice_scores.append(train_dice / len(dataloader_train))

    valid_loss = 0
    valid_dice = 0
    contact_model.eval()

    with torch.no_grad():
        for i, samples in enumerate(dataloader_valid):
            tactiles = samples['tactile'].float().to(device)
            contacts = samples['contact'].float().to(device)
            contacts_resized = F.interpolate(contacts, size=(74, 55), mode='bilinear',

            # forward pass contact_model
            output = contact_model(tactiles)
```

```
            # compute contact loss
            loss = contact_criterion(output, contacts_resized)

            valid_loss += loss.item()
            dice_score = dice_coefficient(output, contacts_resized)
            valid_dice += dice_score.item()


    valid_losses.append(valid_loss / datalen_valid)
    valid_dice_scores.append(valid_dice / len(dataloader_valid))

    # save contact_model with torch.save
    torch.save(contact_model.state_dict(), f"contact_model_epoch_{epoch}.pt")

elapse = time.time() - start
print('Time used (Sec): ', elapse, ' per epoch used: ', elapse / contact_epochs)
plt.figure(figsize=(10, 5))
plt.subplot(1, 2, 1)
plot_losses(train_losses, valid_losses)
plt.subplot(1, 2, 2)
plot_accuracy(train_dice_scores, valid_dice_scores)
```

```
93%|█████████ | 14/15 [10:35<00:40, 40.73s/it]
```

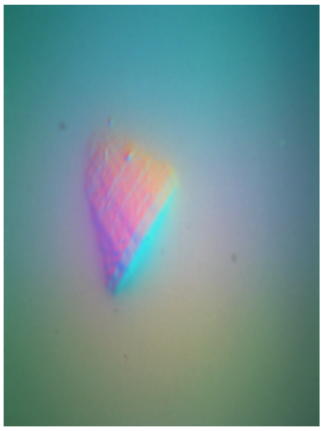


Tactile Image 66

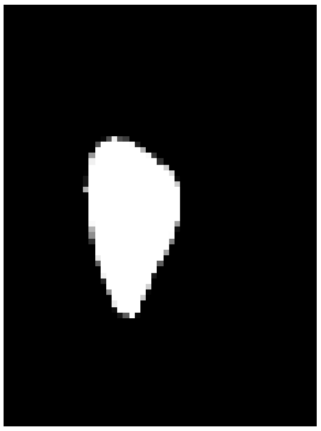
True Contact Mask

Predicted Contact Mask

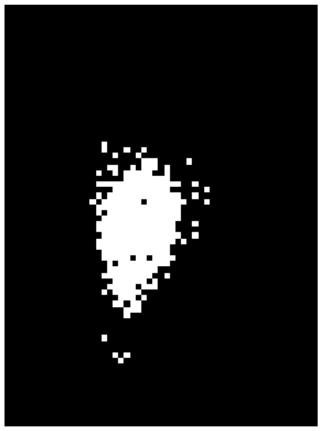
Tactile Image 67



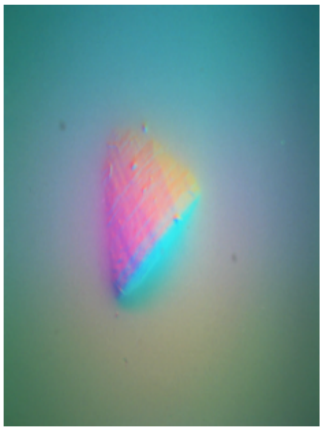
True Contact Mask



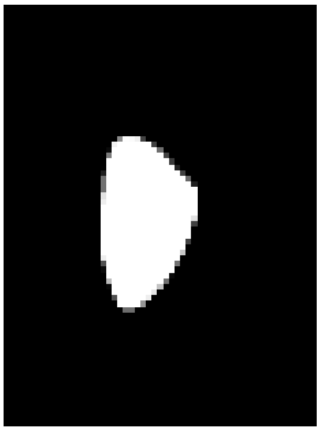
Predicted Contact Mask



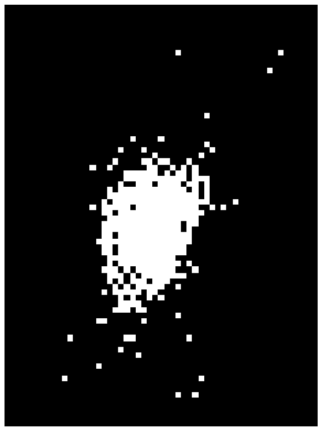
Tactile Image 68



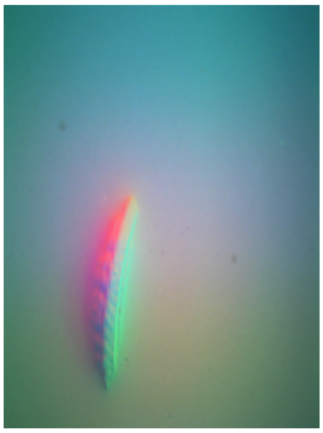
True Contact Mask



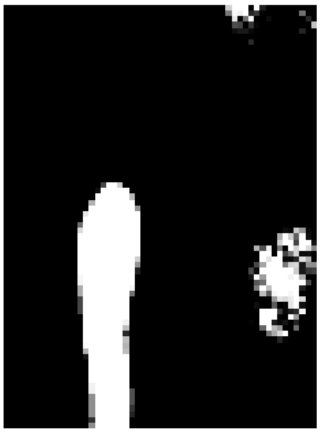
Predicted Contact Mask



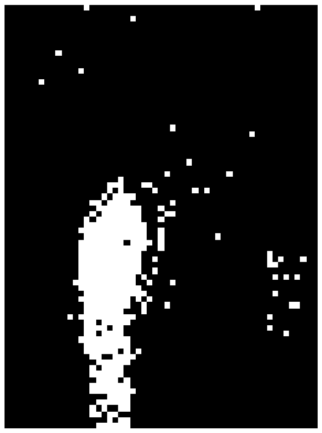
Tactile Image 69



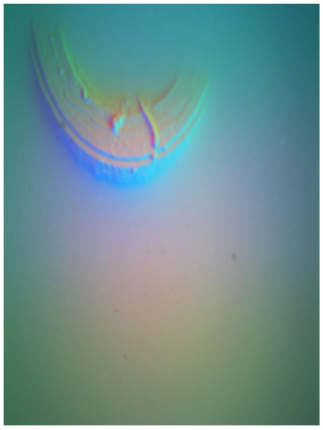
True Contact Mask



Predicted Contact Mask



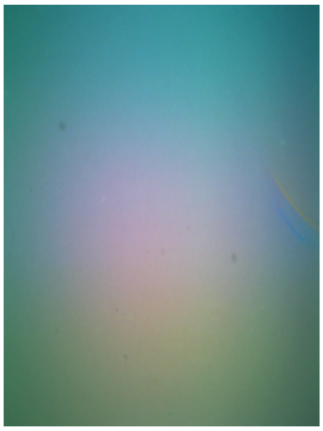
Tactile Image 70



True Contact Mask

Predicted Contact Mask

Tactile Image 71



True Contact Mask

Predicted Contact Mask

Tactile Image 72

True Contact Mask

Predicted Contact Mask

Tactile Image 73

True Contact Mask

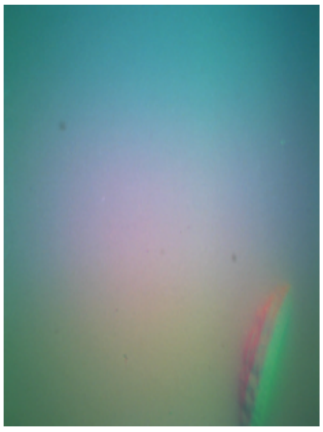
Predicted Contact Mask

Tactile Image 74

True Contact Mask

Predicted Contact Mask

Tactile Image 75

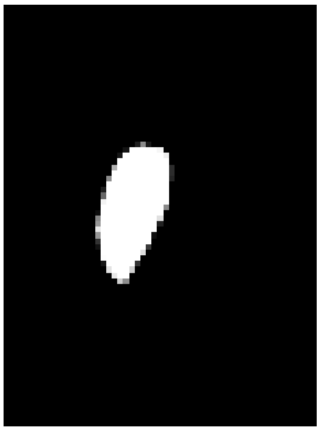


True Contact Mask

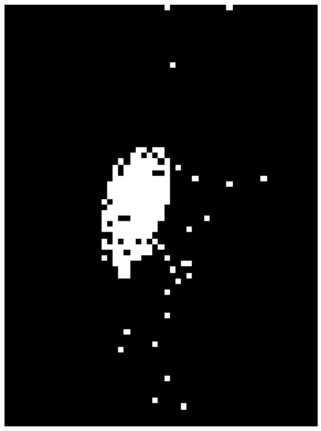
Predicted Contact Mask

Tactile Image 76

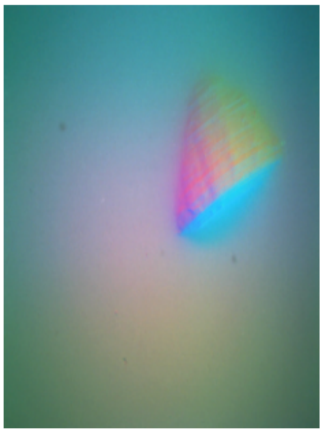
True Contact Mask



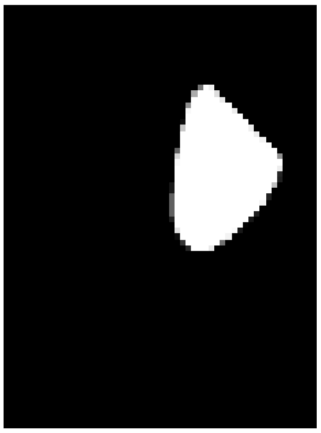
Predicted Contact Mask



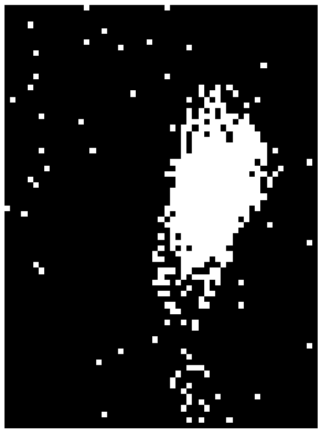
Tactile Image 77

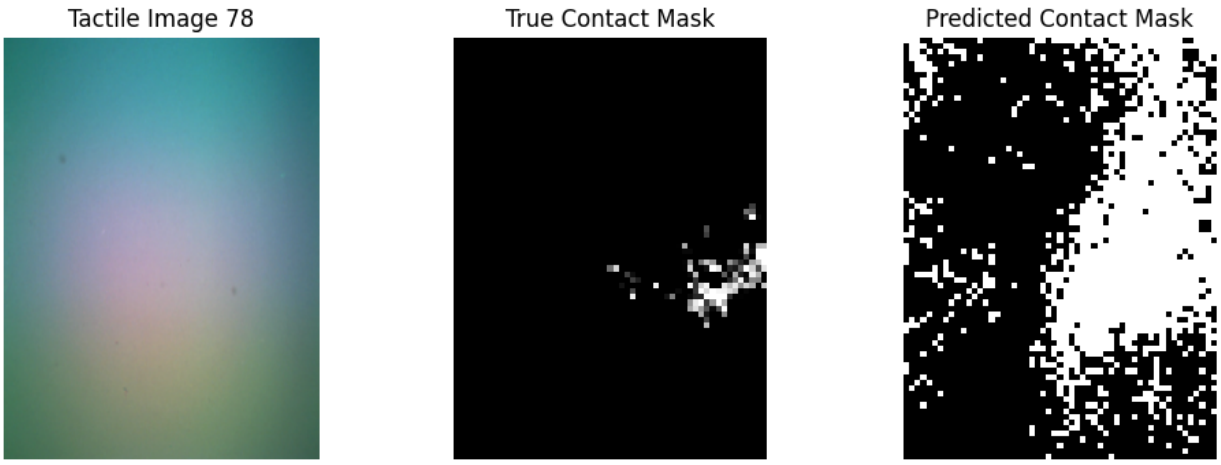


True Contact Mask

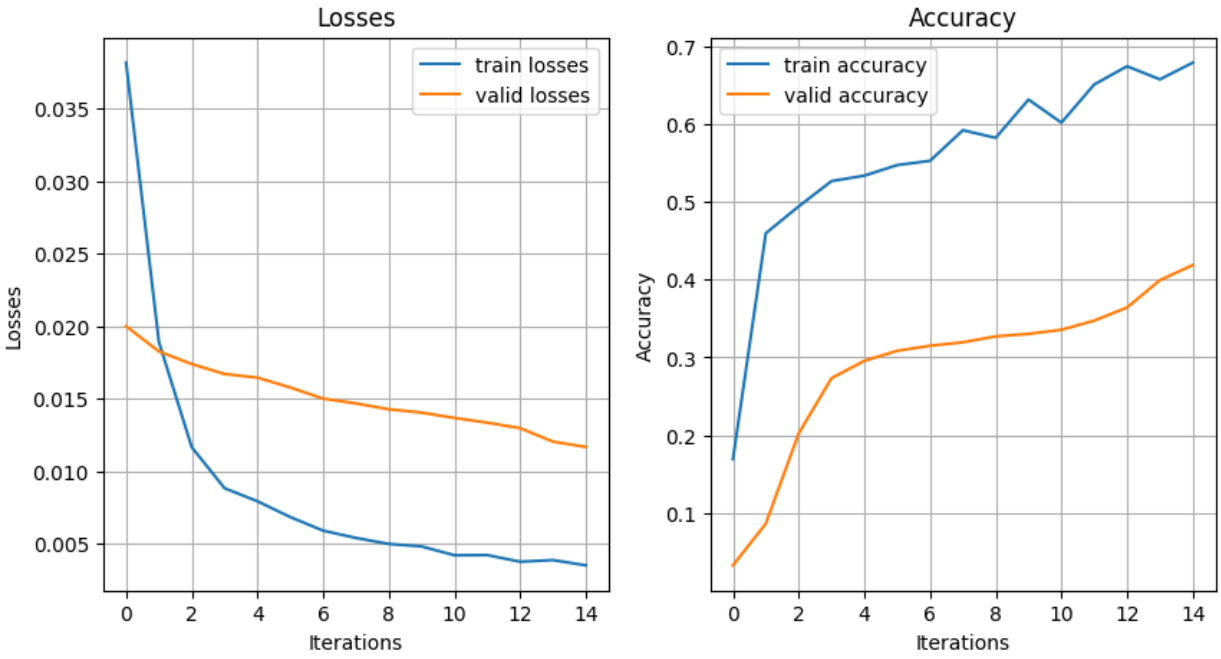


Predicted Contact Mask






```
100%|██████████| 15/15 [11:21<00:00, 45.44s/it]
Time used (Sec):  681.6220779418945  per epoch used:  45.441471862792966
```



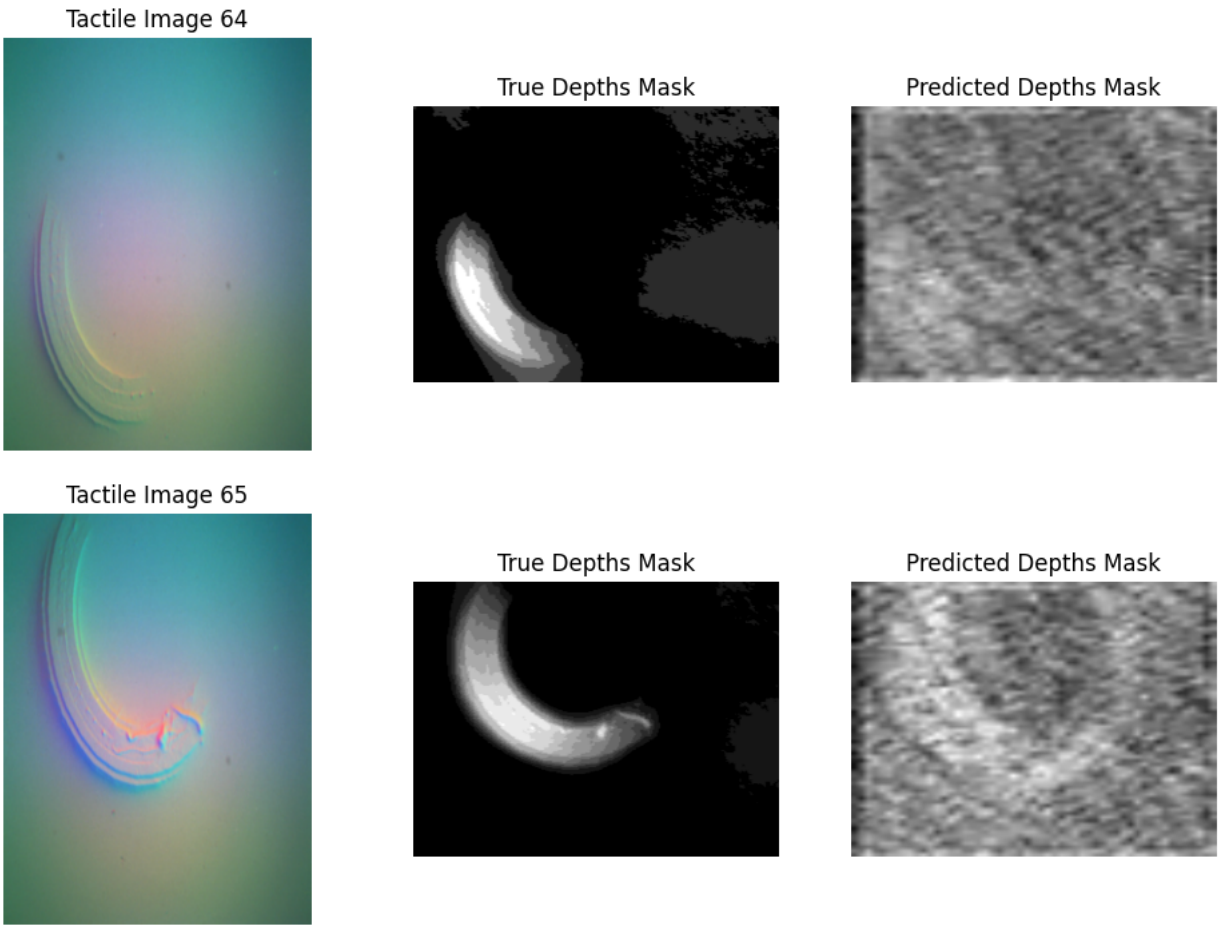
In [9]:

```python
# Tactile Depth Model Training Loop
train_losses_, valid_losses_ = [], []
train_mse_scores = []
valid_mse_scores = []
tl_b_ = []
start = time.time()
depth_epochs = 15
mse_loss_fn = nn.MSELoss()

for epoch in range(depth_epochs):
    print('>', end=' ')
    train_loss = 0
    train_mse = 0
    tactile_depth_model.train()
    contact_model.eval()  # Ensure contact_model is in evaluation mode

    for i, samples in enumerate(dataloader_train):
        tactiles = samples['tactile'].float().to(device)
        depths = samples['depth'].float().to(device)
        depths_resized = F.interpolate(depths, size=(240, 320), mode='bilinear', align
```

```
        with torch.no_grad():
            # Get the output from the contact model
            contact_output = contact_model(tactiles)

        # Forward pass in TactileDepthNet
        output = tactile_depth_model(tactiles, contact_output)

        # compute mse score
        mse_score = mse_loss_fn(output, depths_resized)
        train_mse += mse_score.item()

        # Compute loss
        loss = tactile_depth_criterion(output, depths_resized)
        train_loss += loss.item()
        tl_b_.append(loss.item())

        # Backward pass
        tactile_depth_optimizer.zero_grad()
        loss.backward()

        # Optimization
        tactile_depth_optimizer.step()

    if epoch == depth_epochs - 1:
        for j in range(tactiles.size(0)):
            tactile_image = tactiles[j].cpu().permute(1, 2, 0)  # Change the order of
            true_depths = depths_resized[j].cpu().squeeze()  # Remove unnecessary dime
            predicted_depth = output[j].cpu().squeeze()

            # Apply threshold to predicted contact mask to make it binary

            # Plot the images
            plt.figure(figsize=(12, 4))
            plt.subplot(1, 3, 1)
            plt.imshow(tactile_image.numpy(), cmap='gray')
            plt.title(f'Tactile Image {i * dataloader_valid.batch_size + j}')
            plt.axis('off')

            plt.subplot(1, 3, 2)
            plt.imshow(true_depths.numpy(), cmap='gray')
            plt.title('True Depths Mask')
            plt.axis('off')

            predicted_depth_numpy = predicted_depth.detach().cpu().numpy()
            plt.subplot(1, 3, 3)
            plt.imshow(predicted_depth_numpy, cmap='gray')
            plt.title('Predicted Depths Mask')
            plt.axis('off')

            plt.show()

    train_losses_.append(train_loss / datalen_train)
    train_mse_scores.append(train_mse / len(dataloader_train))
    valid_loss = 0
    valid_mse = 0
    tactile_depth_model.eval()

    with torch.no_grad():
        for i, samples in enumerate(dataloader_valid):
            tactiles = samples['tactile'].float().to(device)
```

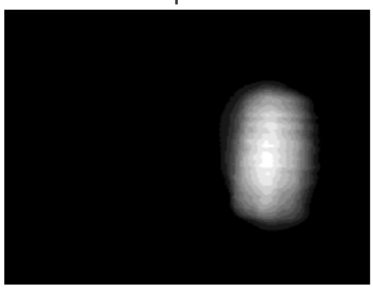
```
            depths = samples['depth'].float().to(device)
            depths_resized = F.interpolate(depths, size=(240, 320), mode='bilinear', a

            # Get the output from the contact model
            contact_output = contact_model(tactiles)

            # Forward pass in TactileDepthNet
            output = tactile_depth_model(tactiles, contact_output)

            # Compute loss
            loss = tactile_depth_criterion(output, depths_resized)
            valid_loss += loss.item()
            mse_score = mse_loss_fn(output, depths_resized)
            valid_mse += mse_score.item()

    valid_losses_.append(valid_loss / datalen_valid)
    valid_mse_scores.append(valid_mse / len(dataloader_valid))

    # Save model
    torch.save(tactile_depth_model.state_dict(), f"tactile_depth_model_epoch_{epoch}.p

elapse = time.time() - start
print('Time used (Sec): ', elapse, ' per epoch used: ', elapse / depth_epochs)
plt.figure(figsize=(10, 5))
plt.subplot(1, 2, 1)
plot_losses(train_losses, valid_losses)
plt.subplot(1, 2, 2)
plot_accuracy(train_mse_scores, valid_mse_scores)
```

> > > > > > > > > > > > > > >

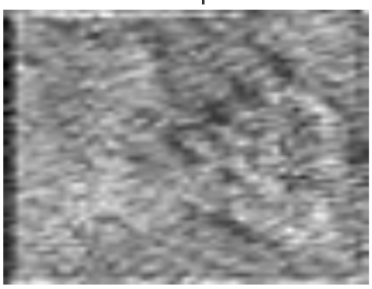


Tactile Image 66

True Depths Mask

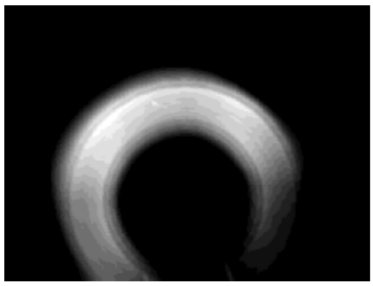


Predicted Depths Mask

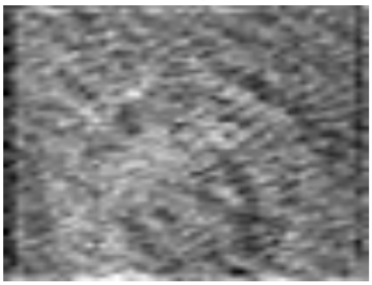


Tactile Image 67

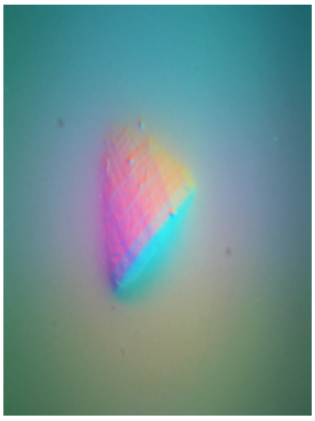
True Depths Mask



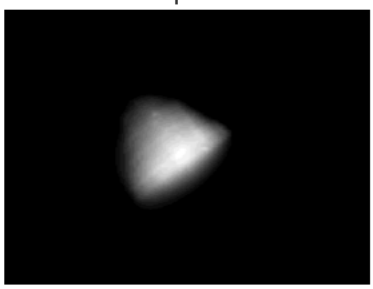
Predicted Depths Mask



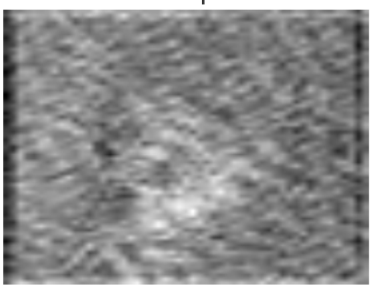
Tactile Image 68



True Depths Mask

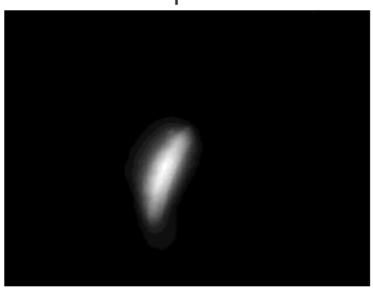


Predicted Depths Mask

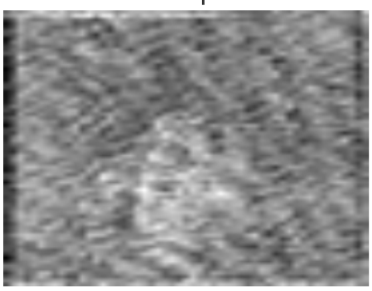


Tactile Image 69

True Depths Mask

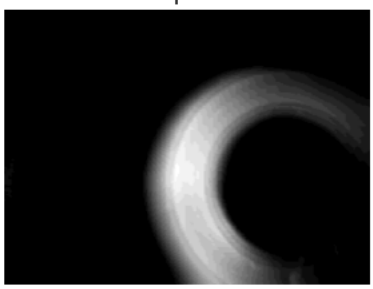


Predicted Depths Mask

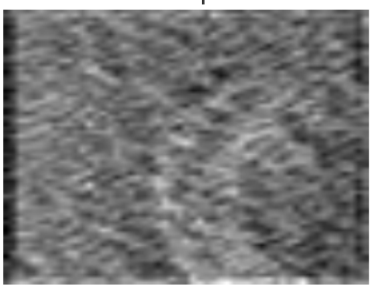


Tactile Image 70

True Depths Mask

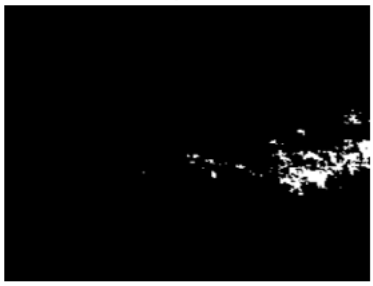


Predicted Depths Mask

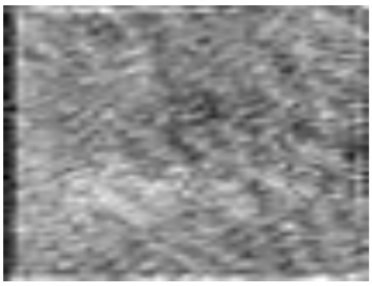


Tactile Image 71

True Depths Mask

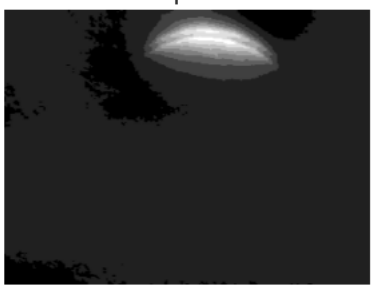


Predicted Depths Mask

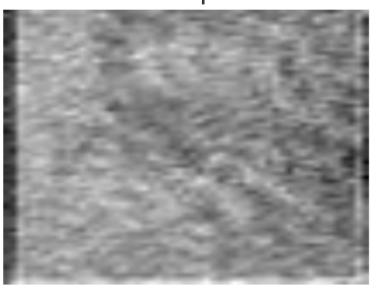


Tactile Image 72

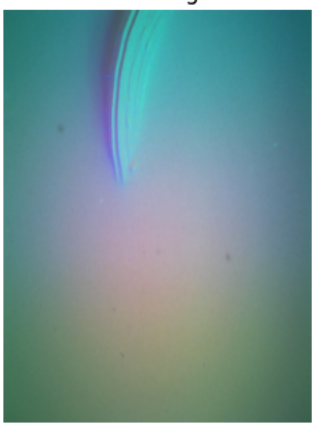
True Depths Mask



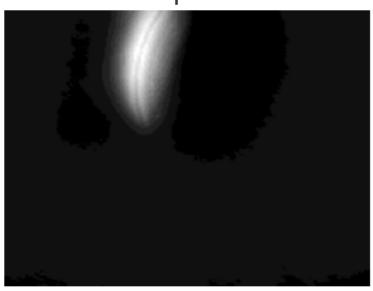
Predicted Depths Mask



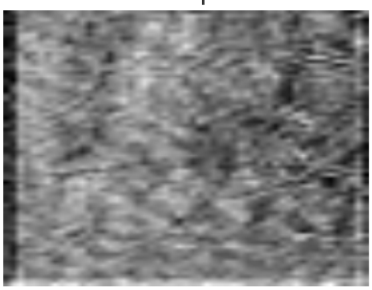
Tactile Image 73



True Depths Mask

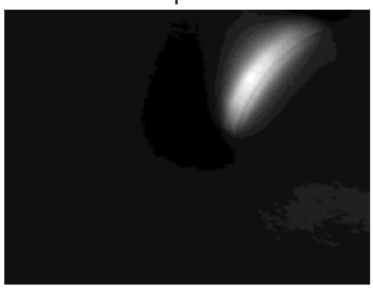


Predicted Depths Mask

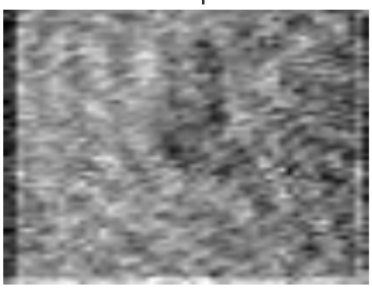


Tactile Image 74

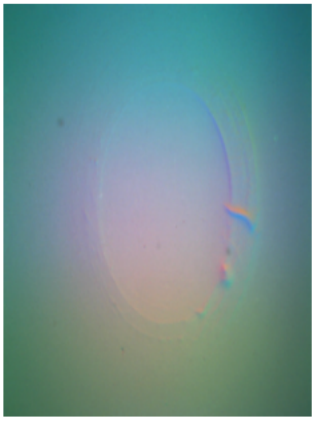
True Depths Mask



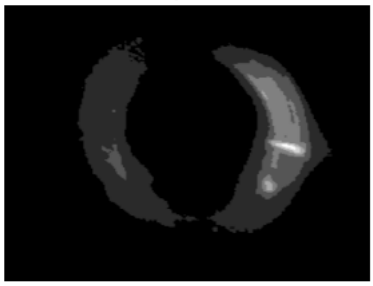
Predicted Depths Mask



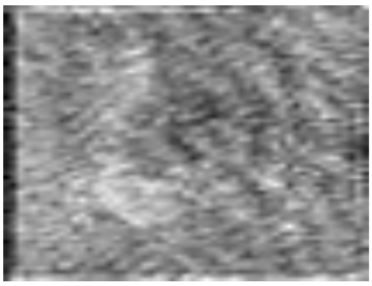
Tactile Image 75



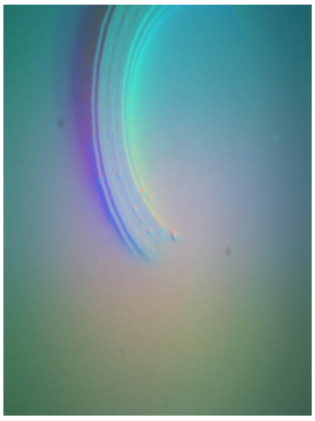
True Depths Mask



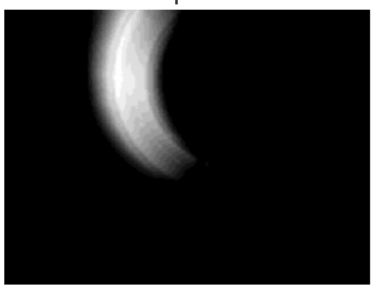
Predicted Depths Mask



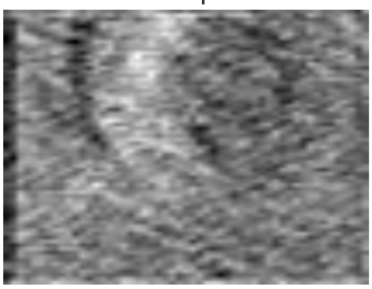
Tactile Image 76



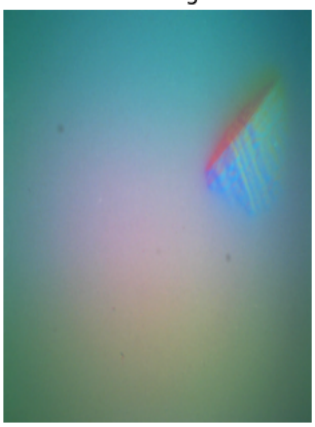
True Depths Mask



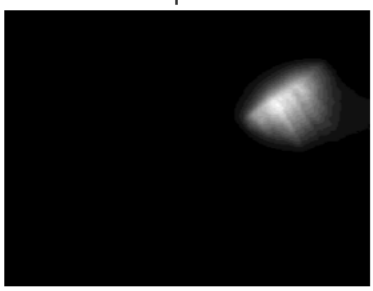
Predicted Depths Mask



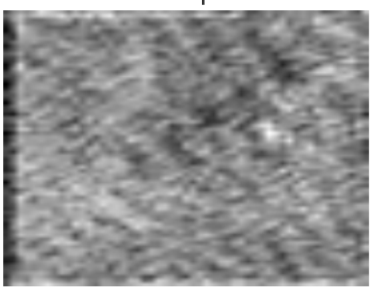
Tactile Image 77



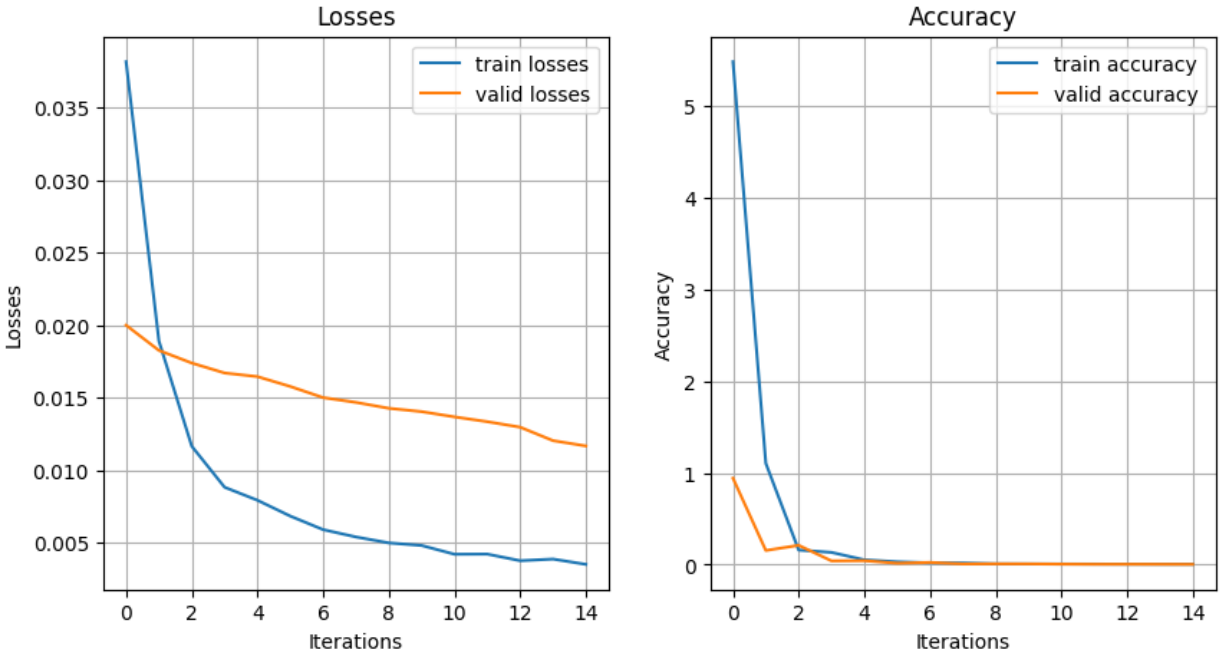
True Depths Mask



Predicted Depths Mask




```
Time used (Sec):  358.2681031227112  per epoch used:  23.884540208180745
```



In [ ]:
```python
# Overfit on single batch for DEPTH
overfit_batch = next(iter(dataloader_train))
train_losses_, valid_losses_ = [], []
train_mse_scores = []
valid_mse_scores = []
tl_b_ = []
start = time.time()
num_epochs = 50
mse_loss_fn = nn.MSELoss()

for epoch in range(num_epochs):
    print('>', end=' ')

    train_loss = 0
    train_mse = 0
    tactile_depth_model.train()
    contact_model.eval()  # Ensure contact_model is in evaluation mode

    tactiles = samples['tactile'].float().to(device)
    depths = samples['depth'].float().to(device)
    depths_resized = F.interpolate(depths, size=(74, 55), mode='bilinear', align_corne
```

```
    with torch.no_grad():
        # Get the output from the contact model
        contact_output = contact_model(tactiles)

    # Forward pass in TactileDepthNet
    output = tactile_depth_model(tactiles, contact_output)

    # compute mse score
    mse_score = mse_loss_fn(output, depths_resized)
    train_mse += mse_score.item()

    # Compute loss
    loss = tactile_depth_criterion(output, depths_resized)
    train_loss += loss.item()
    tl_b_.append(loss.item())

    # Backward pass
    tactile_depth_optimizer.zero_grad()
    loss.backward()

    # Optimization
    tactile_depth_optimizer.step()

    if epoch == num_epochs - 1:
        for j in range(tactiles.size(0)):
            tactile_image = tactiles[j].cpu().permute(1, 2, 0)  # Change the order of
            true_depths = depths_resized[j].cpu().squeeze()  # Remove unnecessary dime
            predicted_depth = output[j].cpu().squeeze()

            # Apply threshold to predicted contact mask to make it binary

            # Plot the images
            plt.figure(figsize=(12, 4))
            plt.subplot(1, 3, 1)
            plt.imshow(tactile_image.numpy(), cmap='gray')
            plt.title(f'Tactile Image {i * dataloader_valid.batch_size + j}')
            plt.axis('off')

            plt.subplot(1, 3, 2)
            plt.imshow(true_depths.numpy(), cmap='gray')
            plt.title('True Depths Mask')
            plt.axis('off')

            predicted_depth_numpy = predicted_depth.detach().cpu().numpy()
            plt.subplot(1, 3, 3)
            plt.imshow(predicted_depth_numpy, cmap='gray')
            plt.title('Predicted Depths Mask')
            plt.axis('off')

            plt.show()

    train_losses_.append(train_loss / datalen_train)
    train_mse_scores.append(train_mse / len(dataloader_train))
    valid_loss = 0
    valid_mse = 0
    tactile_depth_model.eval()

    with torch.no_grad():
        for i, samples in enumerate(dataloader_valid):
            tactiles = samples['tactile'].float().to(device)
```

```
            depths = samples['depth'].float().to(device)
            depths_resized = F.interpolate(depths, size=(74, 55), mode='bilinear', ali

            # Get the output from the contact model
            contact_output = contact_model(tactiles)

            # Forward pass in TactileDepthNet
            output = tactile_depth_model(tactiles, contact_output)

            # Compute loss
            loss = tactile_depth_criterion(output, depths_resized)
            valid_loss += loss.item()
            mse_score = mse_loss_fn(output, depths_resized)
            valid_mse += mse_score.item()

    valid_losses_.append(valid_loss / datalen_valid)
    valid_mse_scores.append(valid_mse / len(dataloader_valid))

    # Save model
    torch.save(tactile_depth_model.state_dict(), f"tactile_depth_model_epoch_{epoch}.p


elapse = time.time() - start
print('Time used (Sec): ', elapse, ' per epoch used: ', elapse / num_epochs)
plt.figure(figsize=(10, 5))
plt.subplot(1, 2, 1)
plot_losses(train_losses, valid_losses)
plt.subplot(1, 2, 2)
plot_mse(train_mse_scores, valid_mse_scores)
```

> >

```
---------------------------------------------------------------------------
KeyboardInterrupt                         Traceback (most recent call last)
<ipython-input-10-9b22d381b6da> in <cell line: 11>()
     26
     27     # Forward pass in TactileDepthNet
---> 28     output = tactile_depth_model(tactiles, contact_output)
     29
     30     # compute mse score

/usr/local/lib/python3.10/dist-packages/torch/nn/modules/module.py in _wrapped_call_i
mpl(self, *args, **kwargs)
   1516             return self._compiled_call_impl(*args, **kwargs)  # type: ignore
[misc]
   1517         else:
-> 1518             return self._call_impl(*args, **kwargs)
   1519
   1520     def _call_impl(self, *args, **kwargs):

/usr/local/lib/python3.10/dist-packages/torch/nn/modules/module.py in _call_impl(sel
f, *args, **kwargs)
   1525                 or _global_backward_pre_hooks or _global_backward_hooks
   1526                 or _global_forward_hooks or _global_forward_pre_hooks):
-> 1527             return forward_call(*args, **kwargs)
   1528
   1529         try:

/usr/local/lib/python3.10/dist-packages/torch/nn/parallel/data_parallel.py in forward
(self, *inputs, **kwargs)
    165         with torch.autograd.profiler.record_function("DataParallel.forward"):
    166             if not self.device_ids:
--> 167                 return self.module(*inputs, **kwargs)
    168
    169             for t in chain(self.module.parameters(), self.module.buffers()):

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   1525                 or _global_backward_pre_hooks or _global_backward_hooks
   1526                 or _global_forward_hooks or _global_forward_pre_hooks):
-> 1527             return forward_call(*args, **kwargs)
   1528
   1529         try:

<ipython-input-3-28e947679845> in forward(self, x, contact_output_batch)
     87
     88     def forward(self, x, contact_output_batch):
---> 89         x = self.pool1(F.relu(self.fine1(x)))
     90         contact_output_batch_resized = F.interpolate(contact_output_batch, si
ze=(x.size(2), x.size(3)), mode='bilinear', align_corners=False)
     91         # Concatenate with contact output feature map

/usr/local/lib/python3.10/dist-packages/torch/nn/modules/module.py in _wrapped_call_i
```

```
mpl(self, *args, **kwargs)
   1516             return self._compiled_call_impl(*args, **kwargs)  # type: ignore
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-> 1518             return self._call_impl(*args, **kwargs)
   1519
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   1526                 or _global_forward_hooks or _global_forward_pre_hooks):
-> 1527             return forward_call(*args, **kwargs)
   1528
   1529         try:

/usr/local/lib/python3.10/dist-packages/torch/nn/modules/conv.py in forward(self, inp
ut)
    458
    459     def forward(self, input: Tensor) -> Tensor:
--> 460         return self._conv_forward(input, self.weight, self.bias)
    461
    462 class Conv3d(_ConvNd):

/usr/local/lib/python3.10/dist-packages/torch/nn/modules/conv.py in _conv_forward(sel
f, input, weight, bias)
    454                             weight, bias, self.stride,
    455                             _pair(0), self.dilation, self.groups)
--> 456         return F.conv2d(input, weight, bias, self.stride,
    457                         self.padding, self.dilation, self.groups)
    458

KeyboardInterrupt:
```

In [ ]:

```python
import matplotlib.pyplot as plt
import numpy as np
import torch

# Assuming you have defined your model, dataloader, and other necessary components

# Initialize variables
lr_start = 1e-6
lr_end = 1e-1
num_iterations = 10000  # Adjust this based on your dataset size and desired granulari
lr_lambda = lambda x: np.exp(x * np.log(lr_end / lr_start) / num_iterations)
scheduler = torch.optim.lr_scheduler.LambdaLR(tactile_depth_optimizer, lr_lambda)
train_losses = []
lrs = []
dataset_train = TactileDataset(data_dir_train / 'tactile', data_dir_train / 'depth', t
dataloader_train = DataLoader(dataset_train, batch_size=bs, shuffle=True)

# Training Loop
for iteration, samples in enumerate(dataloader_train):
    if iteration >= num_iterations:
        break

    # Training step
    tactiles = samples['tactile'].float().to(device)
    depths = samples['depth'].float().to(device)
    depths_resized = F.interpolate(depths, size=(74, 55), mode='bilinear', align_corne
```

```
    # Get the output from the contact model
    contact_output = contact_model(tactiles)

    # Forward pass in TactileDepthNet
    output = tactile_depth_model(tactiles, contact_output)

    # Compute loss
    loss = tactile_depth_criterion(output, depths_resized)

    # Backward pass and optimization
    tactile_depth_optimizer.zero_grad()
    loss.backward()
    tactile_depth_optimizer.step()

    # Update learning rate
    scheduler.step()
    current_lr = scheduler.get_last_lr()[0]
    lrs.append(current_lr)
    train_losses.append(loss.item())

    # Print all learning rates
    for i, lr in enumerate(lrs):
        print(f"Iteration {i}, Learning Rate {lr}")


# After this loop, lrs and train_losses should have the same length


# Plotting
plt.figure(figsize=(10, 5))
plt.plot(range(len(train_losses)), train_losses)
plt.xlabel('Iteration')
plt.ylabel('Loss')
plt.title('Loss vs. Iteration')
plt.show()

# And for learning rate:
plt.figure(figsize=(10, 5))
plt.plot(range(len(lrs)), lrs)
plt.xlabel('Iteration')
plt.ylabel('Learning Rate')
plt.title('Learning Rate over Iterations')
plt.show()
```

```
---------------------------------------------------------------------------
KeyboardInterrupt                         Traceback (most recent call last)
<ipython-input-18-1d24d6b908ba> in <cell line: 19>()
     27
     28     # Get the output from the contact model
---> 29     contact_output = contact_model(tactiles)
     30
     31     # Forward pass in TactileDepthNet

/usr/local/lib/python3.10/dist-packages/torch/nn/modules/module.py in _wrapped_call_i
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(self, *inputs, **kwargs)
    165         with torch.autograd.profiler.record_function("DataParallel.forward"):
    166             if not self.device_ids:
--> 167                 return self.module(*inputs, **kwargs)
    168
    169             for t in chain(self.module.parameters(), self.module.buffers()):

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   1526                 or _global_forward_hooks or _global_forward_pre_hooks):
-> 1527             return forward_call(*args, **kwargs)
   1528
   1529         try:

<ipython-input-4-28e947679845> in forward(self, x)
     45     def forward(self, x):
     46         x = self.pool1(F.relu(self.bn1(self.conv1(x))))
---> 47         x = self.pool2(F.relu(self.bn2(self.conv2(x))))
     48         x = F.relu(self.bn3(self.conv3(x)))
     49         x = F.relu(self.bn4(self.conv4(x)))

/usr/local/lib/python3.10/dist-packages/torch/nn/modules/module.py in _wrapped_call_i
mpl(self, *args, **kwargs)
```

```
   1516             return self._compiled_call_impl(*args, **kwargs)  # type: ignore
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    458
    459     def forward(self, input: Tensor) -> Tensor:
--> 460         return self._conv_forward(input, self.weight, self.bias)
    461
    462 class Conv3d(_ConvNd):

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    454                             weight, bias, self.stride,
    455                             _pair(0), self.dilation, self.groups)
--> 456         return F.conv2d(input, weight, bias, self.stride,
    457                         self.padding, self.dilation, self.groups)
    458

KeyboardInterrupt:
```
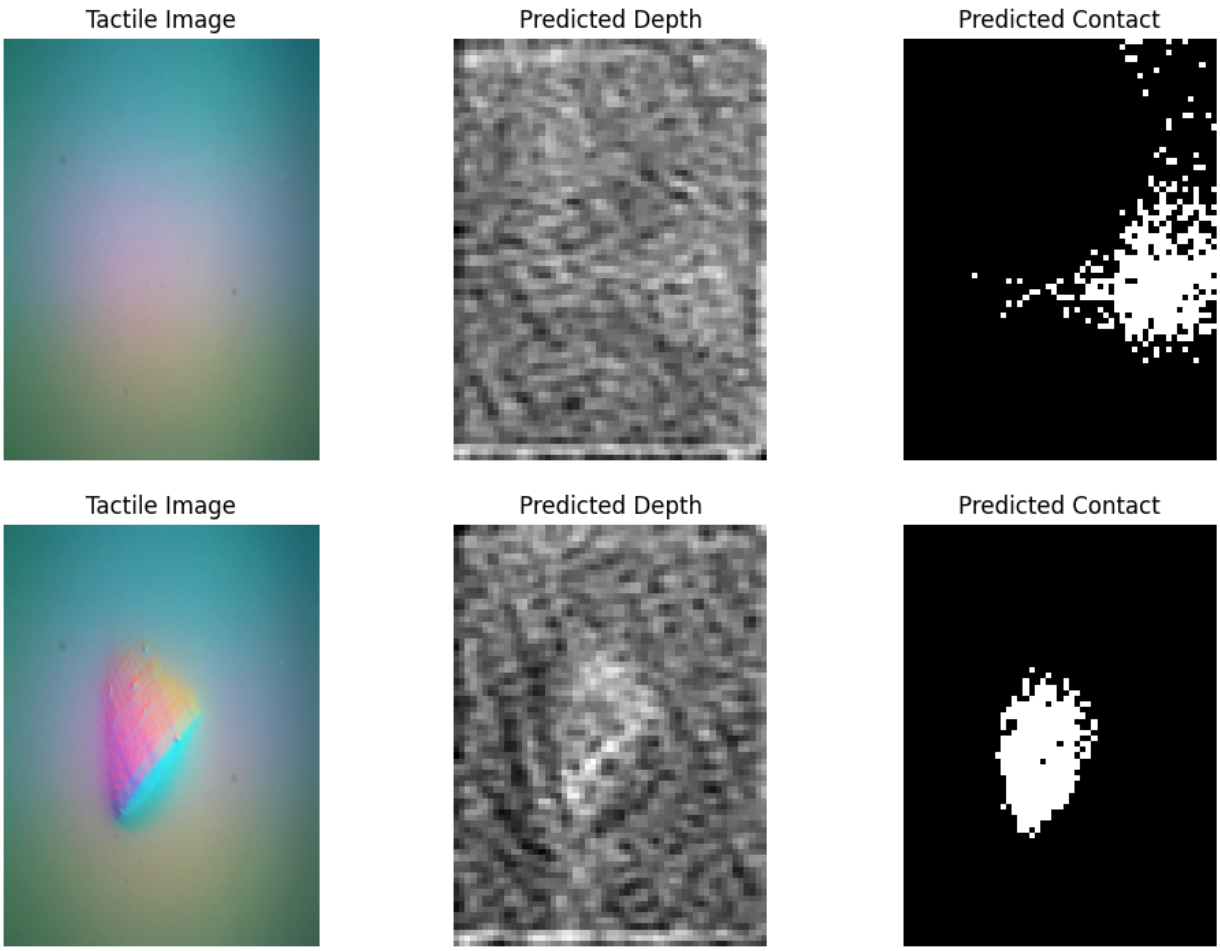
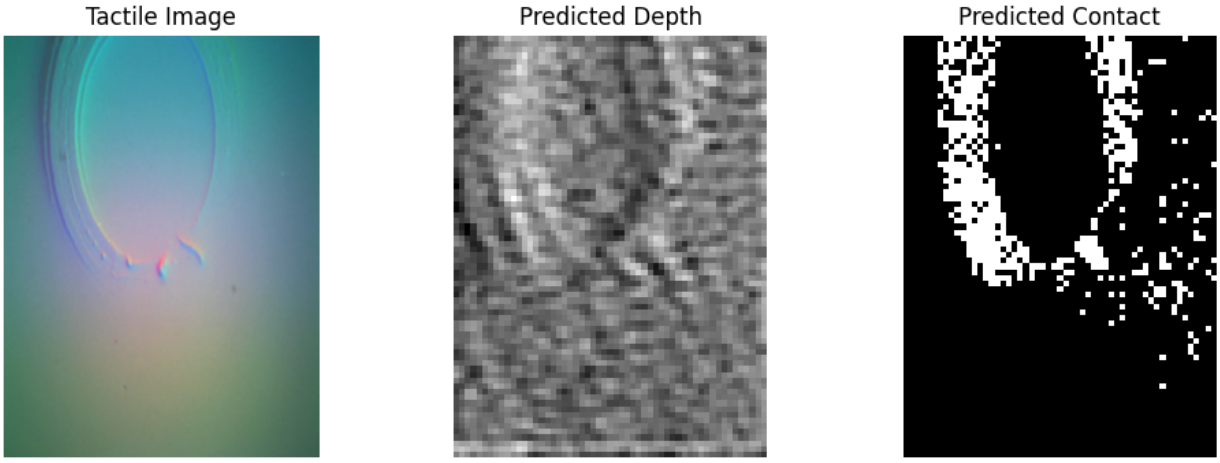

In [ ]:
```
plt.subplot(311)
plt.plot(tl_b, label='train loss')
plt.grid(True)
plt.legend()

plt.subplot(312)
plt.plot(tl_b[100:], label='train loss')
plt.grid(True)
plt.legend()

plt.subplot(313)
plt.plot(tl_b[300:], label='train loss')
fml = np.mean(tl_b[-320:])
plt.axhline(y = fml, color='r', linestyle='-', label='final mean train loss: {:.2f}'.f
plt.grid(True)
plt.legend()
```

In [ ]:
```
## Evaluation
## You should evaluate multiple error and accuracy metrics that are used for depth est
import numpy as np
import matplotlib.pyplot as plt

# Evaluation Metrics
def rmse(predictions, targets):
    return np.sqrt(((predictions - targets) ** 2).mean())
```

```python
def scale_invariant_error(predictions, targets):
    epsilon = 1e-6  # Small constant to avoid log(0)
    predictions = np.maximum(predictions, epsilon)  # Replaces negative values with ep

    valid_mask = targets > 0  # Create a mask for non-zero targets
    if np.sum(valid_mask) == 0:
        return np.nan  # Return NaN if there are no valid targets

    predictions_valid = predictions[valid_mask]
    targets_valid = targets[valid_mask]

    log_diff = np.log(predictions_valid + epsilon) - np.log(targets_valid + epsilon)
    n = len(predictions_valid)
    return (np.square(log_diff).mean()) - (np.square(log_diff.mean()) / n)


# Initialize metric accumulators
accum_rmse = 0
accum_scale_inv_err = 0
num_samples = 0

# Load state for contact model
contact_path = f"contact_model_epoch_{contact_epochs - 1}.pt"
contact_model.load_state_dict(torch.load(contact_path, map_location=device))

# Load state for depth model
depth_path = f"tactile_depth_model_epoch_{depth_epochs - 1}.pt"
tactile_depth_model.load_state_dict(torch.load(depth_path, map_location=device))

# Evaluation loop
for i, samples in enumerate(dataloader_train):
    tactiles = samples['tactile'].float().to(device)
    depths = samples['depth'].float().to(device)
    depths_resized = F.interpolate(depths, size=(74, 55), mode='bilinear', align_corne

    contact_model.eval()
    tactile_depth_model.eval()

    with torch.no_grad():
        contact_output = contact_model(tactiles)
        tactile_depth_output = tactile_depth_model(tactiles, contact_output)
        predicted_depth = tactile_depth_output.clone()  # Clone to avoid modifying the
        predicted_depth_sample = predicted_depth[i].squeeze()


    # Calculate metrics
    accum_rmse += rmse(tactile_depth_output.cpu().numpy(), depths_resized.cpu().numpy(
    accum_scale_inv_err += scale_invariant_error(tactile_depth_output.cpu().numpy(), d
    num_samples += 1

    if i < 10:  # Plot first 10 samples
        plt.figure(figsize=(12, 4))
        plt.subplot(1, 3, 1)
        plt.imshow(tactiles[i].cpu().permute(1, 2, 0))
        plt.title('Tactile Image')
        plt.axis('off')

        predicted_depth_numpy = predicted_depth_sample.detach().cpu().numpy()
        plt.subplot(1, 3, 2)
        plt.imshow(predicted_depth_numpy, cmap='gray')
```

```
        plt.title('Predicted Depth')
        plt.axis('off')

        predicted_contact_binary = contact_output[i].cpu().squeeze() > 0.5

        plt.subplot(1, 3, 3)
        plt.imshow(predicted_contact_binary, cmap='gray')
        plt.title('Predicted Contact')
        plt.axis('off')

        plt.show()

# Compute average metrics
avg_rmse = accum_rmse / num_samples
avg_scale_inv_err = accum_scale_inv_err / num_samples
print('Average RMSE:', avg_rmse)
print('Average Scale-Invariant Error:', avg_scale_inv_err)


# show 10 sample images (from both the train and test sets) in a subplot figure. Each
```






```
Average RMSE: 0.04209675143162409
Average Scale-Invariant Error: 21.964490924153
```

Define a function below that instantializes the networks again and loads the weights for new predictions. This function will be used for testing purposes.

In [15]:
```
import cv2
import matplotlib.pyplot as plt
import os
def predict(dataloader, contact_model, tactile_depth_model, device, dataset_train, vis
    # Load state for models
    contact_path = f"contact_model_epoch_{contact_epochs - 1}.pt"
    depth_path = f"tactile_depth_model_epoch_{depth_epochs - 1}.pt"
    contact_model.load_state_dict(torch.load(contact_path, map_location=device))
    tactile_depth_model.load_state_dict(torch.load(depth_path, map_location=device))
    count = 0

    save_dir = '/content/saved_images'
    os.makedirs(save_dir, exist_ok=True)

    for i, samples in enumerate(dataloader):
        tactiles = samples['tactile'].float().to(device)

        contact_model.eval()
        tactile_depth_model.eval()

        with torch.no_grad():
            contact_output = contact_model(tactiles)
            tactile_depth_output = tactile_depth_model(tactiles, contact_output)

        for j in range(tactiles.size(0)):  # Iterate through each image in the batch
            predicted_depth_sample = tactile_depth_output[j].cpu().squeeze()
            predicted_depth_numpy = predicted_depth_sample.detach().cpu().numpy()
            predicted_contact_binary = contact_output[j].cpu().squeeze() > 0.5

            if visualize:
                plt.figure(figsize=(12, 4))
                plt.subplot(1, 3, 1)
                plt.imshow(tactiles[j].cpu().permute(1, 2, 0), cmap='gray')
                plt.title(f'Tactile Image {i * dataloader_valid.batch_size + j}')
                plt.axis('off')

                plt.subplot(1, 3, 2)
                plt.imshow(predicted_contact_binary, cmap='gray')
```

```
                plt.title('Predicted Contact')
                plt.axis('off')

                plt.subplot(1, 3, 3)
                plt.imshow(predicted_depth_sample, cmap='gray')
                plt.title('Predicted Depth')
                plt.axis('off')

                plt.show()



                # plt.show()

                # Construct file name and save the figure
                # Normalize or convert the range of predicted_depth_numpy
                if predicted_depth_numpy.dtype == np.float32 or predicted_depth_numpy.
                    # Normalize float images to the range [0, 1]
                    predicted_depth_norm = (predicted_depth_numpy - predicted_depth_nu
                else:
                    # Ensure integer images are within [0, 255]
                    predicted_depth_norm = np.clip(predicted_depth_numpy, 0, 255)

                plt.figure(figsize=(4, 4))
                plt.imshow(predicted_depth_norm, cmap='gray')
                plt.title('Predicted Depth')
                plt.axis('off')


                file_name = dataset_train.__get_file_name__(count)
                count += 1
                save_path = os.path.join(save_dir, file_name)
                cv2.imwrite(save_path, predicted_depth_norm)


            if visualize_3d:
                # Visualize the 3D depth map for each image
                fig = plt.figure(figsize=(14, 10))
                ax = fig.add_subplot(111, projection='3d')
                X, Y = np.meshgrid(np.arange(predicted_depth_numpy.shape[1]), np.arang
                surf = ax.plot_surface(X, Y, predicted_depth_numpy, cmap='viridis', ec
                ax.set_xlabel('X Coordinate')
                ax.set_ylabel('Y Coordinate')
                ax.set_zlabel('Depth')
                fig.colorbar(surf, shrink=0.5, aspect=5)
                plt.show()
```

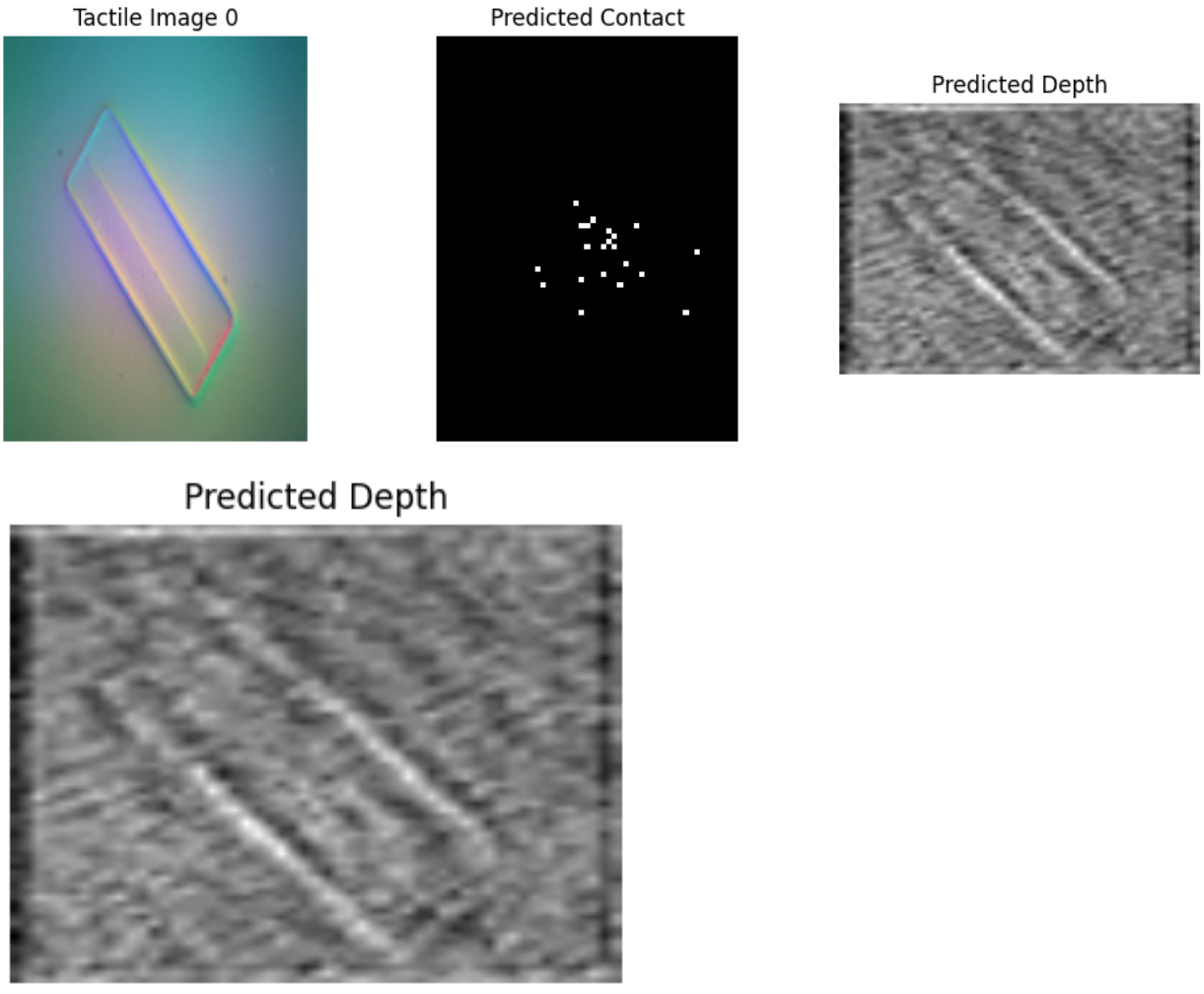
In [ ]:
```
!rm -rf /content/saved_images
```

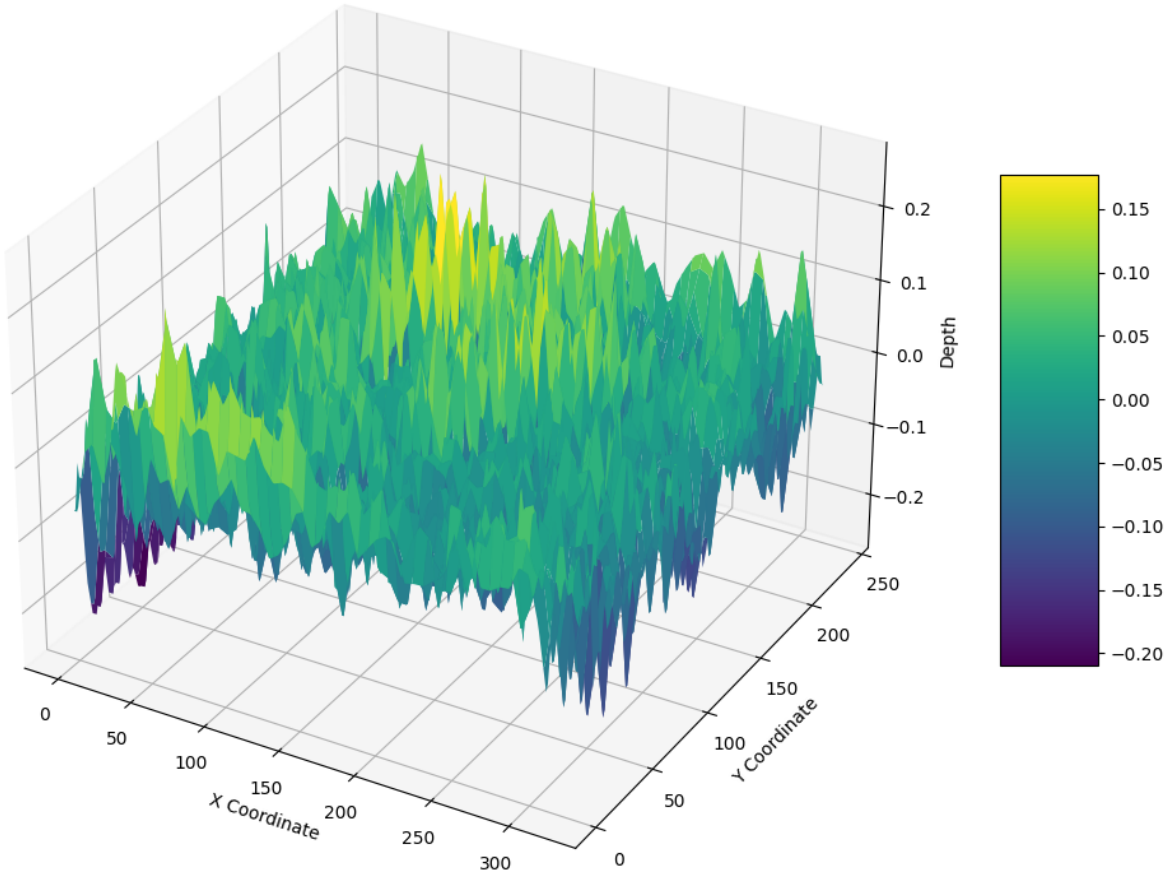
In [14]:
```
import os
import shutil
from google.colab import files

# Zip the folder
folder_path = '/content/saved_images'
zip_path = '/content/saved_images.zip'
shutil.make_archive(zip_path[:-4], 'zip', folder_path)
```

```
# Download the zipped file
files.download(zip_path)
```

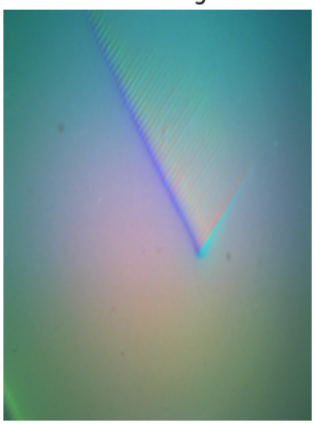
In [ ]:

```
import torch
from PIL import Image
from torchvision.transforms import ToTensor
import matplotlib.pyplot as plt
import numpy as np
import os

trans_train = transforms.Compose([
    # transforms.ToPILImage(),
    transforms.Resize((320, 240)),
    transforms.ToTensor(),
])


# Assuming 'content' and 'data_dir_train' are strings containing directory paths
dataset_train = TactileDataset(os.path.join('/content', 'test'), os.path.join(data_dir
dataloader_train = DataLoader(dataset_train, batch_size=bs, shuffle=True)
dataloader = dataloader_train


# Run the prediction function
predict(dataloader, contact_model, tactile_depth_model, device, dataset_train)
```

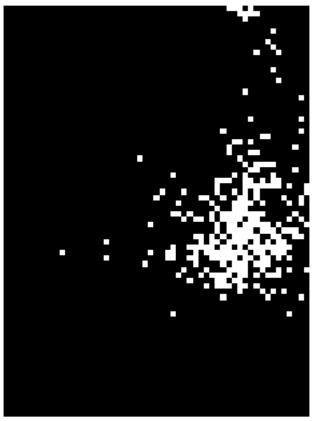




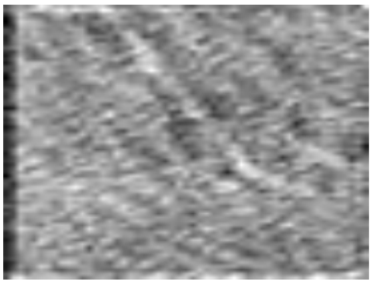
Tactile Image 1

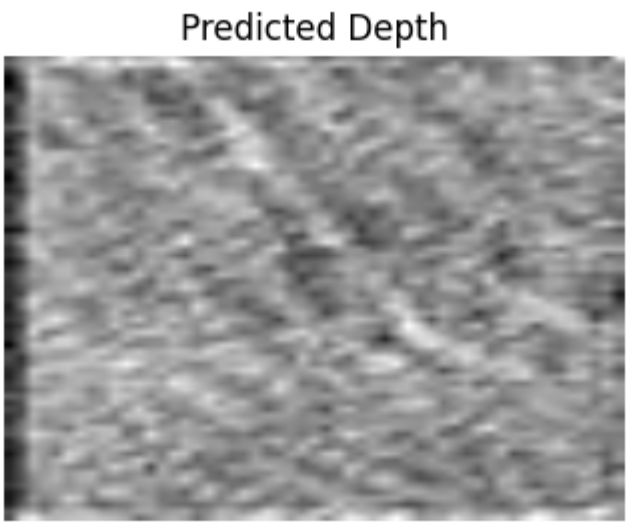


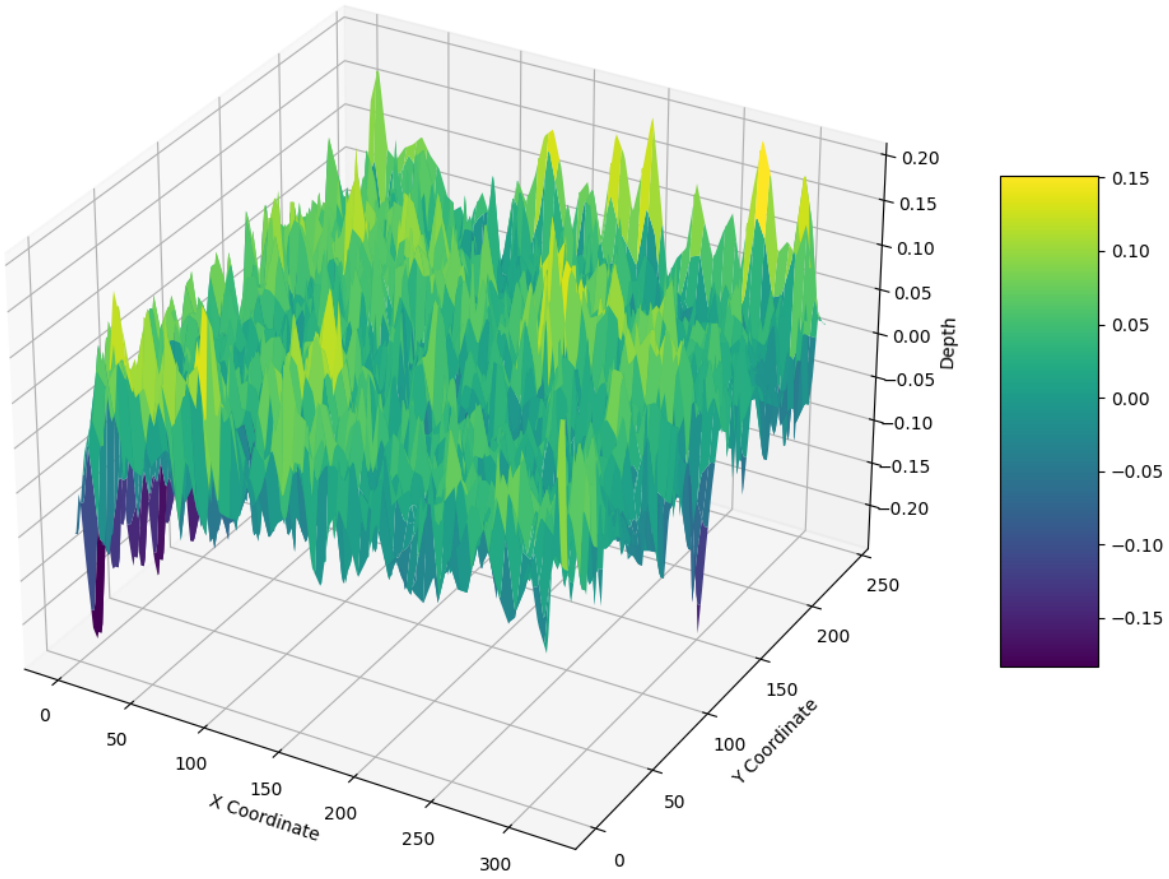
Predicted Contact



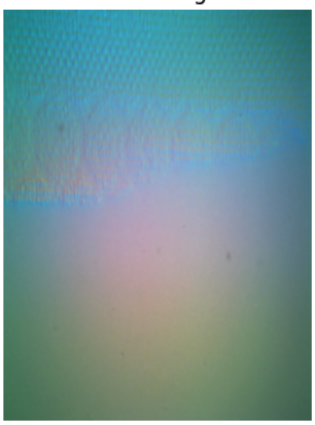
Predicted Depth




Predicted Depth

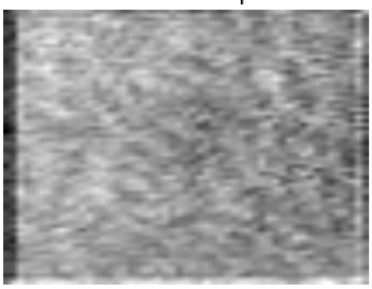

0.20
0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15
−0.20
Depth
0
50
100
150
200
250
300
X Coordinate
0
50
100
150
200
250
Y Coordinate
0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15

Tactile Image 2

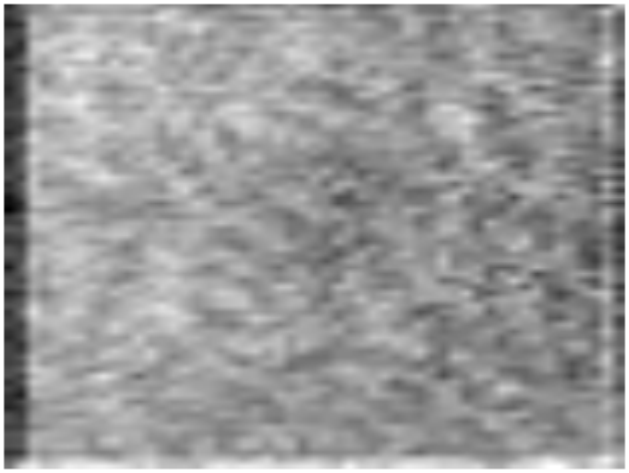


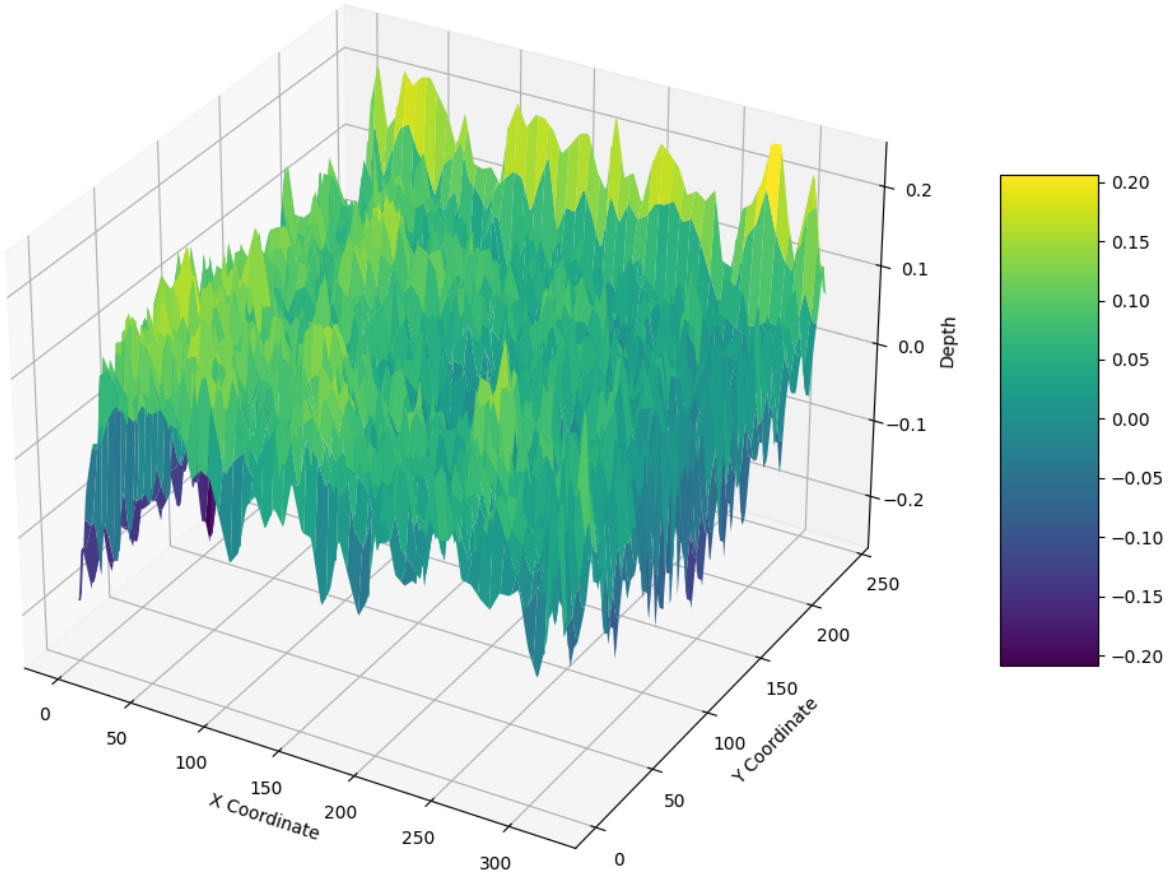
Predicted Contact

Predicted Depth



Predicted Depth

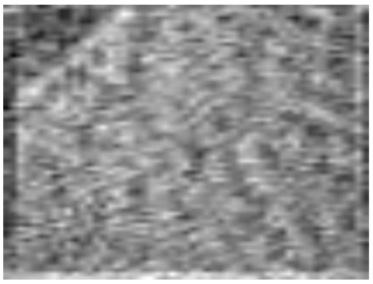


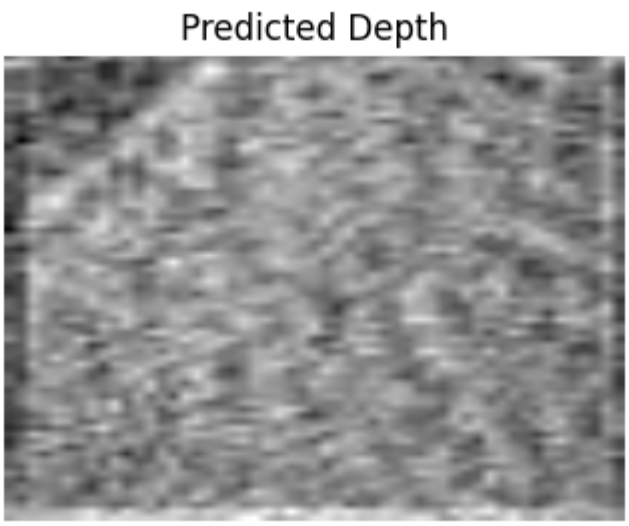


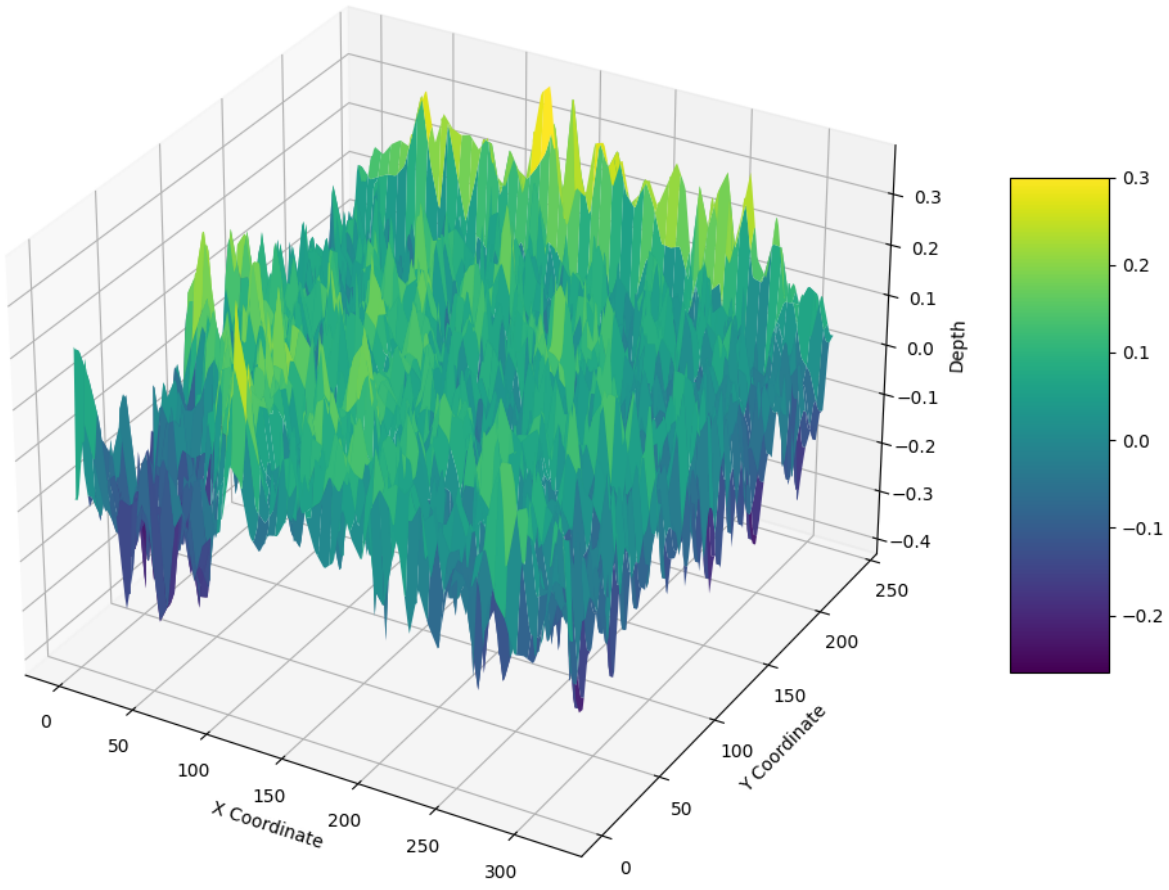
Tactile Image 3

Predicted Contact

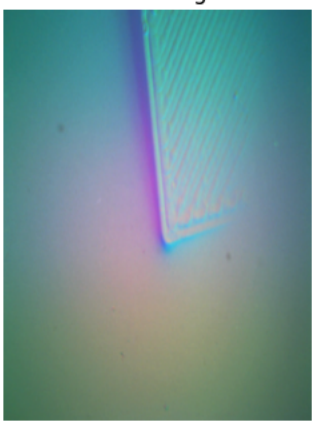
Predicted Depth



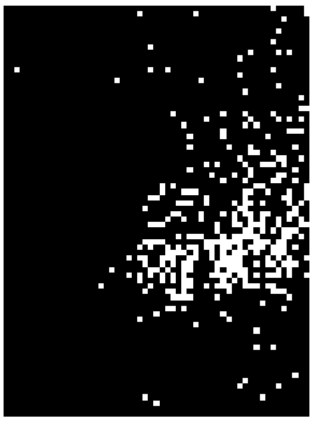

Predicted Depth


0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3
−0.4
Depth
0
50
100
150
200
250
300
X Coordinate
0
50
100
150
200
250
Y Coordinate
0.3
0.2
0.1
0.0
−0.1
−0.2

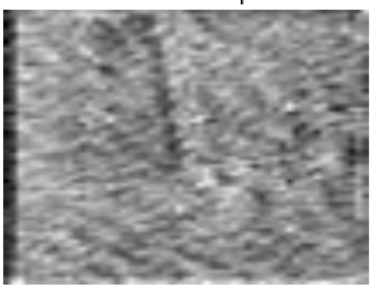
Tactile Image 4



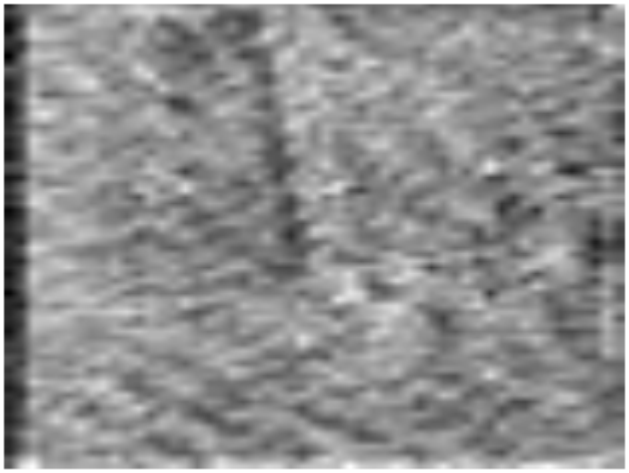
Predicted Contact

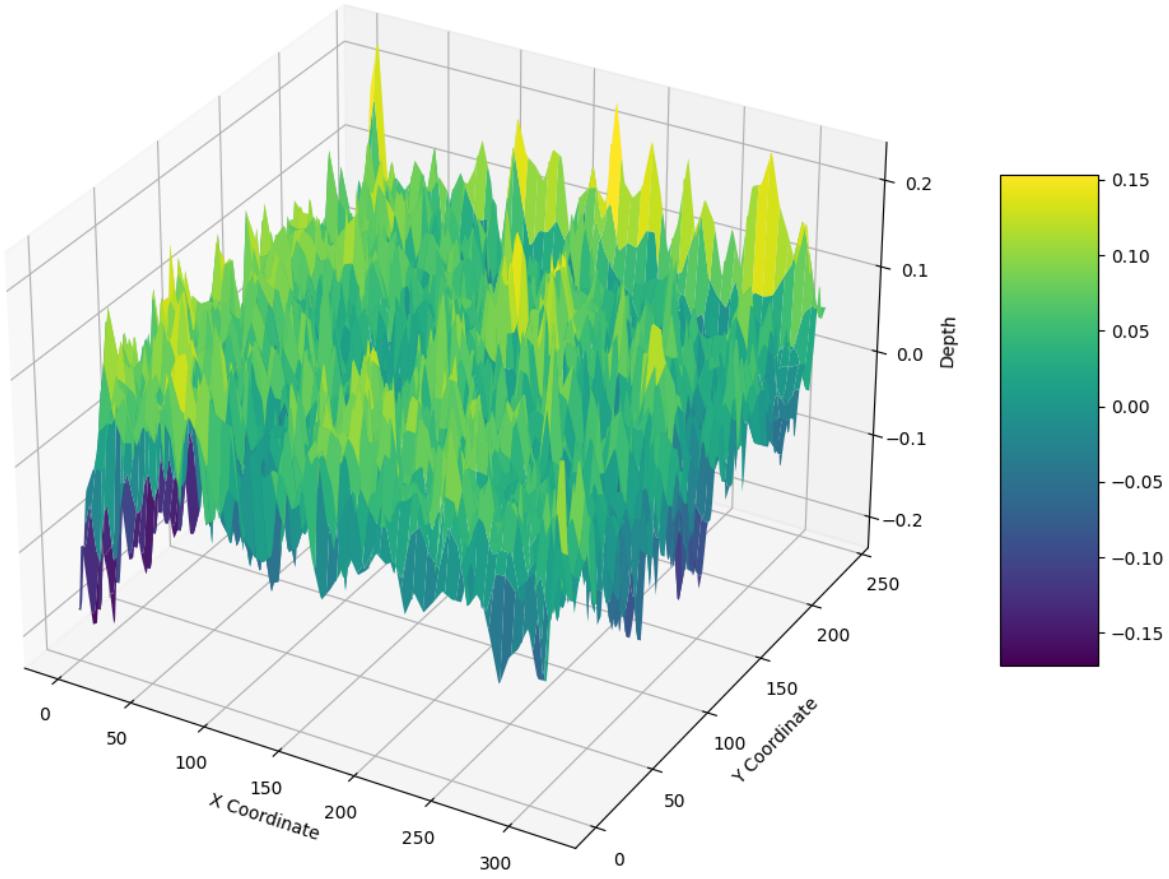


Predicted Depth



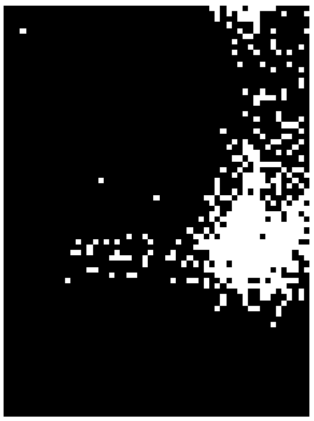
Predicted Depth



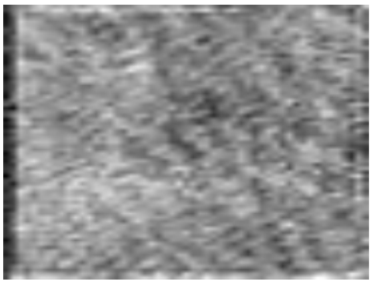


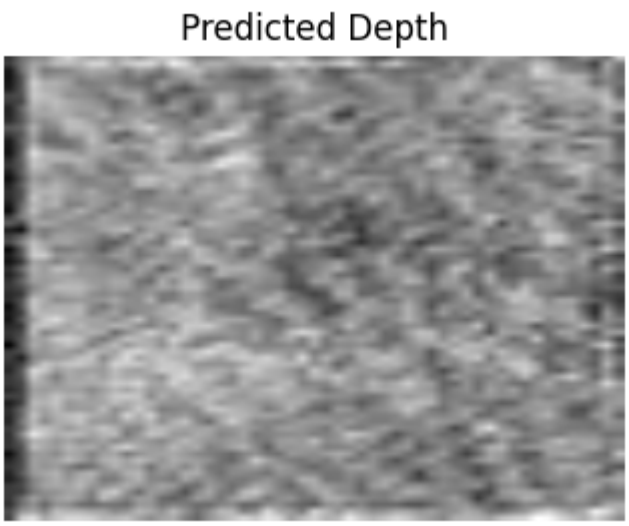
Tactile Image 5

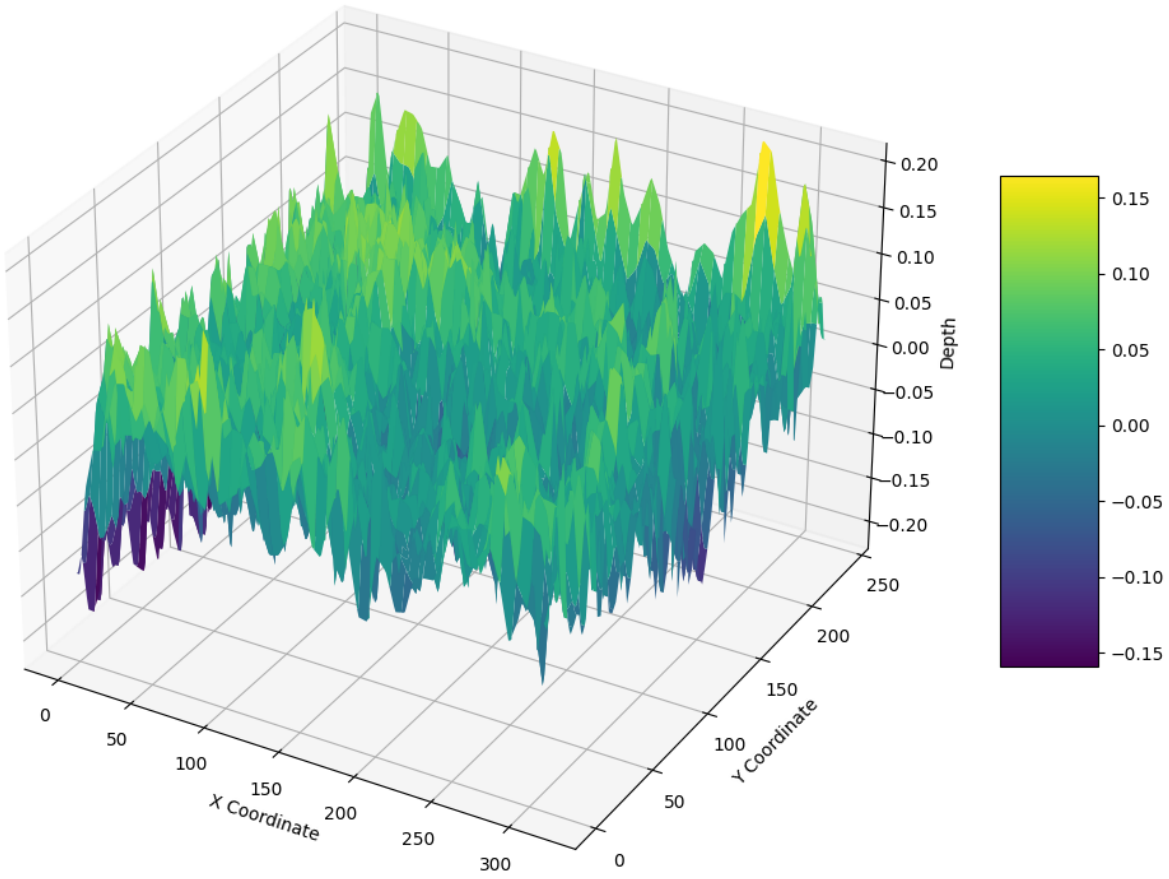
Predicted Contact



Predicted Depth



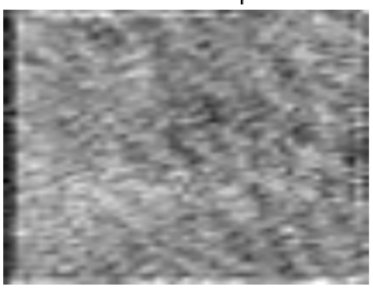

Predicted Depth


0.20
0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15
−0.20
Depth
0
50
100
150
200
250
300
X Coordinate
0
50
100
150
200
250
Y Coordinate
0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15

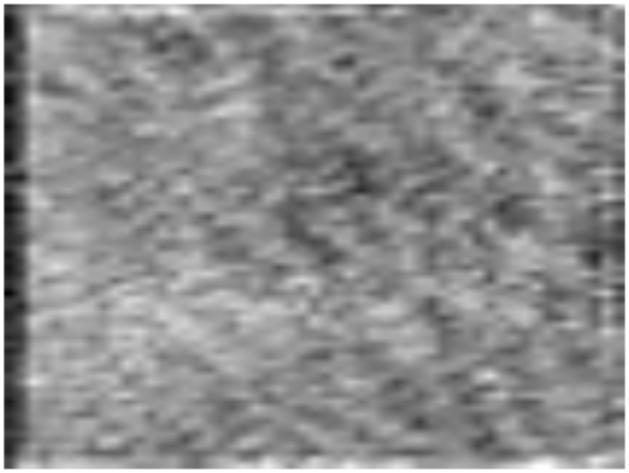
Tactile Image 6

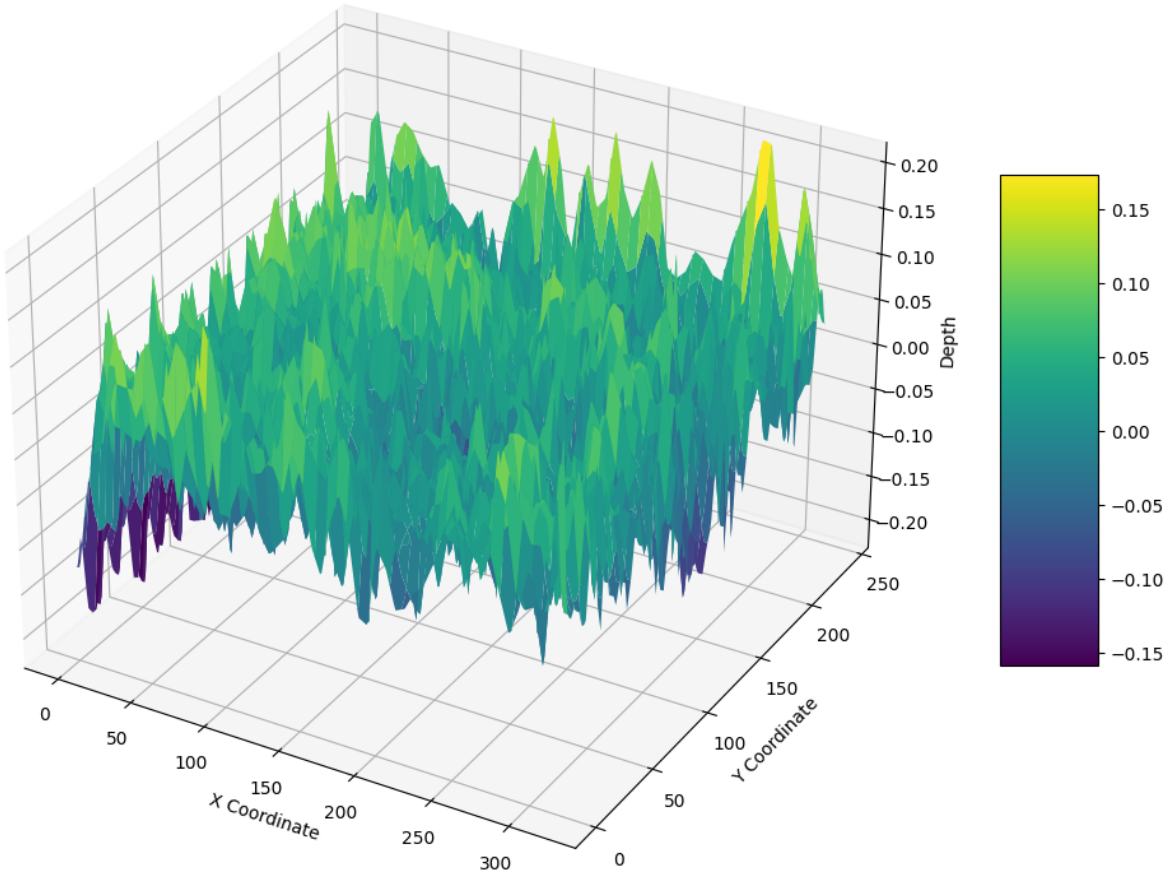
Predicted Contact

Predicted Depth



Predicted Depth

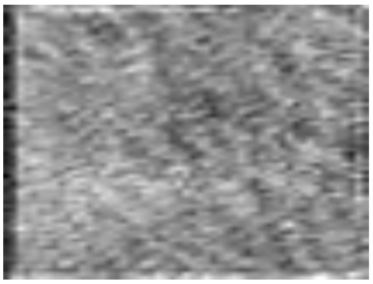


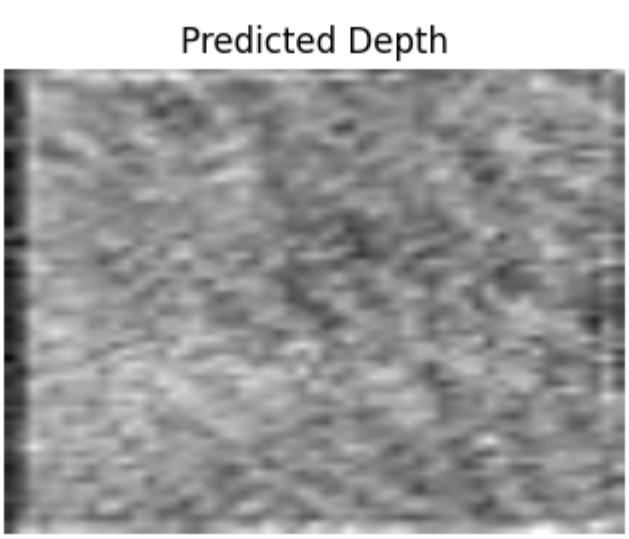


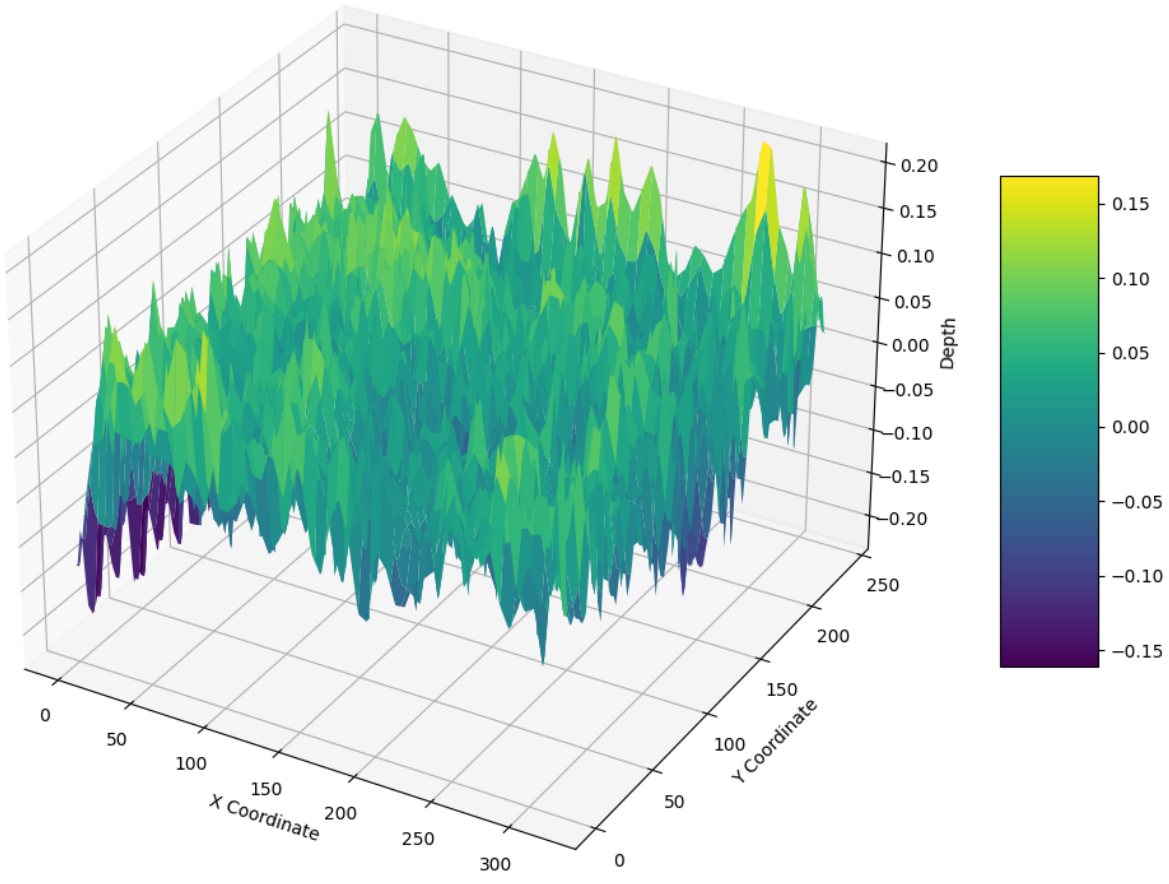
Tactile Image 7

Predicted Contact

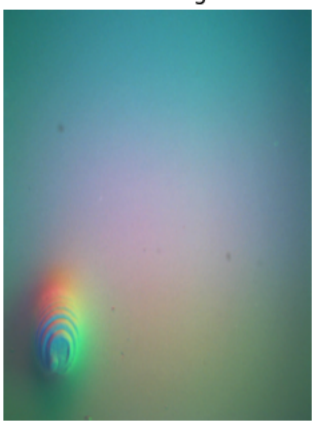
Predicted Depth




Predicted Depth

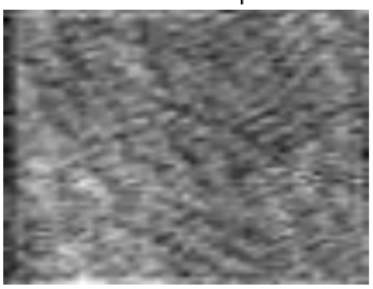

0.20
0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15
−0.20
Depth
0
50
100
150
200
250
300
X Coordinate
0
50
100
150
200
250
Y Coordinate
0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15

Tactile Image 8

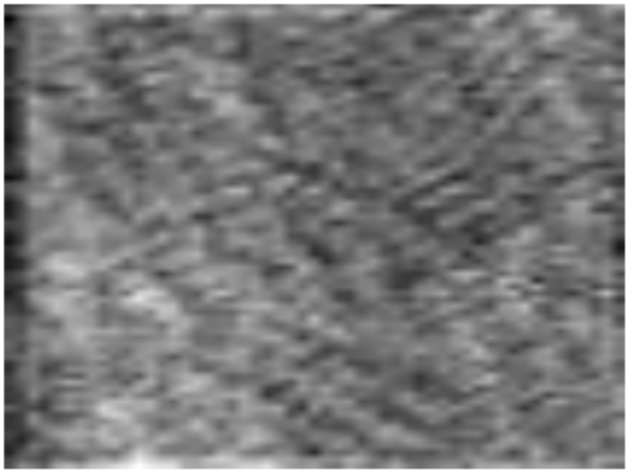


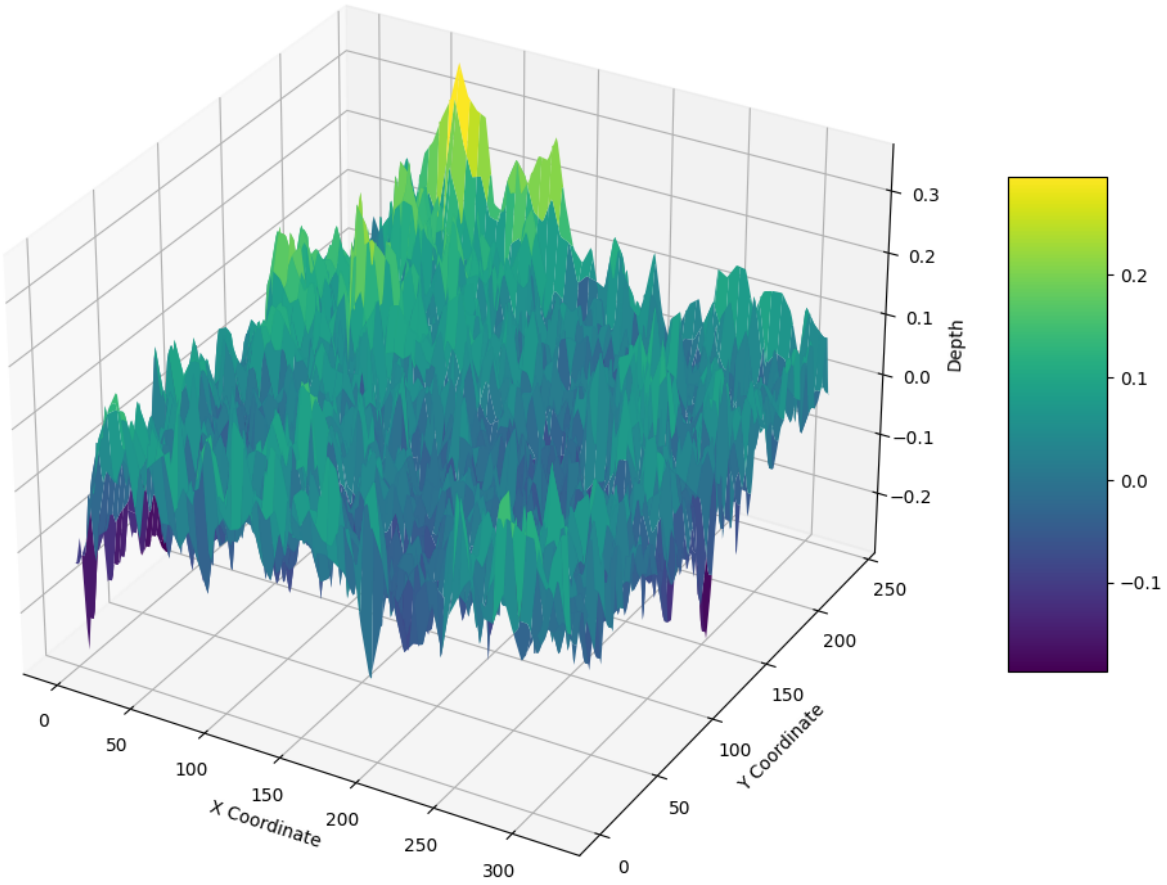
Predicted Contact

Predicted Depth

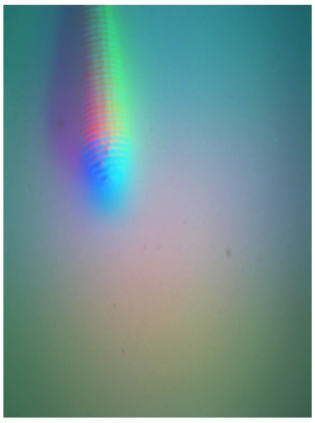


Predicted Depth

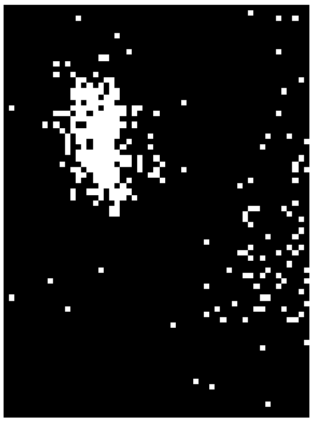




Tactile Image 9



Predicted Contact



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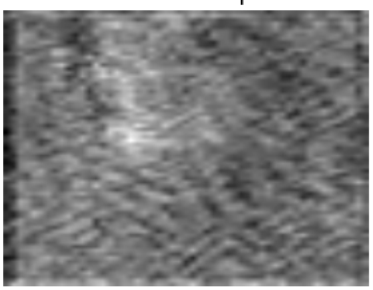

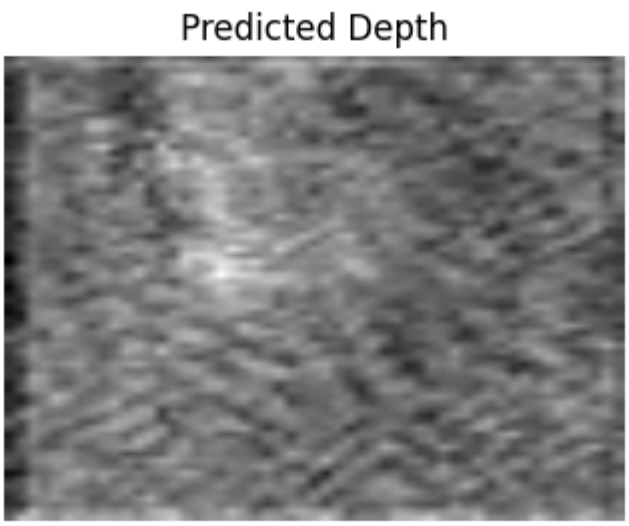
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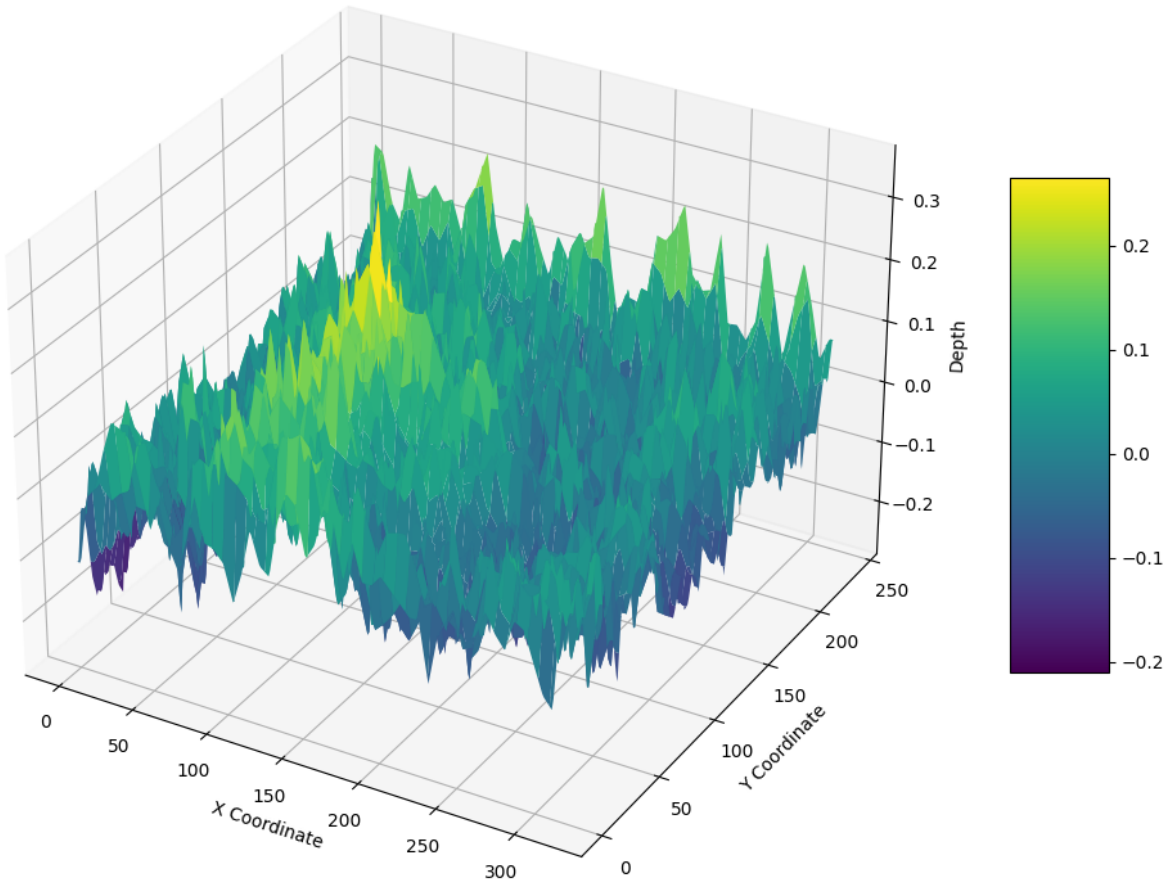
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X Coordinate
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Y Coordinate
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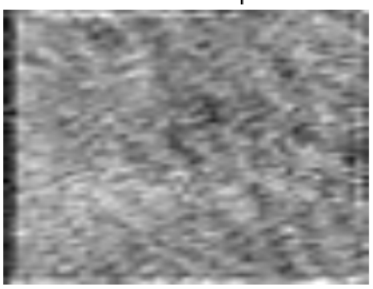
0.0
−0.1
−0.2

Tactile Image 10

Predicted Contact

Predicted Depth



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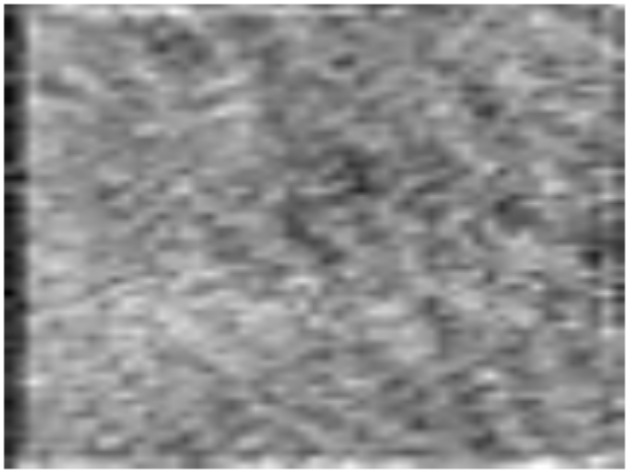
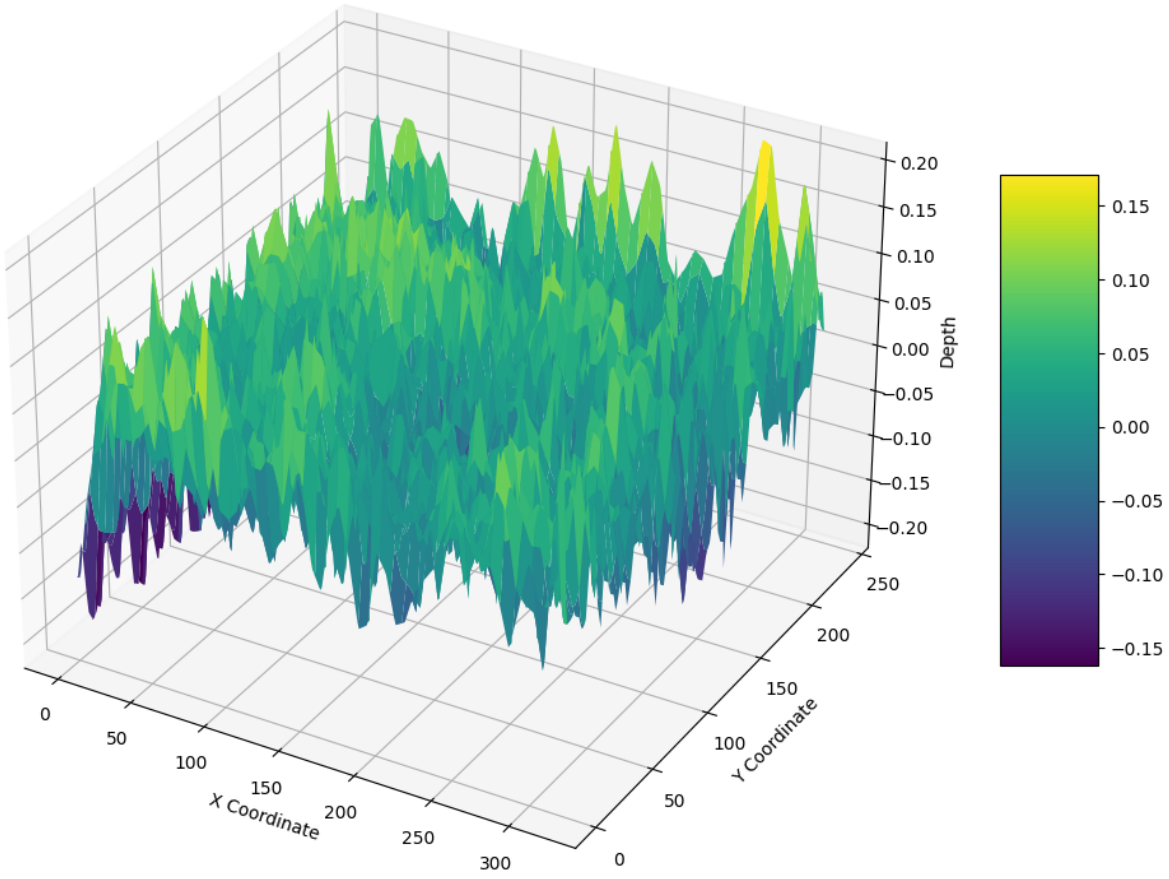
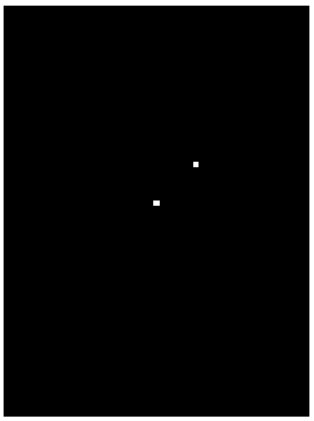




Tactile Image 11

Predicted Contact



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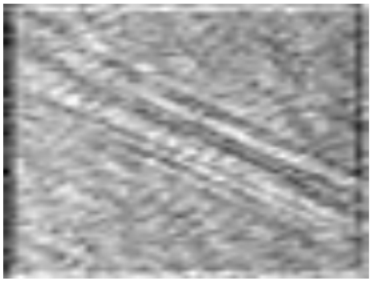

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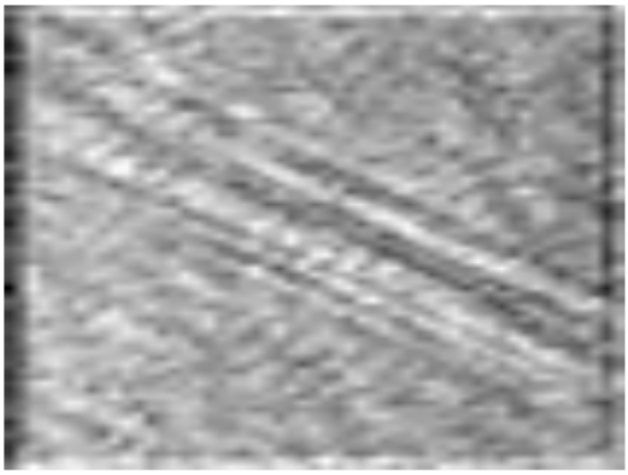
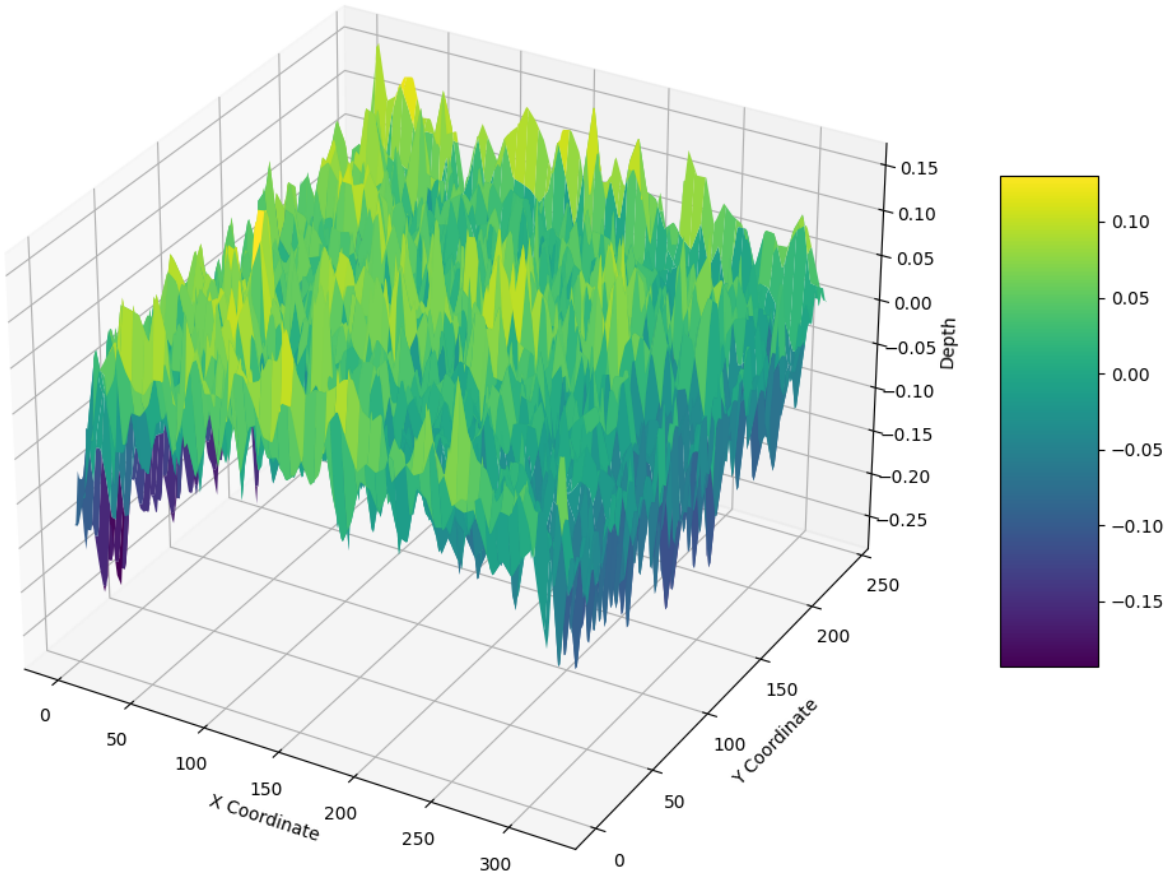
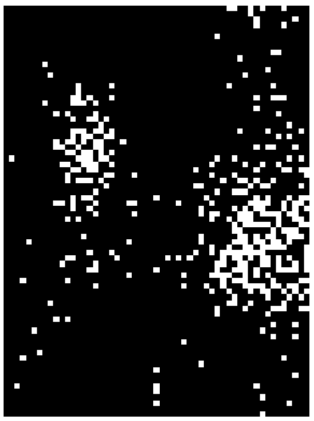




Tactile Image 12

Predicted Contact



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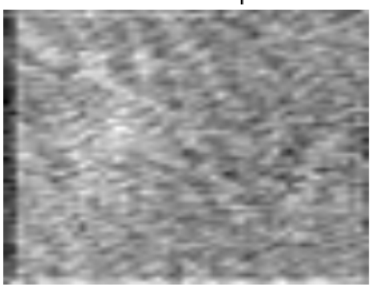

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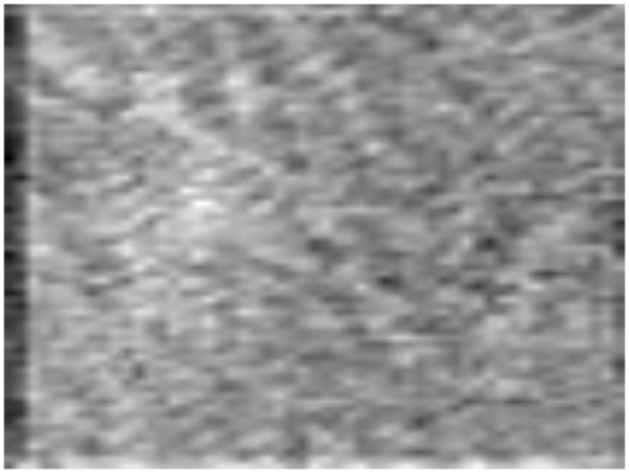
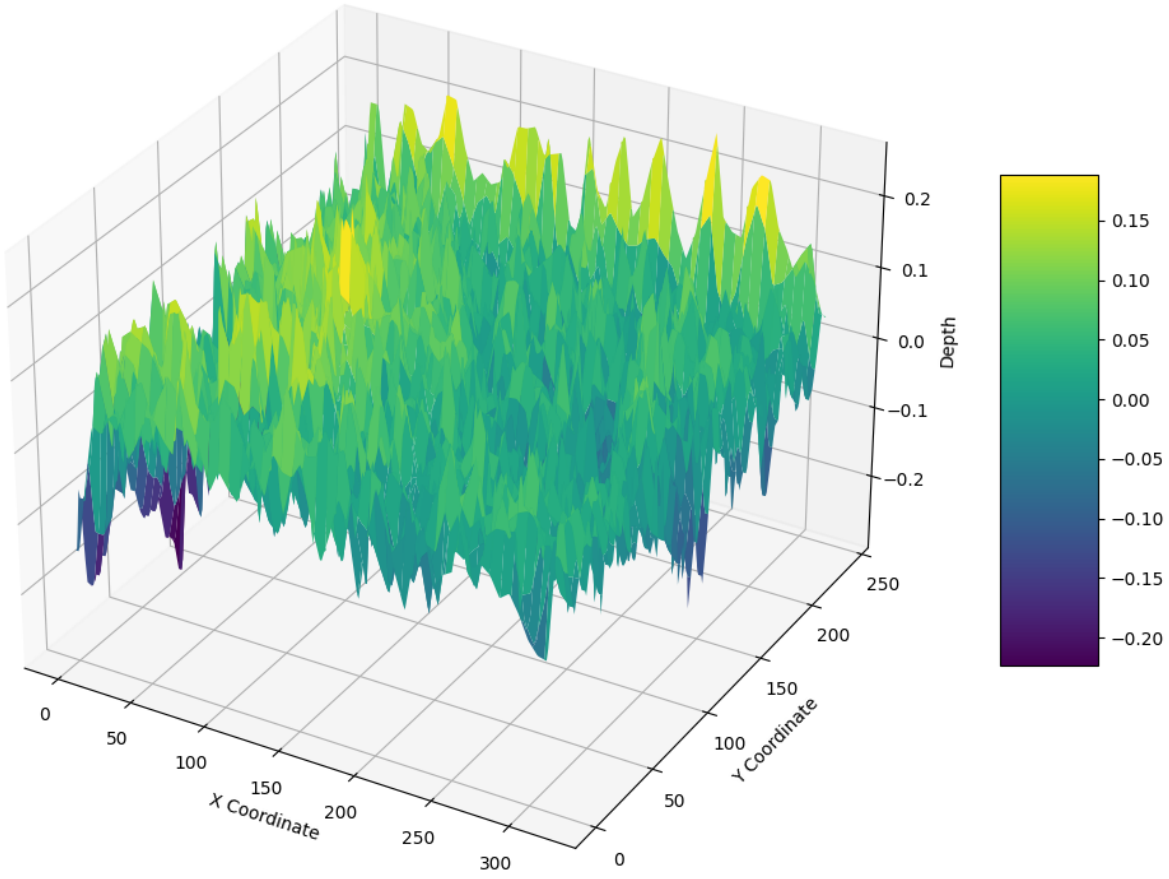
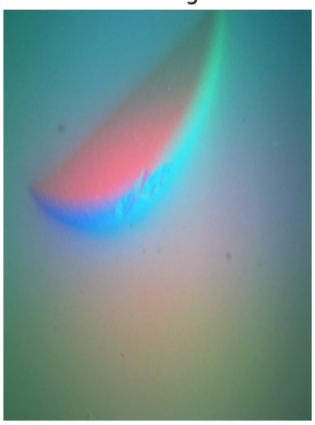




Tactile Image 13



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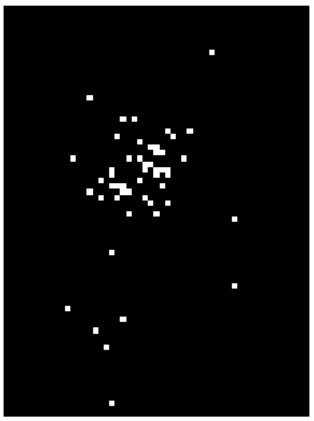
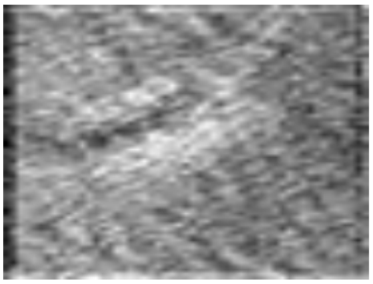
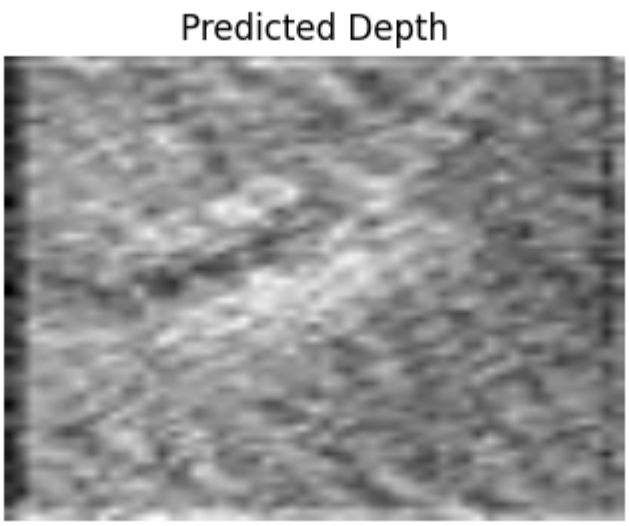


Predicted Depth

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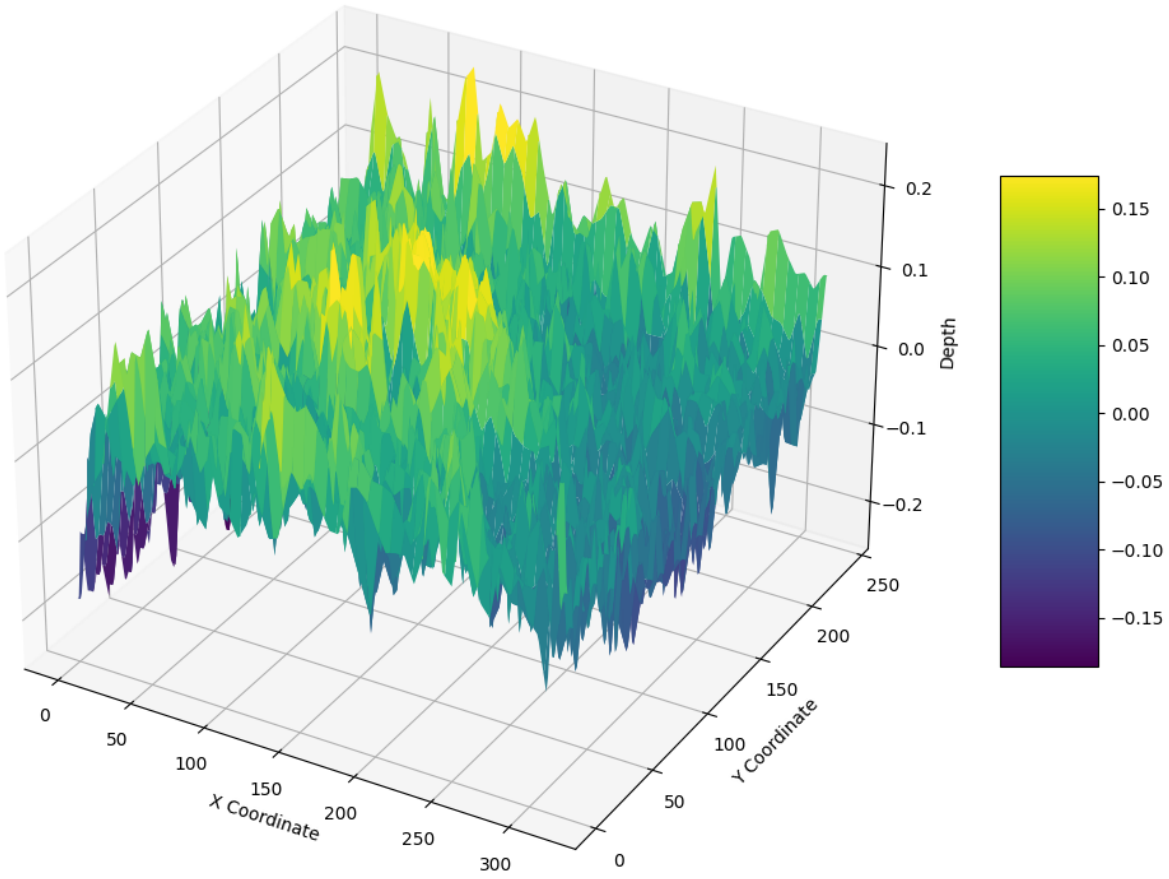
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200
250
Y Coordinate
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0.00
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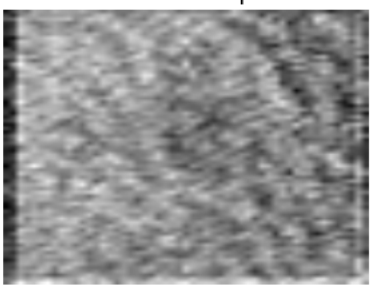
−0.15

Tactile Image 14

Predicted Contact

Predicted Depth



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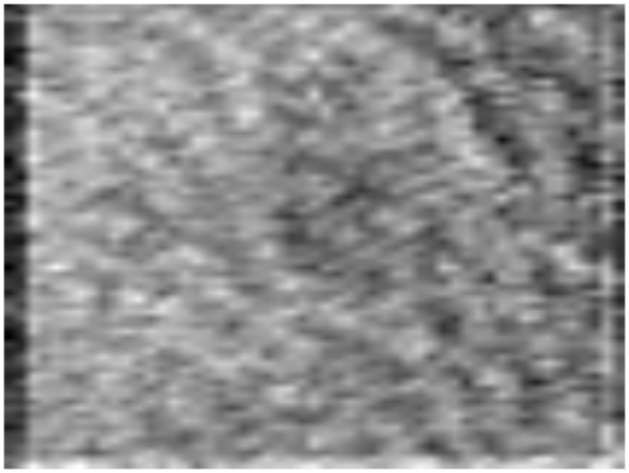
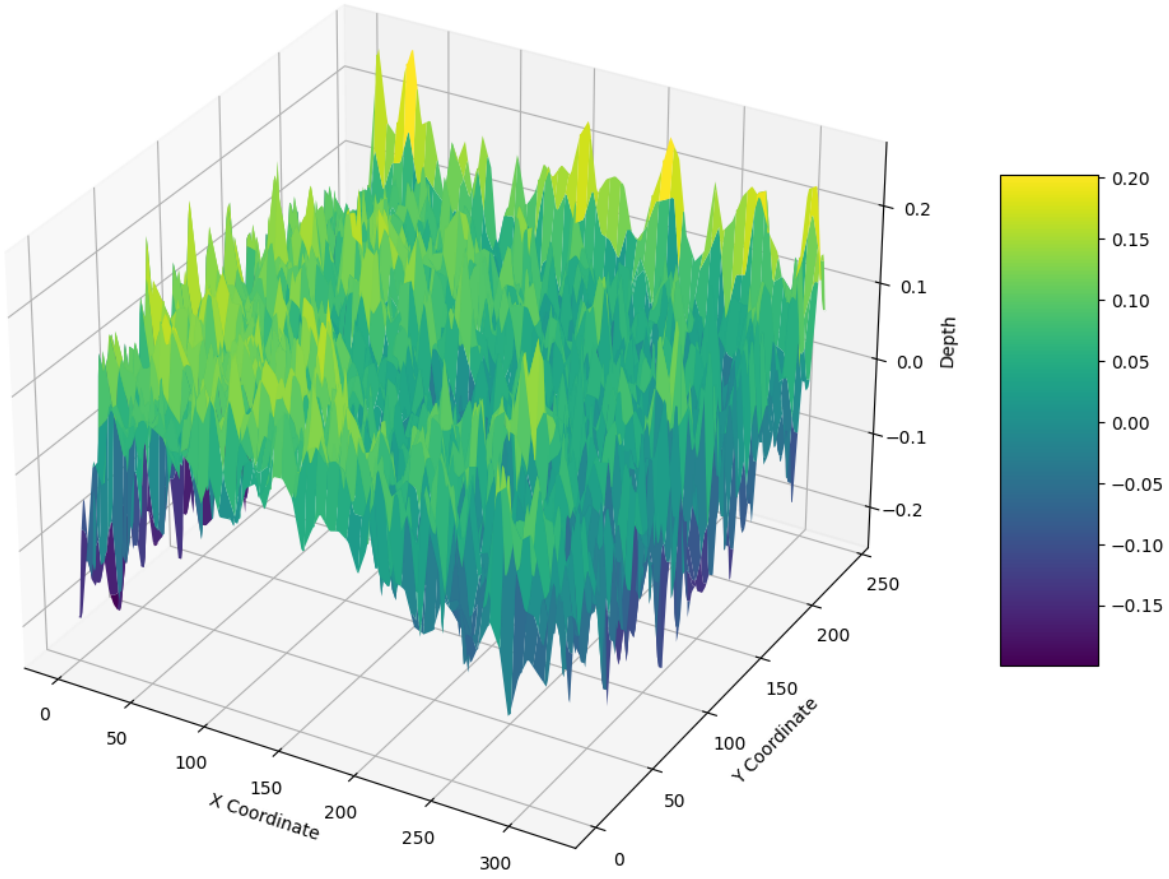
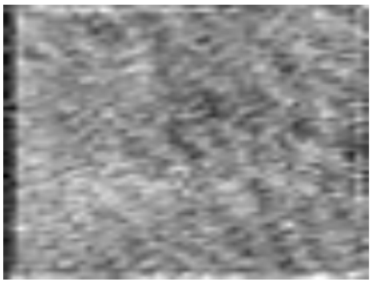


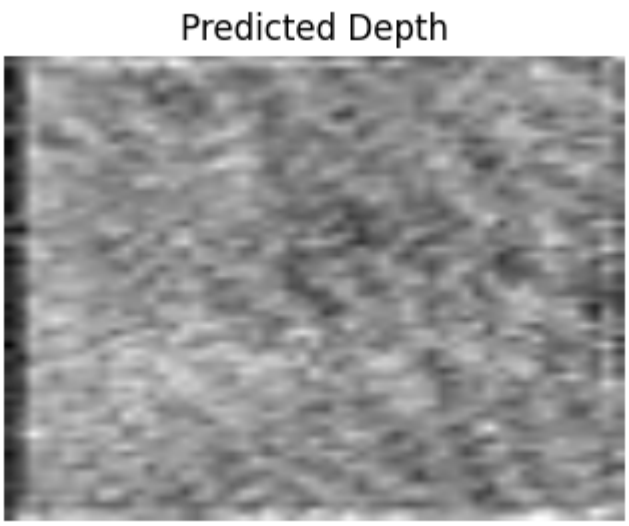


Tactile Image 15

Predicted Contact

Predicted Depth

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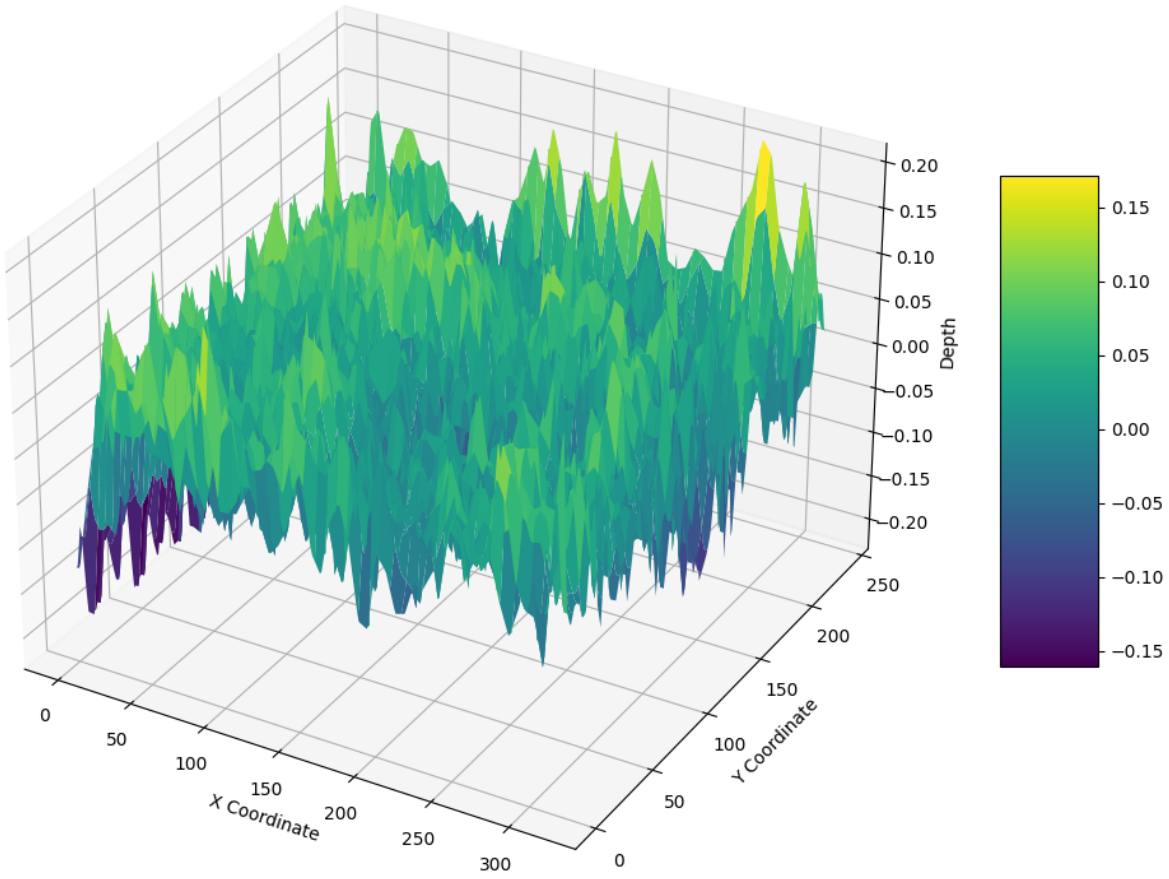
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X Coordinate
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Y Coordinate
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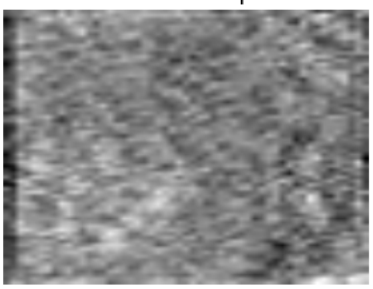
−0.15

Tactile Image 16

Predicted Contact

Predicted Depth



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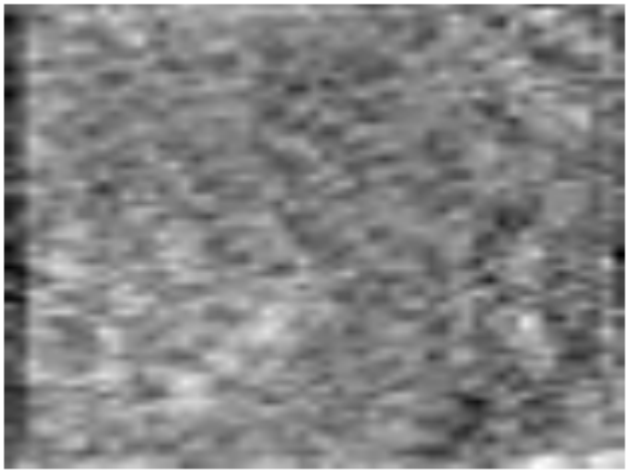
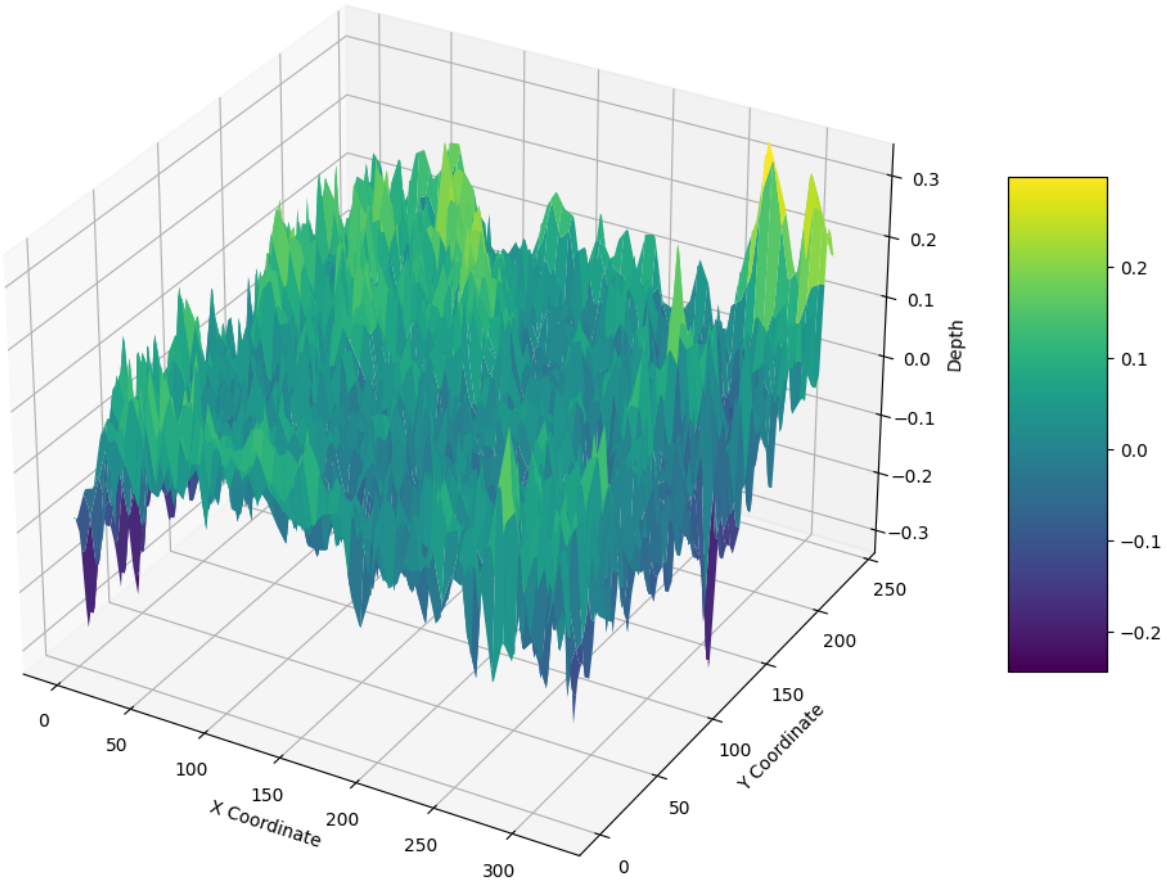
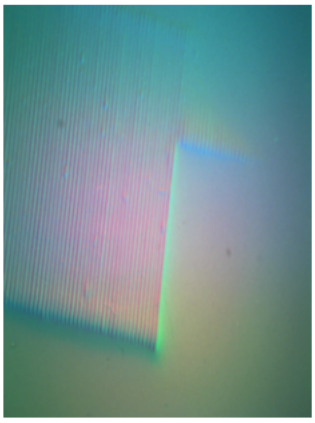




Tactile Image 17



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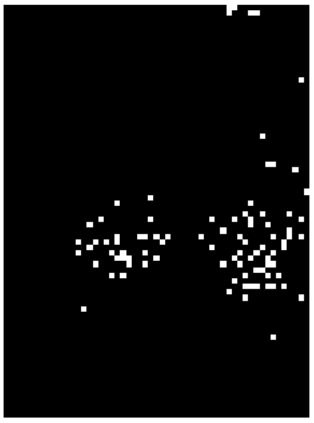

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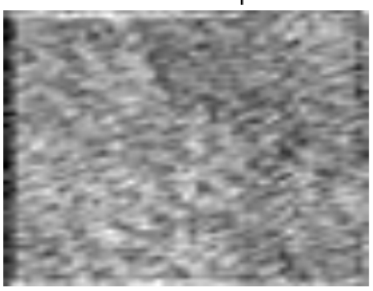

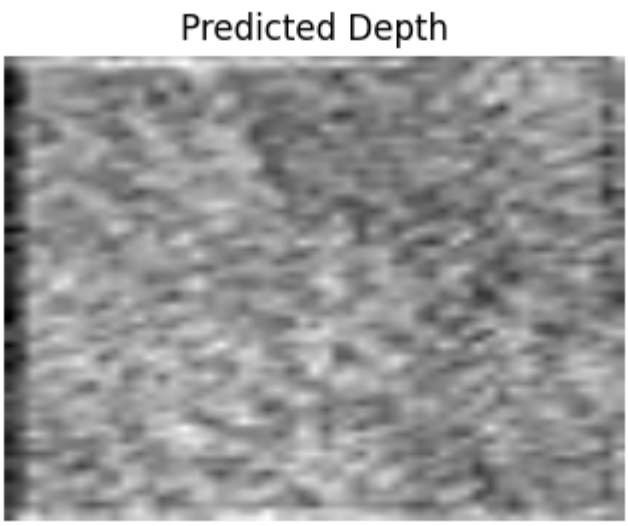
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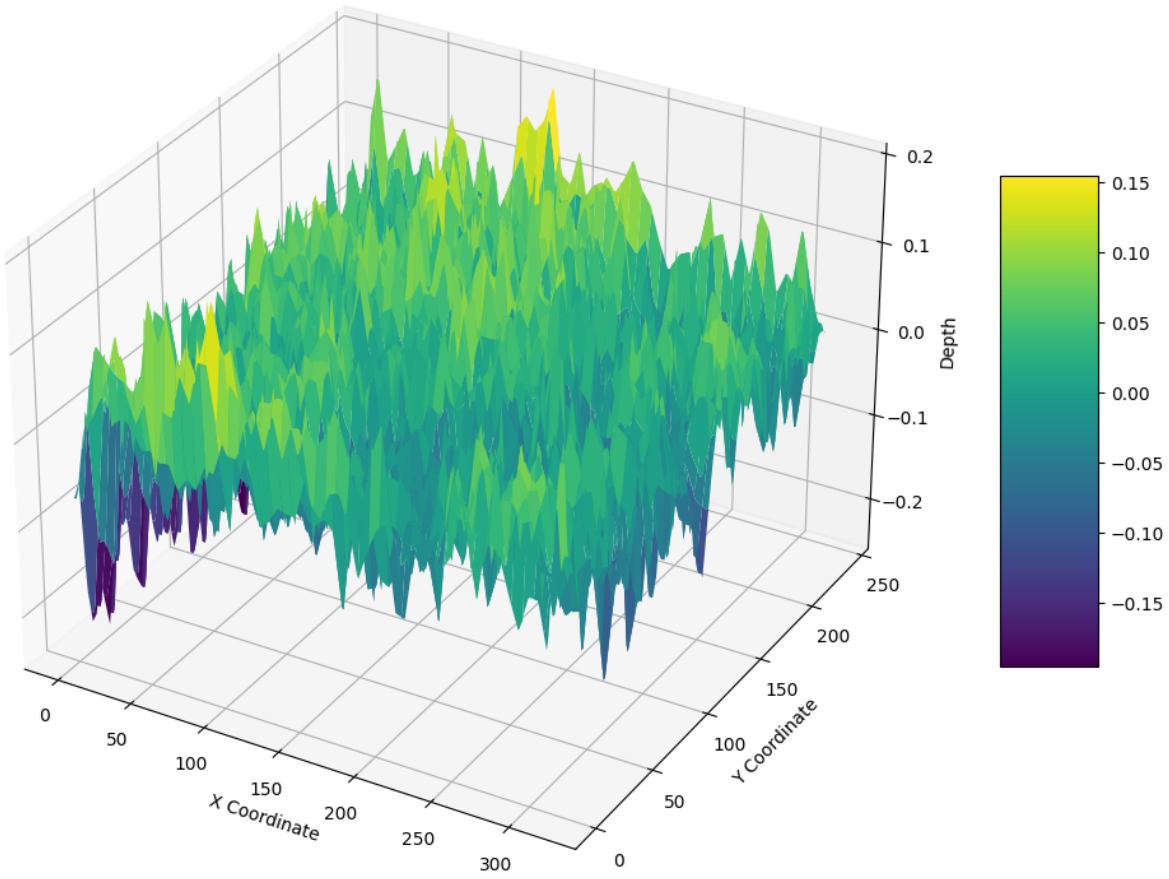
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Y Coordinate
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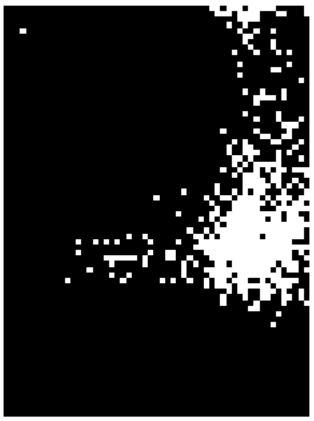
−0.15

Tactile Image 18

Predicted Contact



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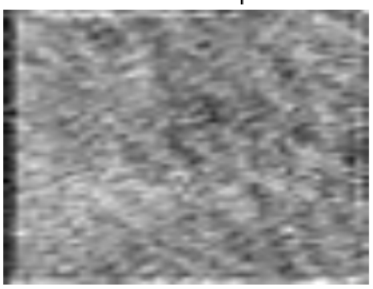

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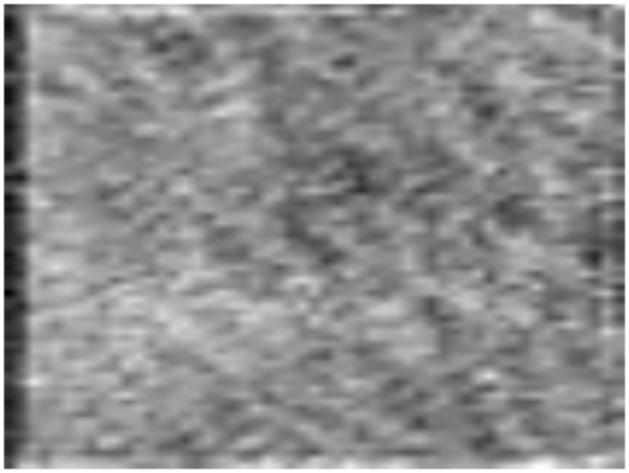
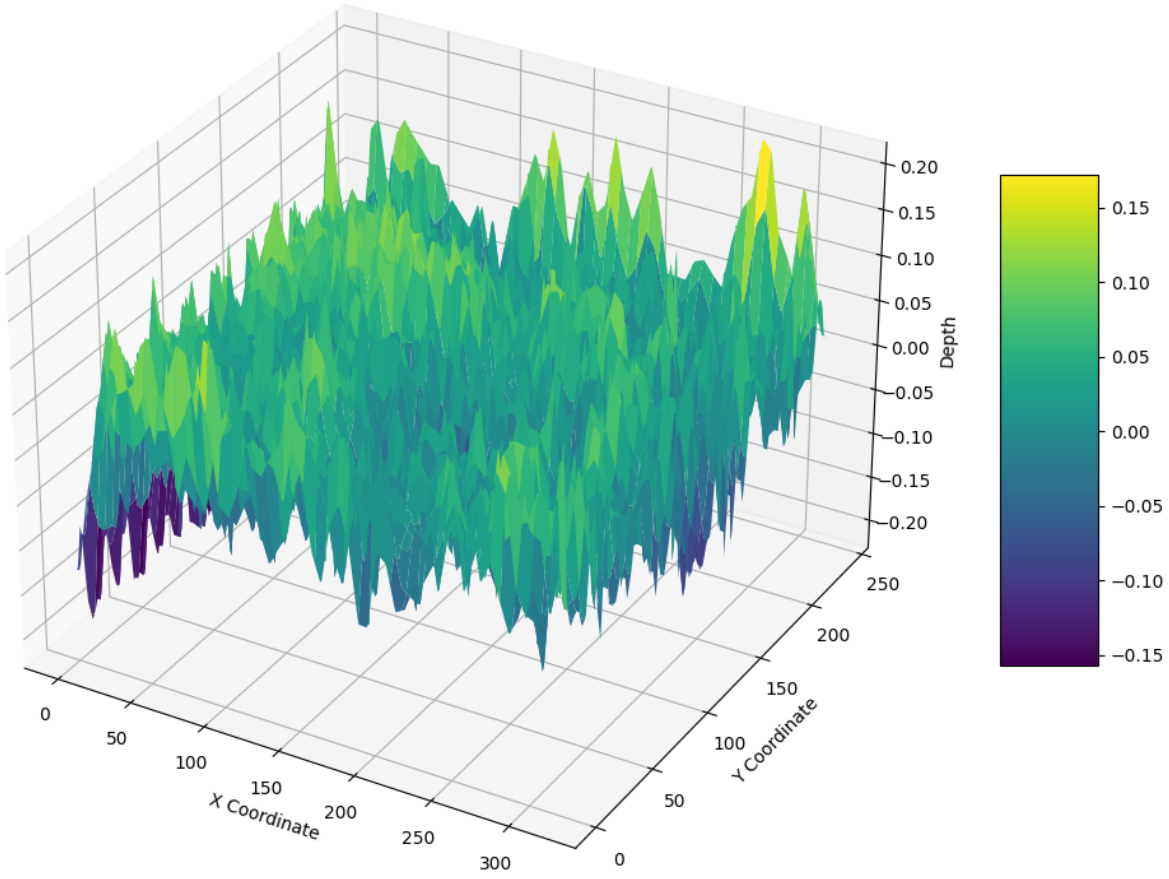
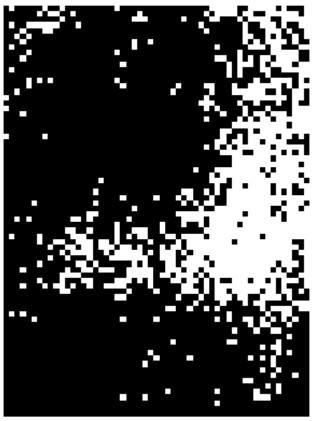


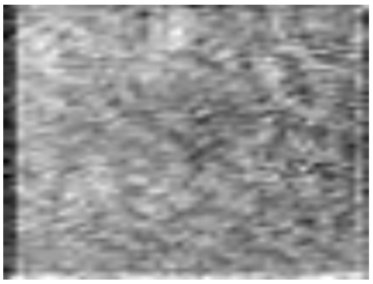


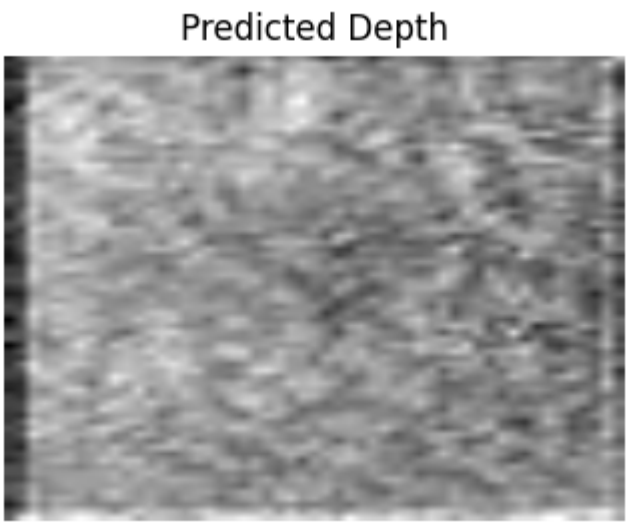
Tactile Image 19

Predicted Contact



Predicted Depth

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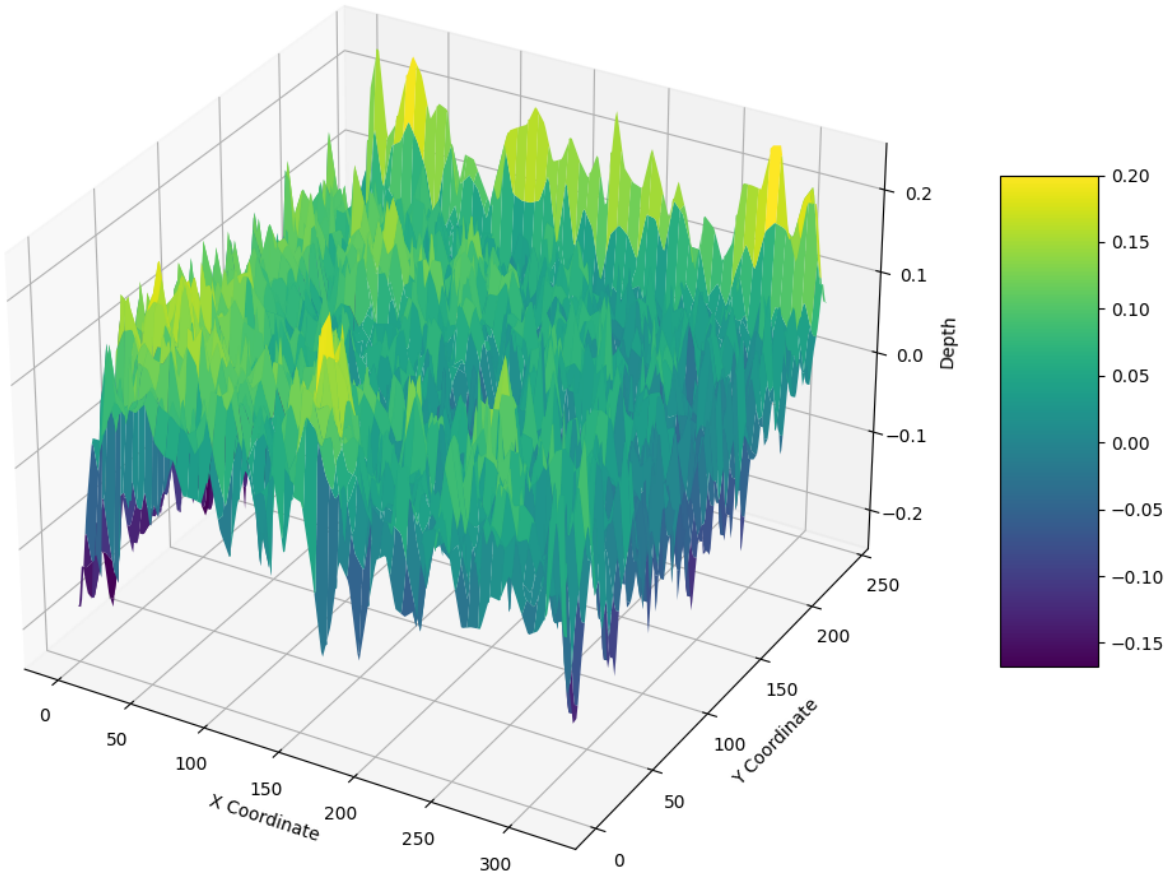
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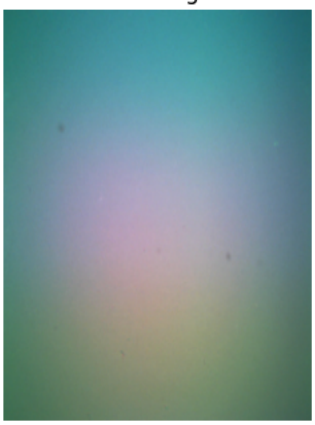
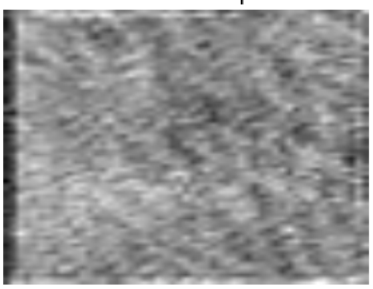
−0.15

Tactile Image 20

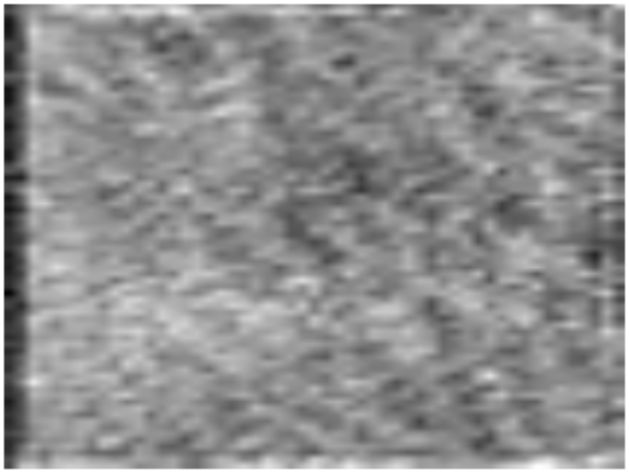


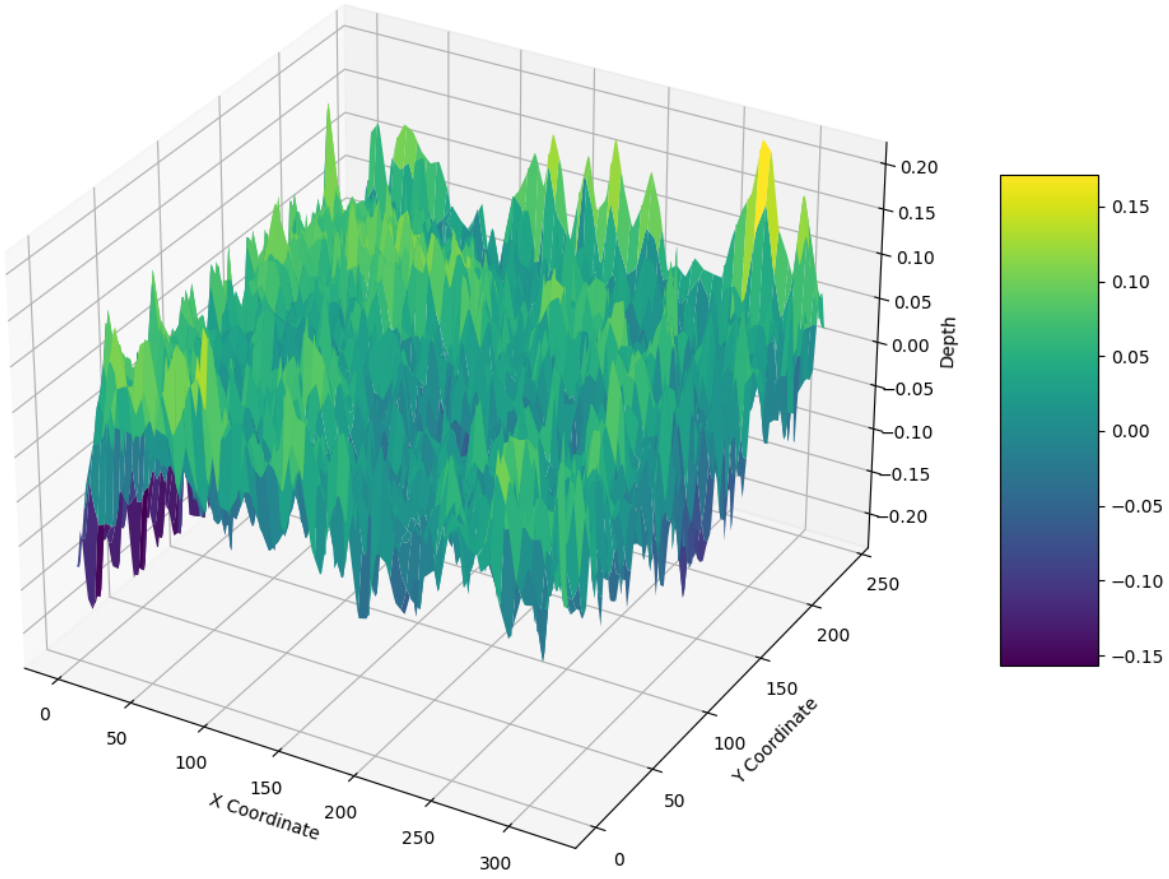
Predicted Contact

Predicted Depth

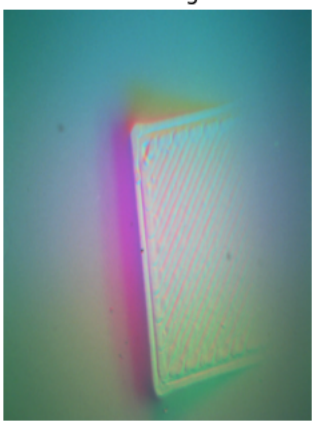


Predicted Depth





Tactile Image 21



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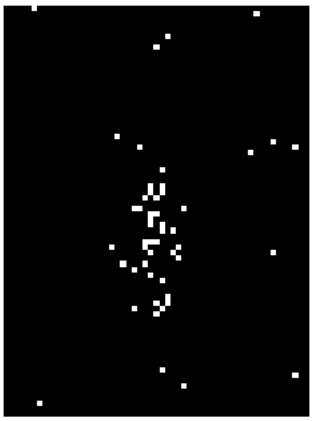

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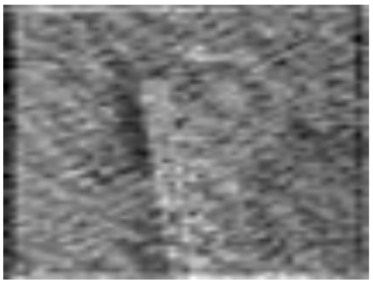

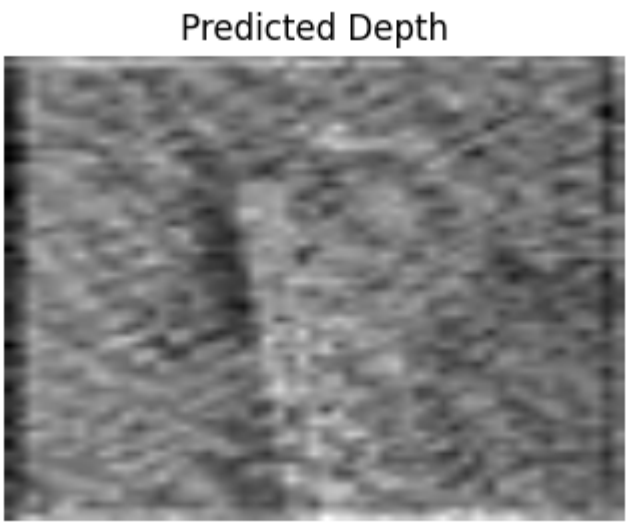
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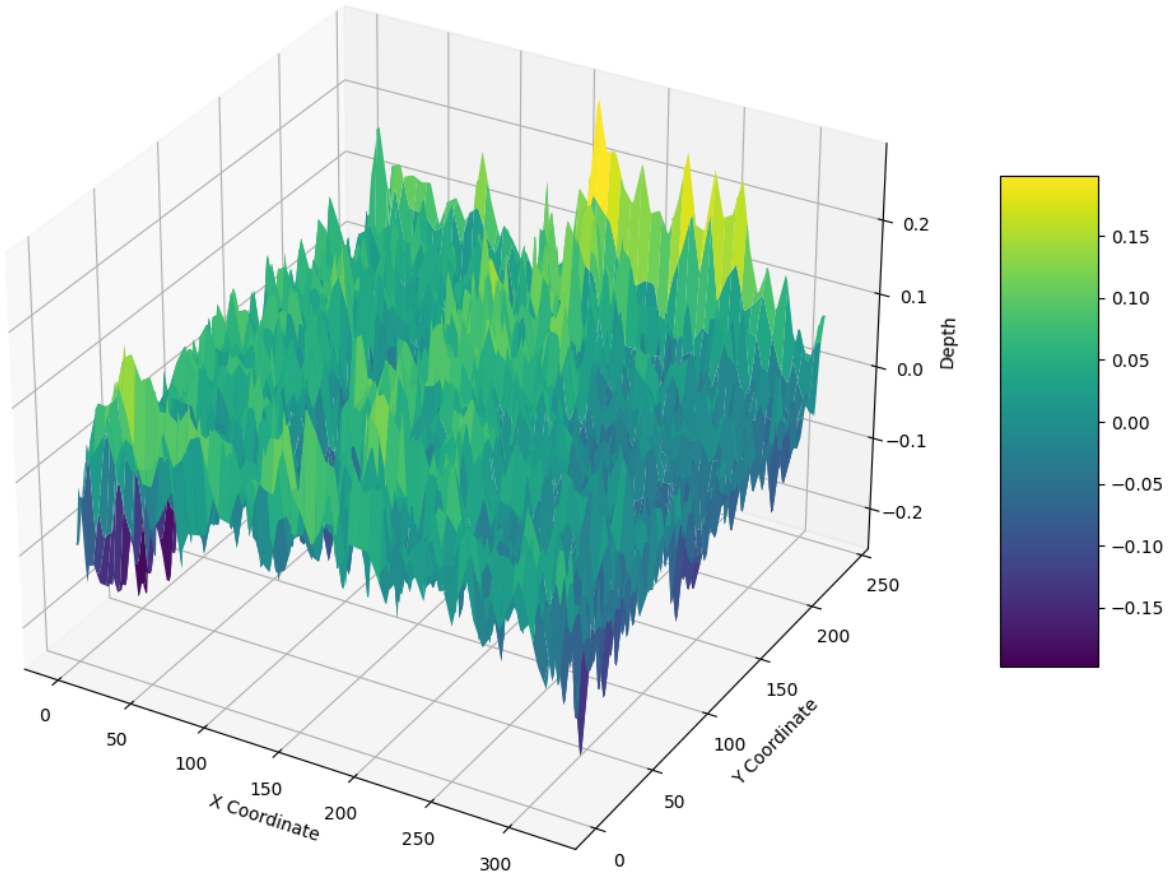
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X Coordinate
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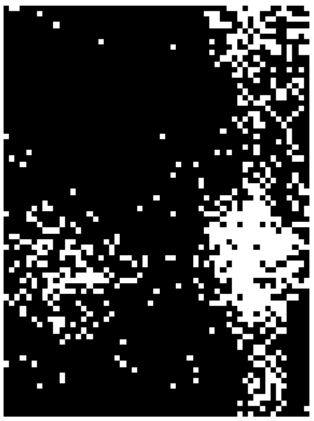
−0.15

Tactile Image 22

Predicted Contact



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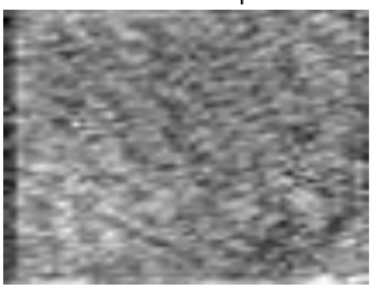

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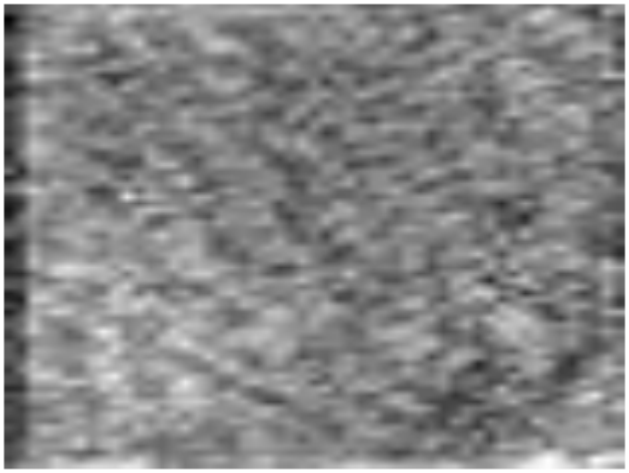
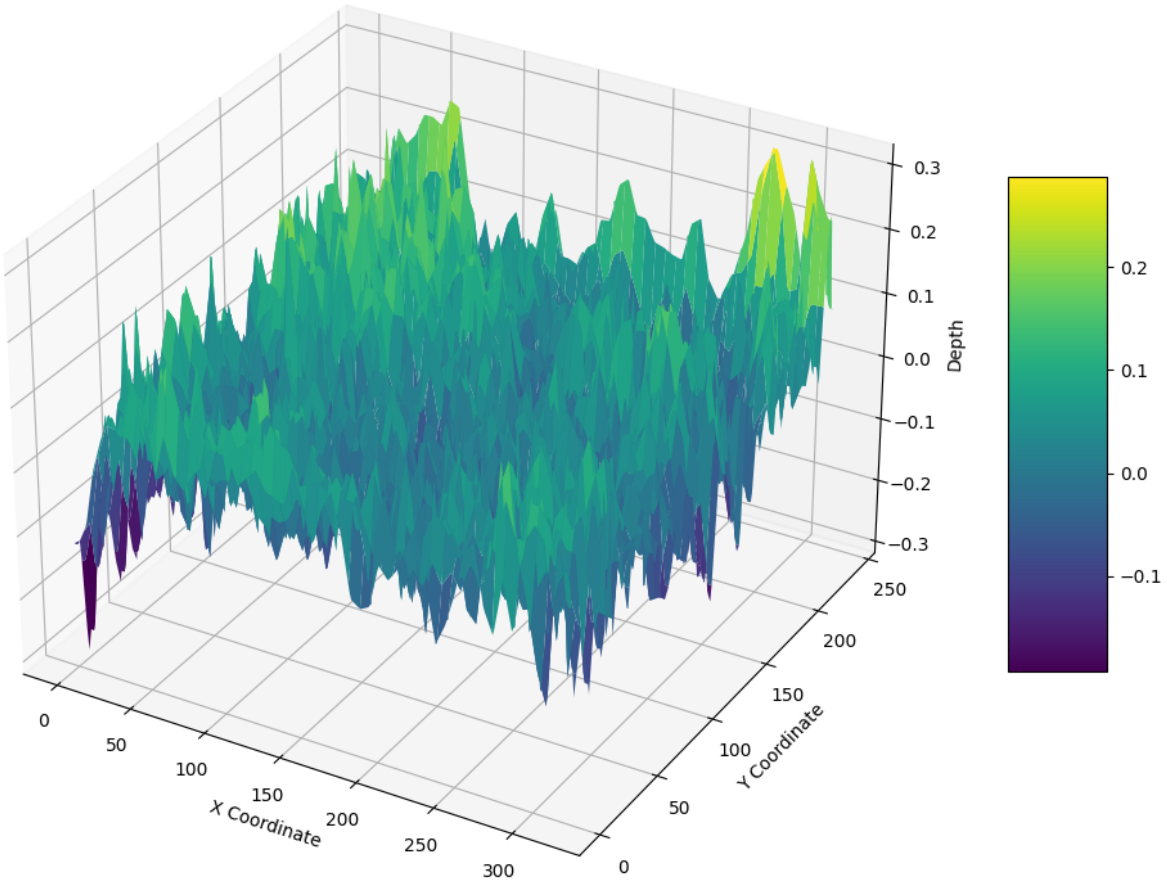
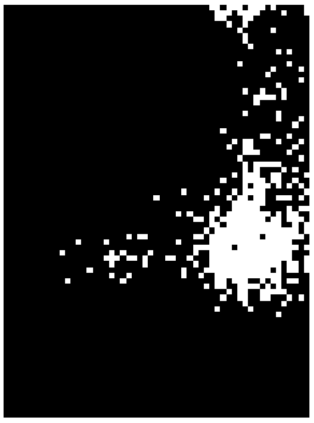




Tactile Image 23

Predicted Contact



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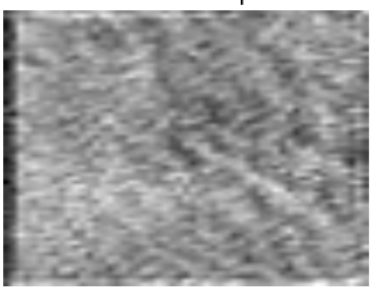

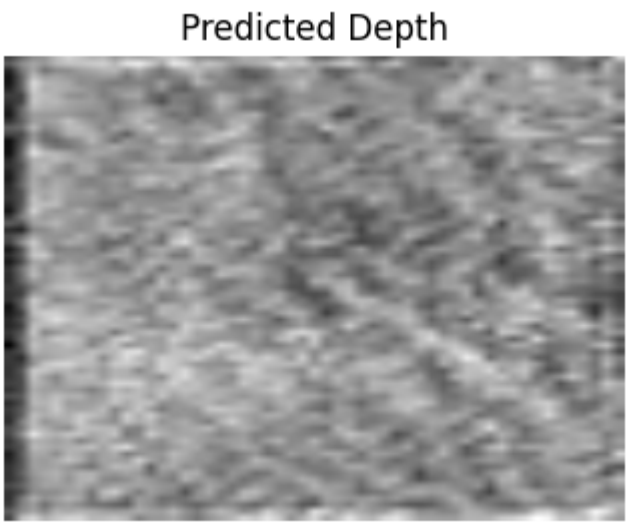
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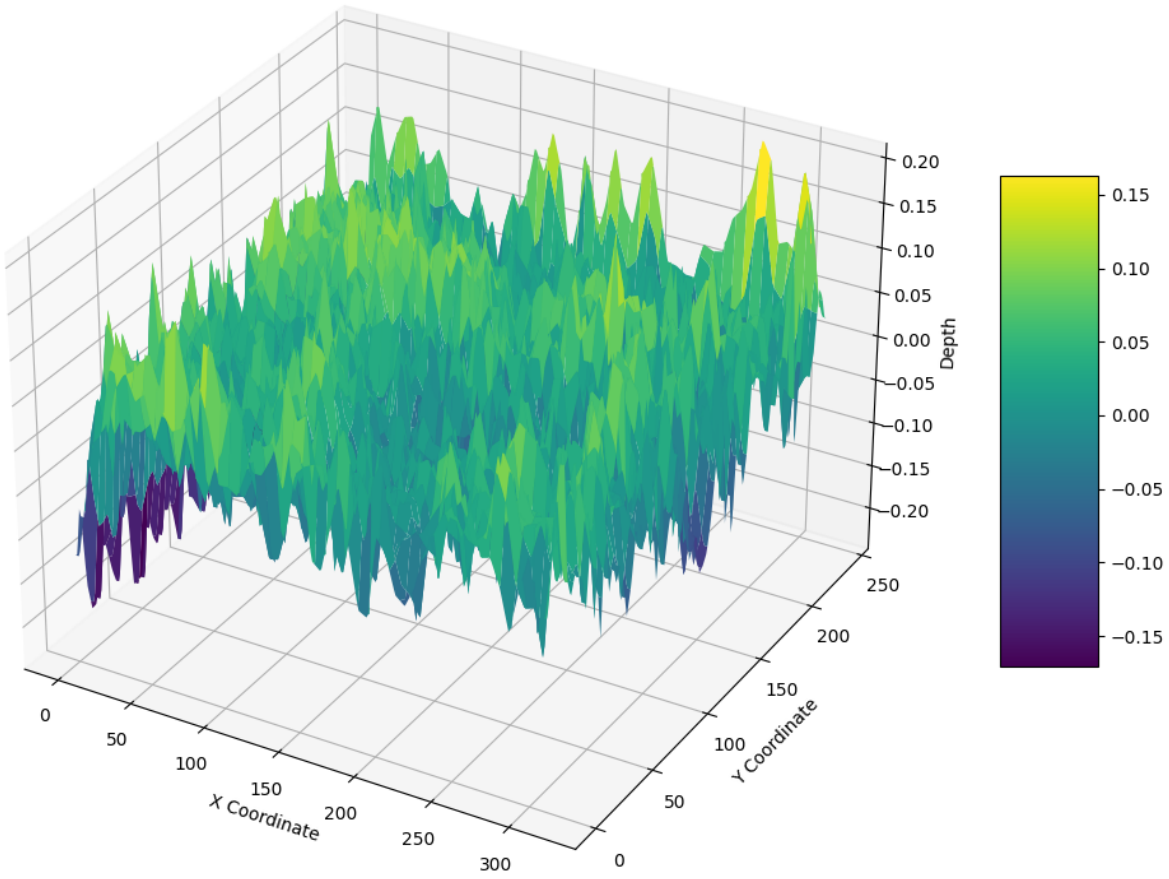
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X Coordinate
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Y Coordinate
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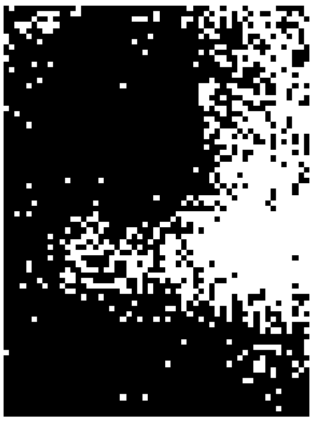
−0.10
−0.15

Tactile Image 24

Predicted Contact



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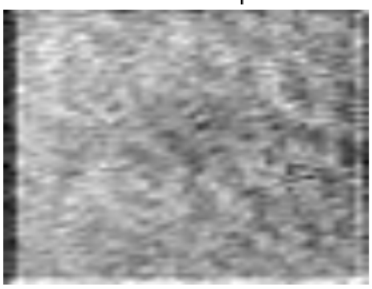
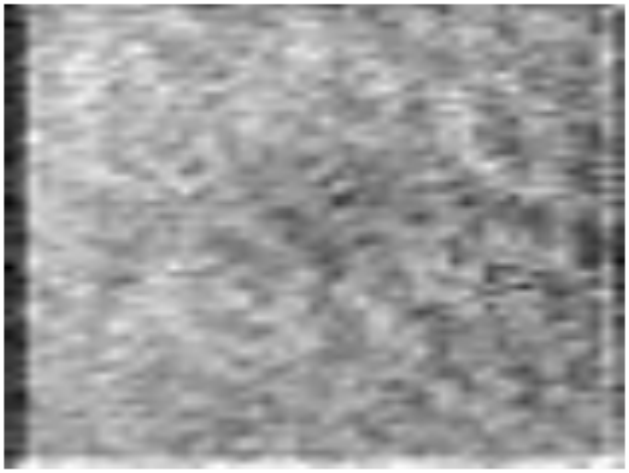
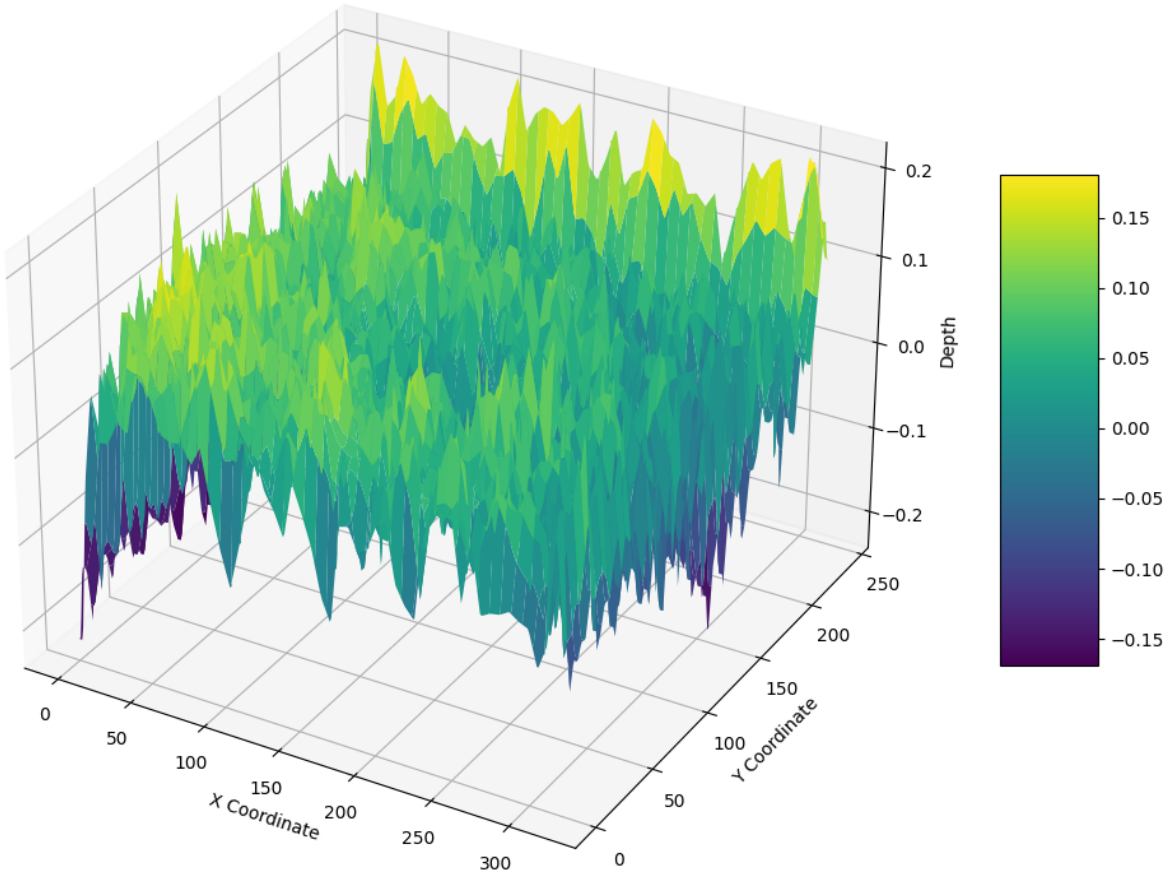


Predicted Depth

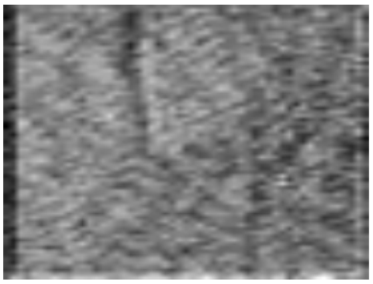




Tactile Image 25

Predicted Contact

Predicted Depth



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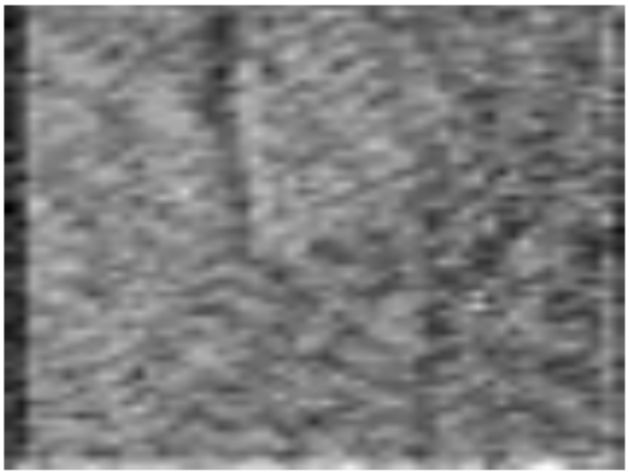
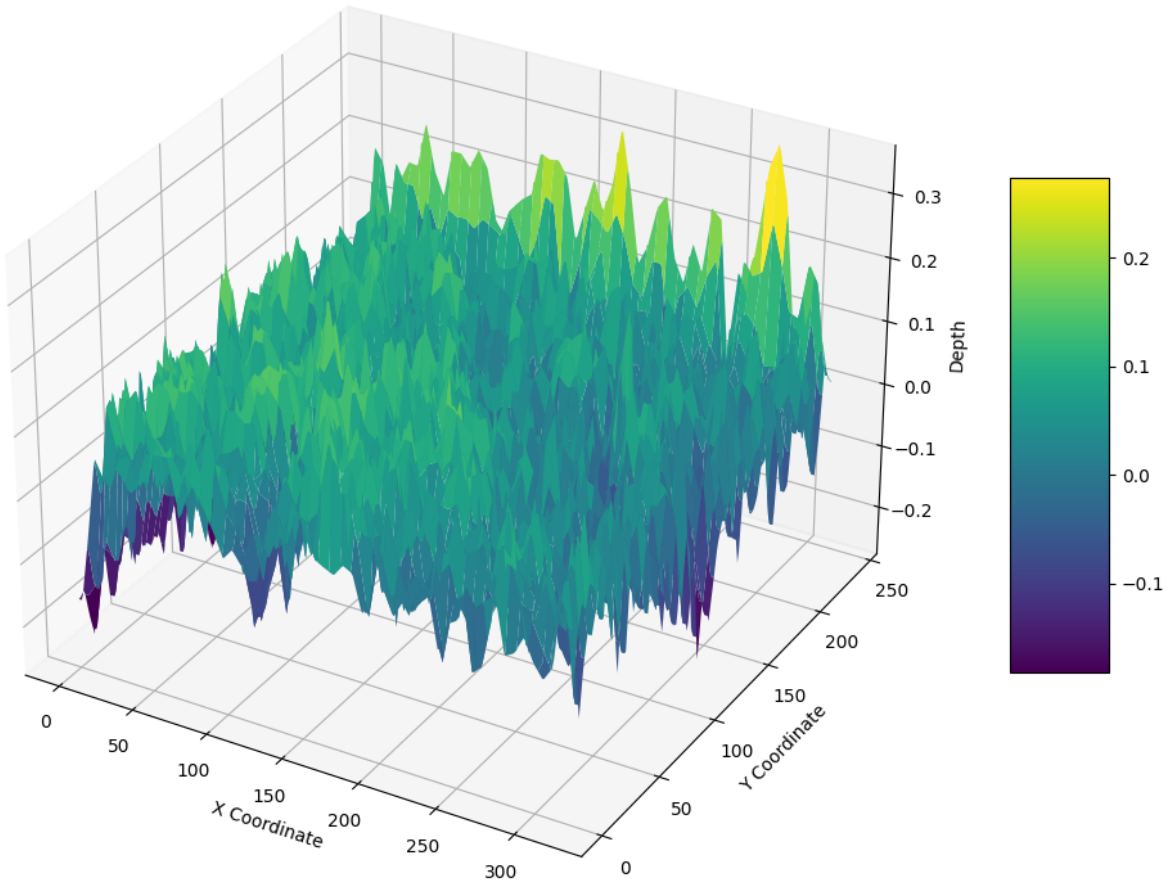
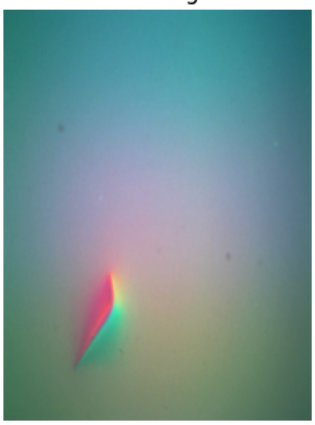




Tactile Image 26



Predicted Contact

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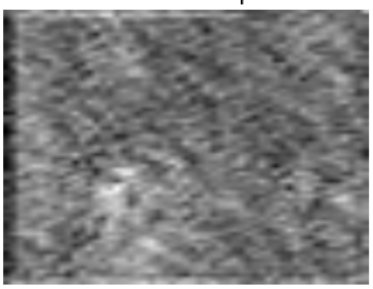

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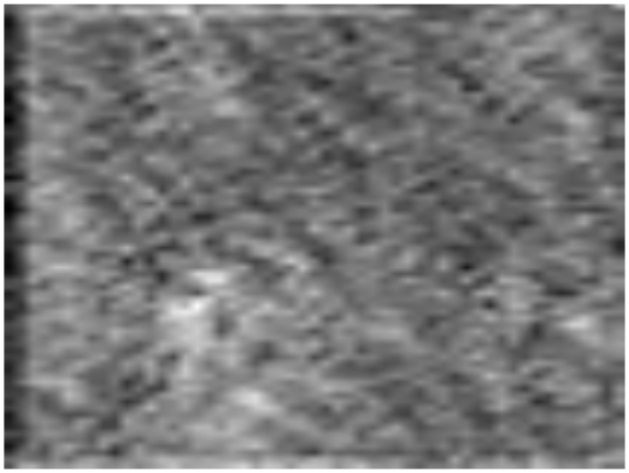
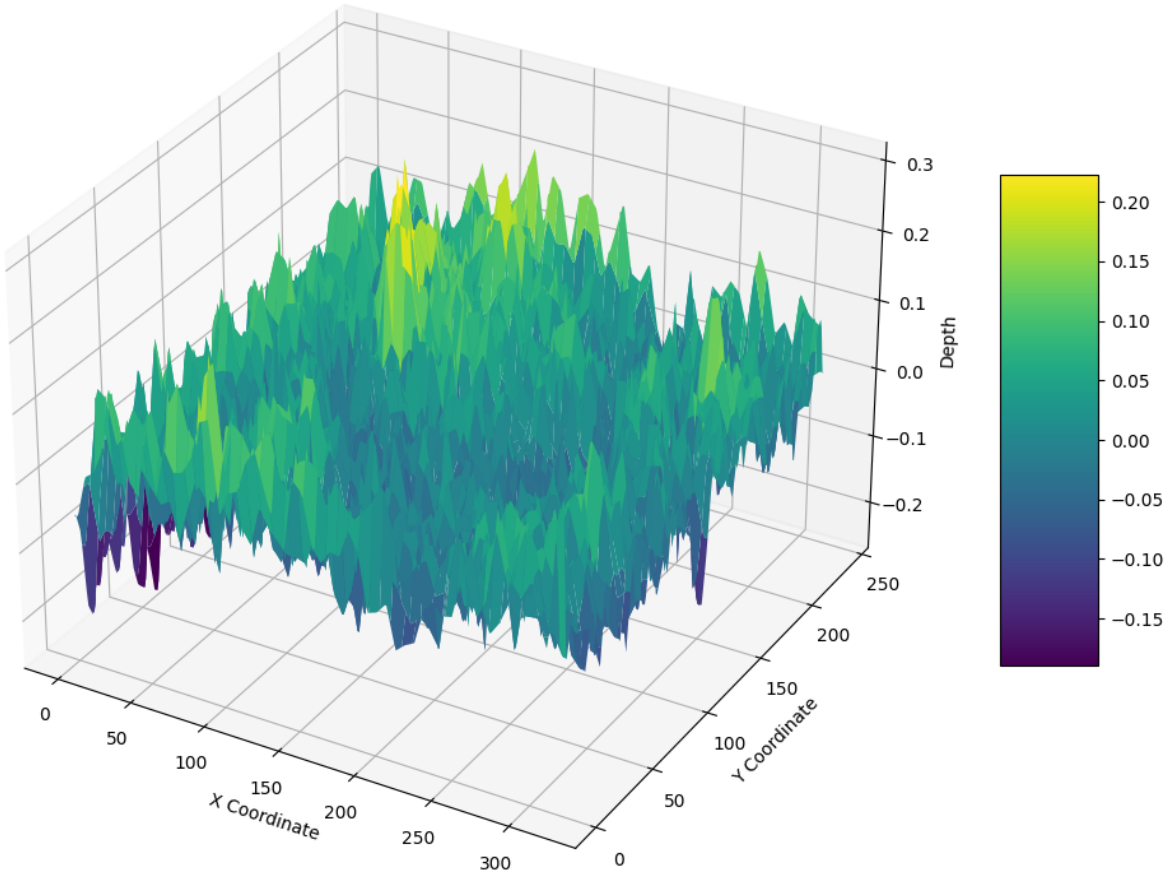
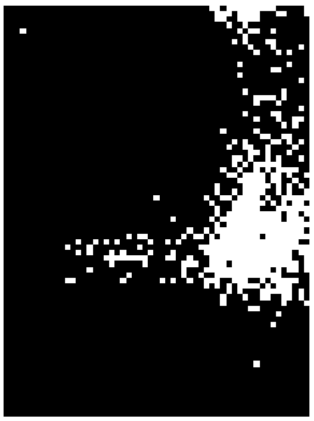




Tactile Image 27

Predicted Contact



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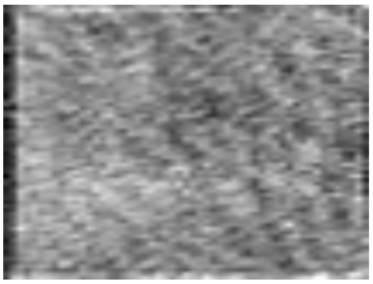

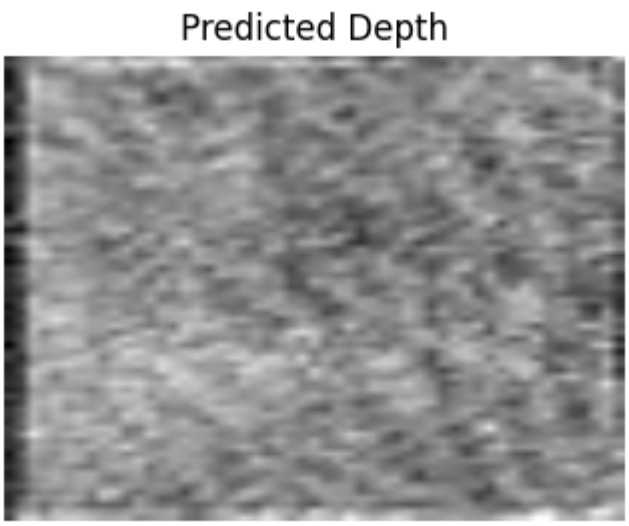
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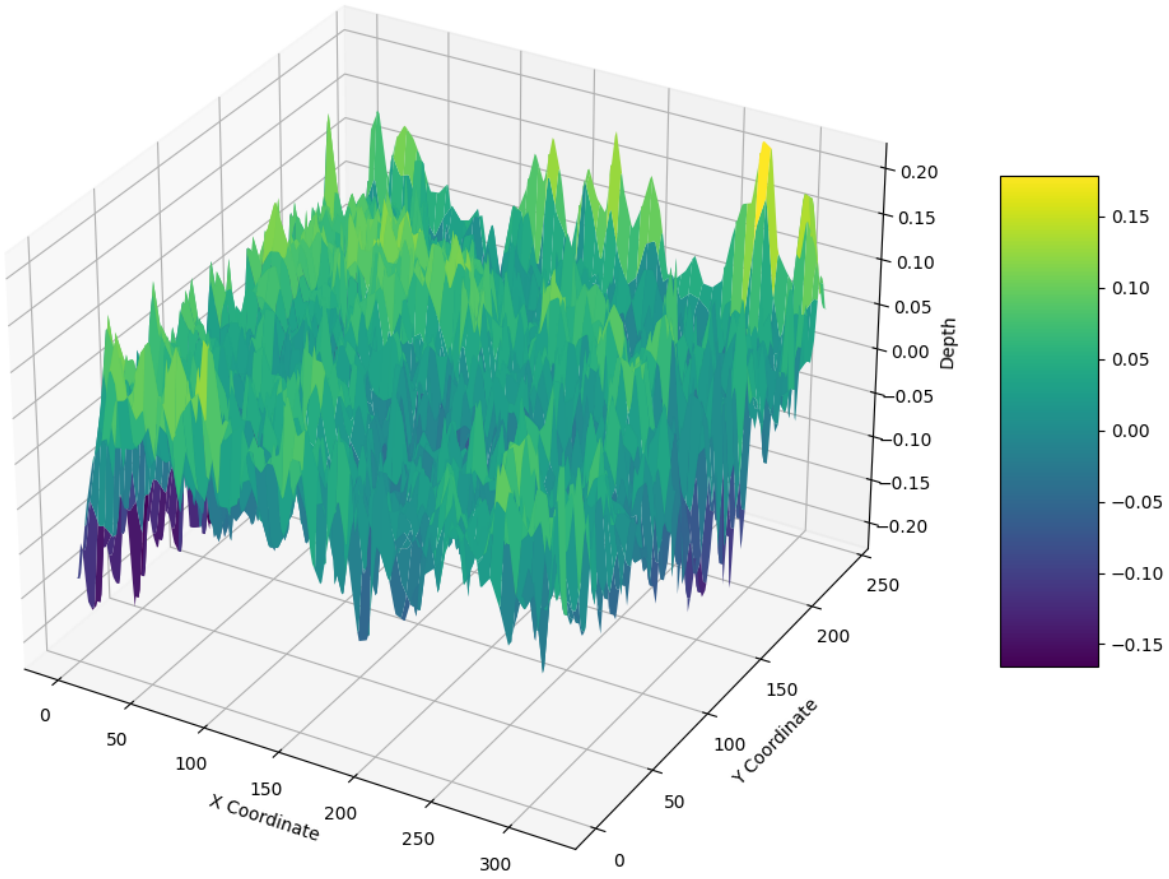
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X Coordinate
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200
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Y Coordinate
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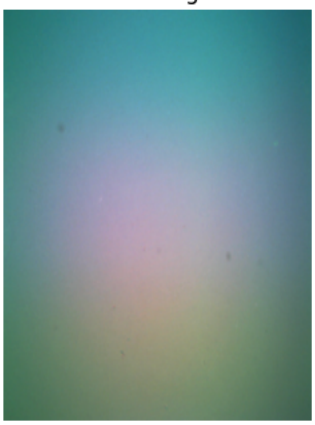
−0.15

Tactile Image 28



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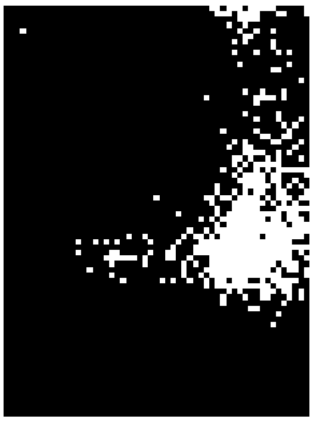

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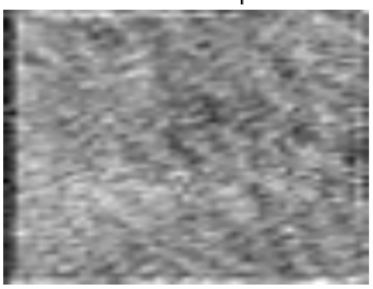

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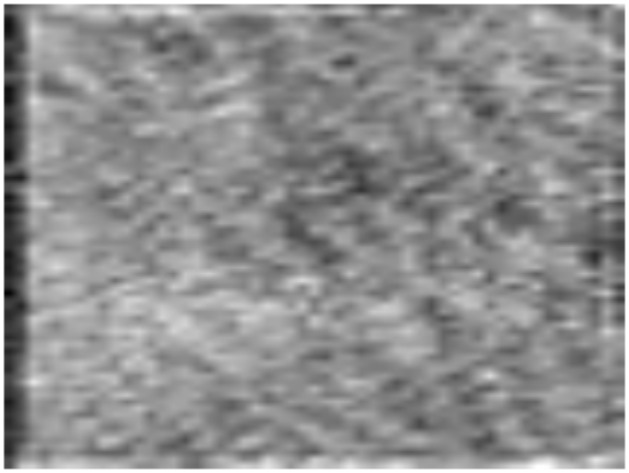
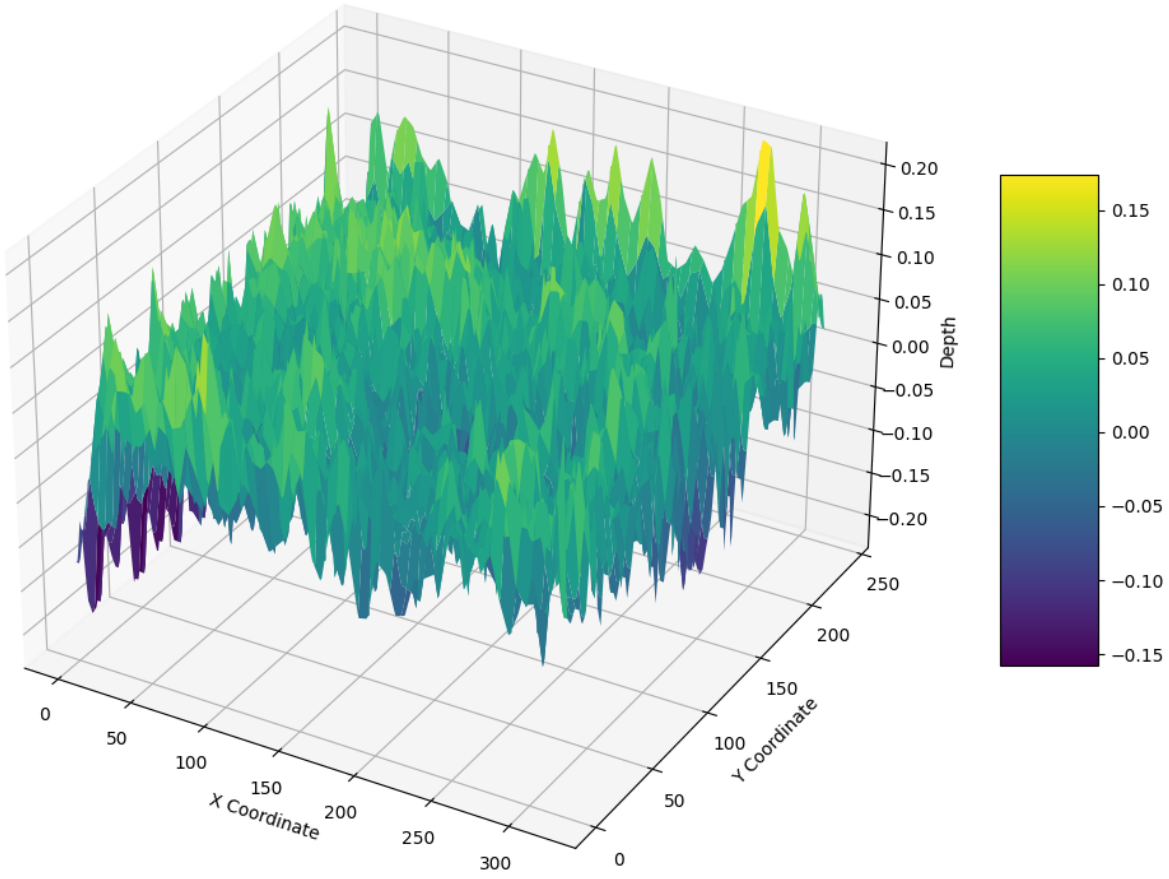
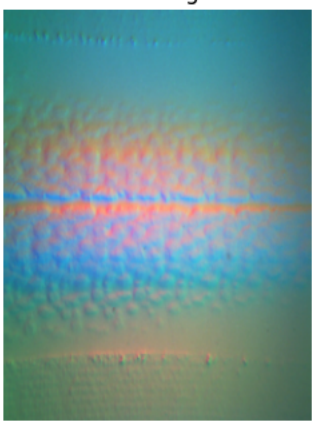




Tactile Image 29



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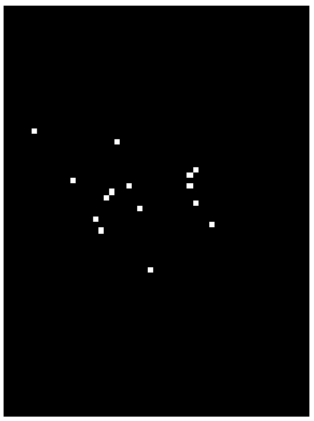

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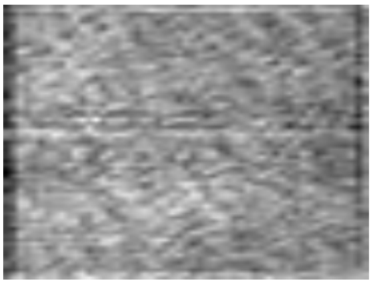
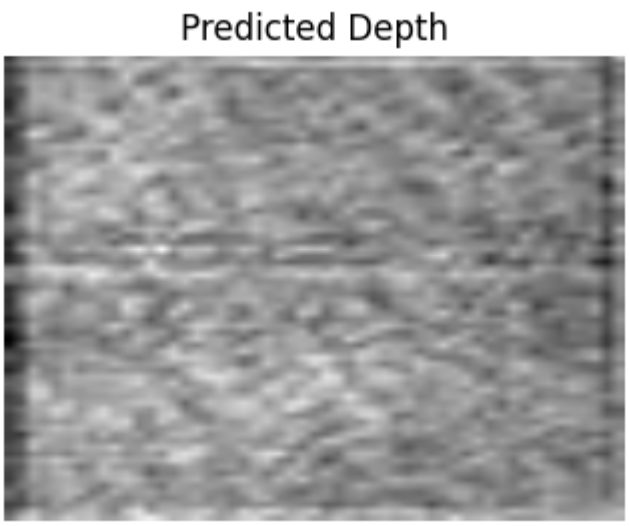
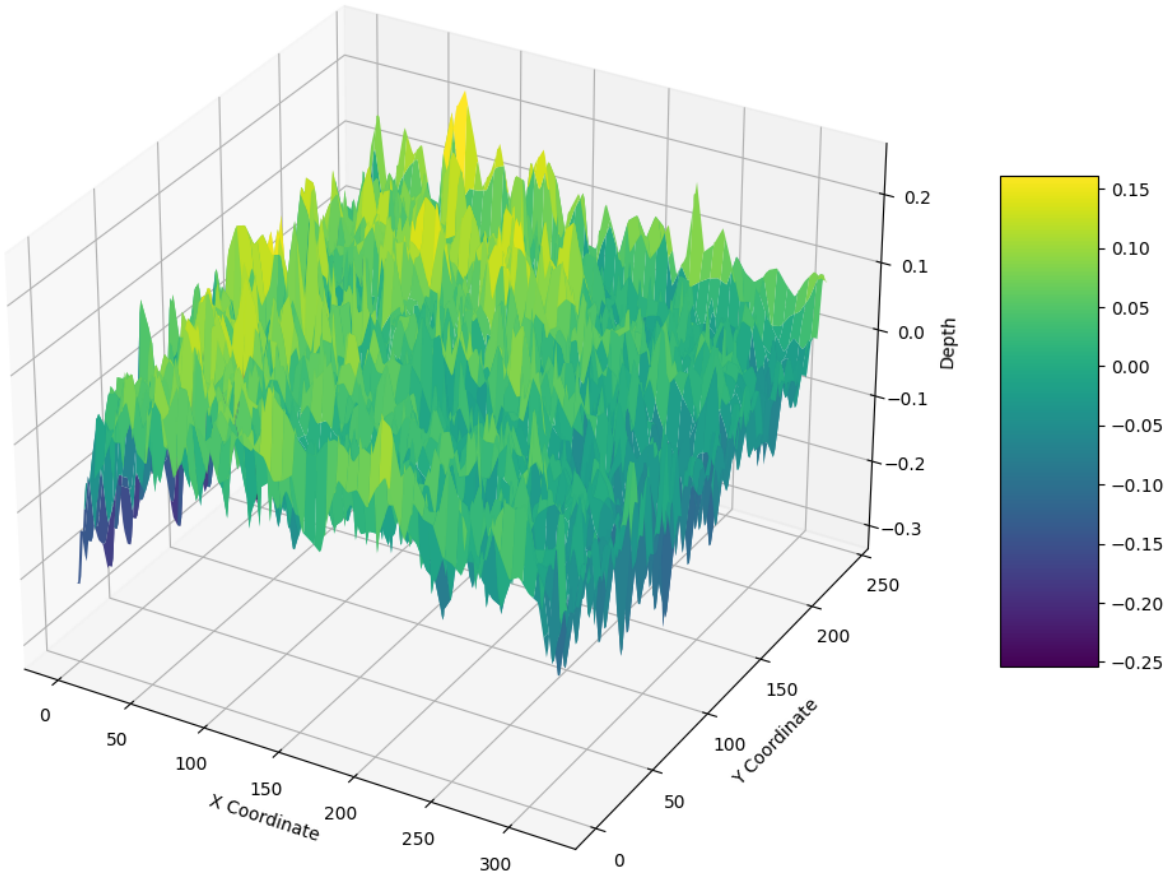



Predicted Depth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Y Coordinate
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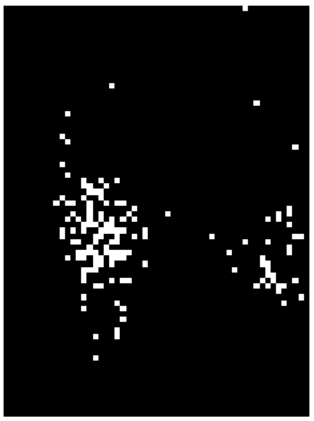
−0.25

Tactile Image 30

Predicted Contact



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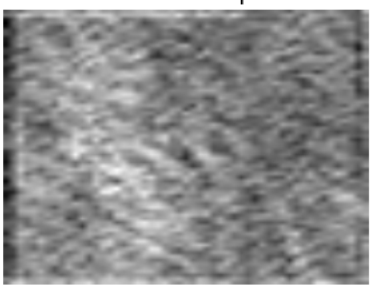

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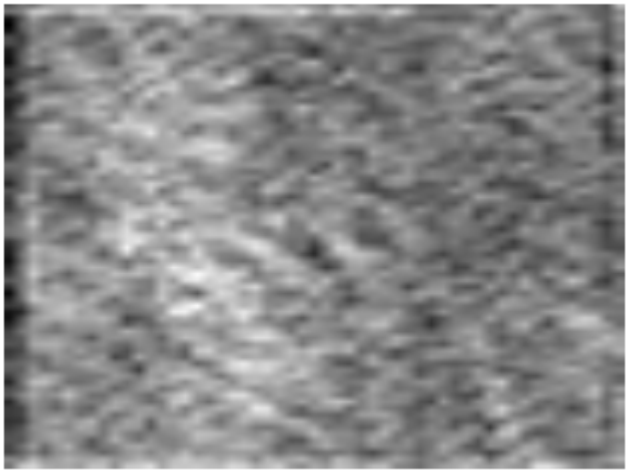
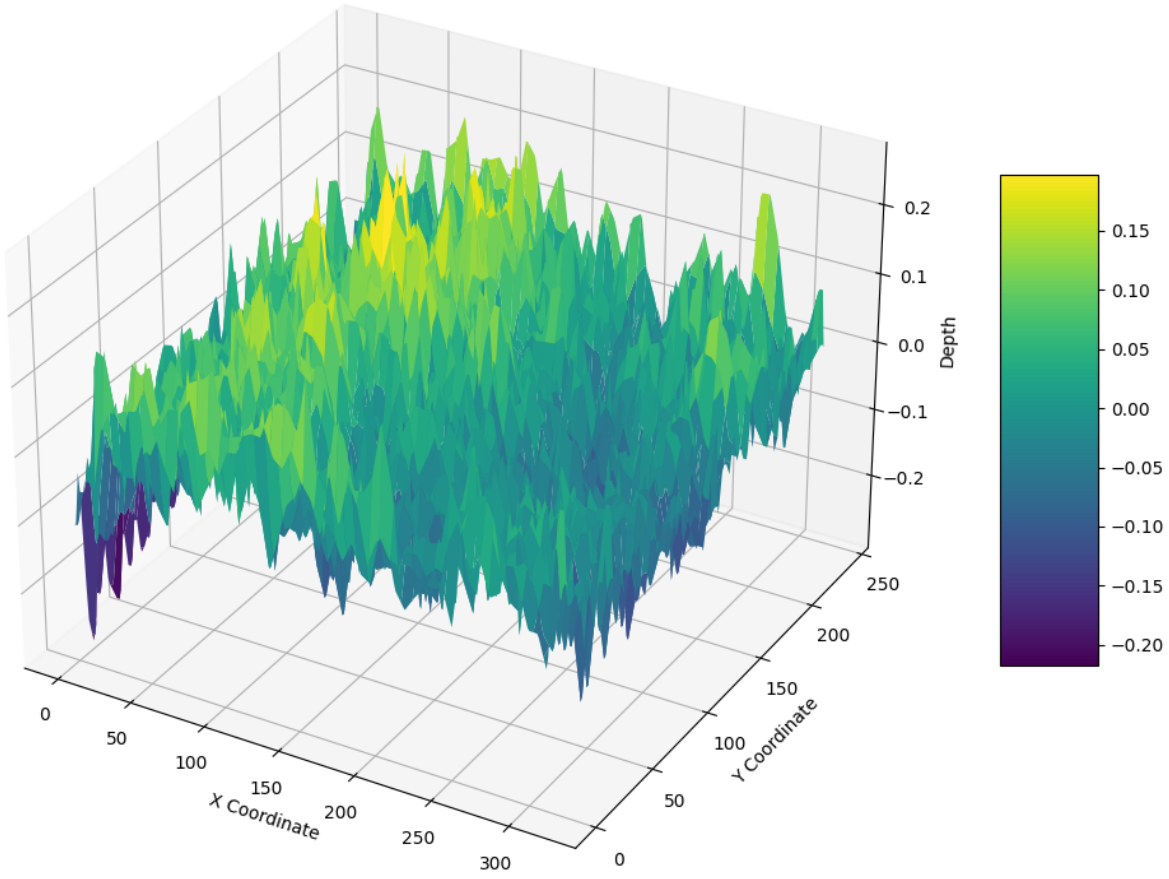
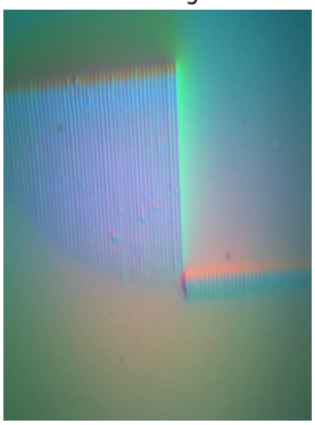
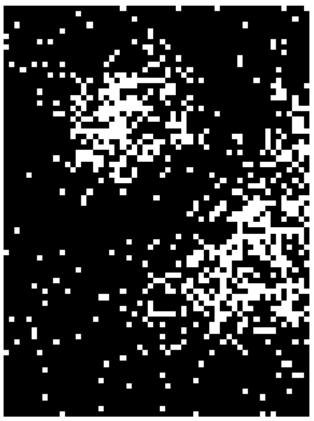




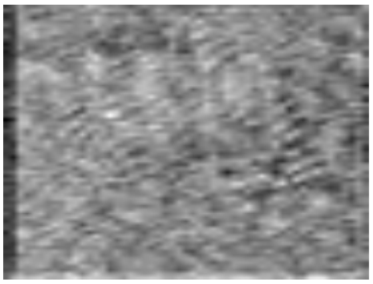
Tactile Image 31

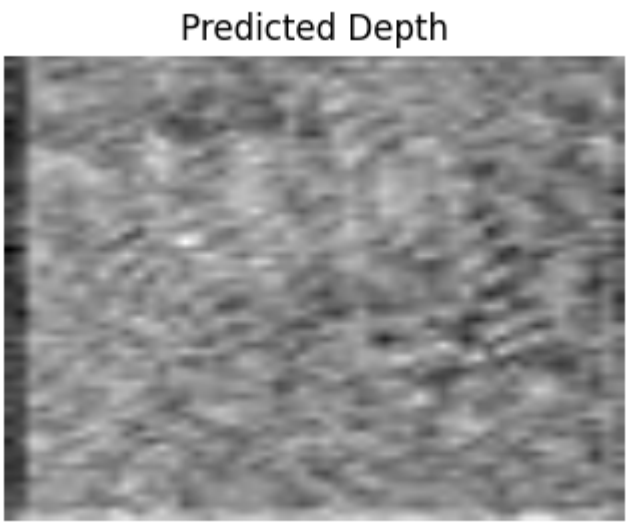


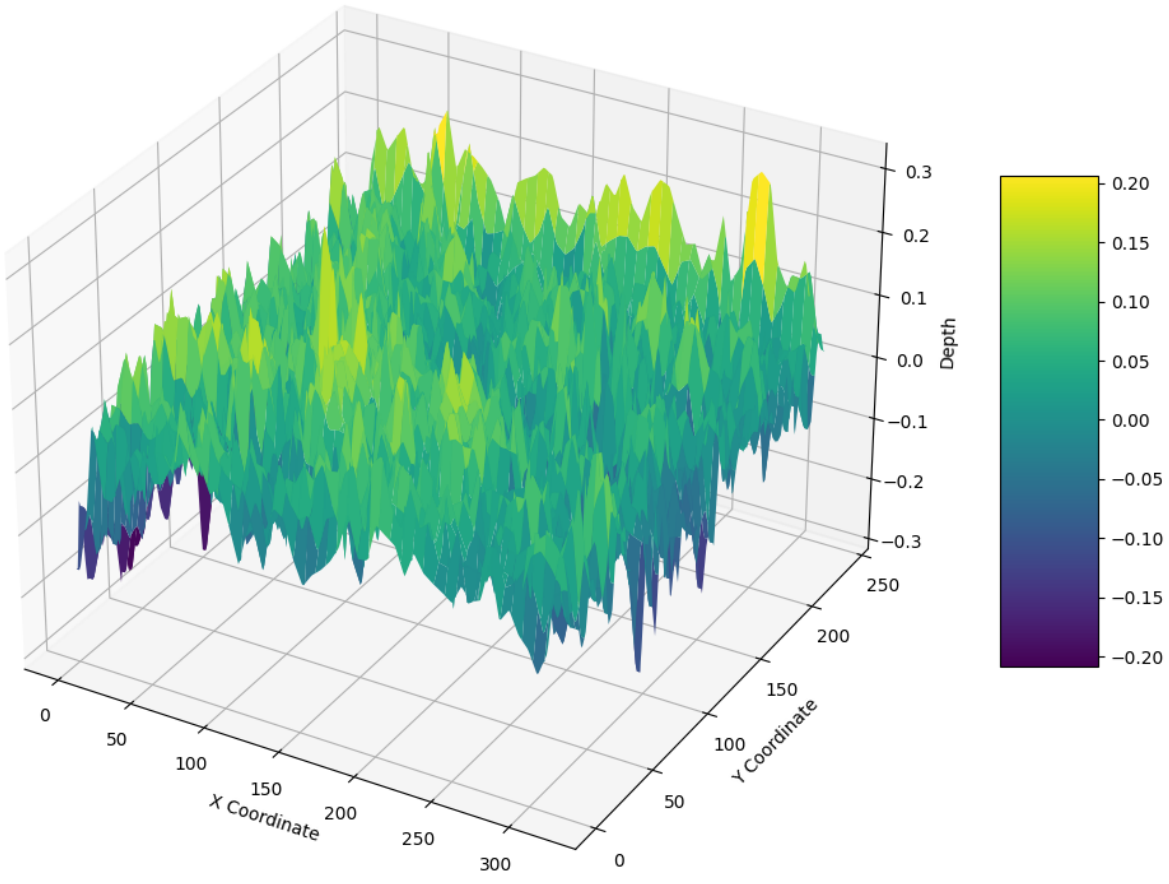
Predicted Contact



Predicted Depth




Predicted Depth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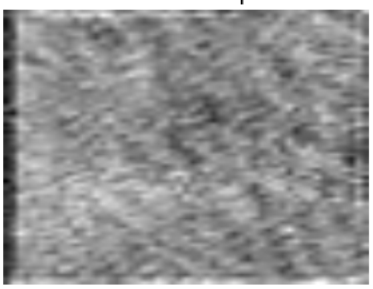
−0.2
−0.3
Depth
0
50
100
150
200
250
300
X Coordinate
0
50
100
150
200
250
Y Coordinate
0.20
0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15
−0.20

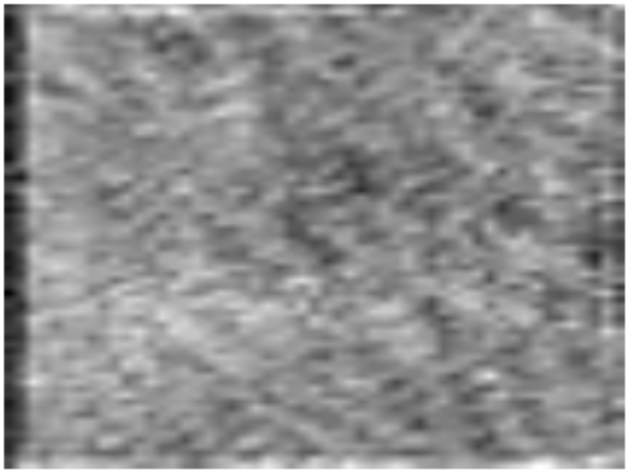
Tactile Image 32

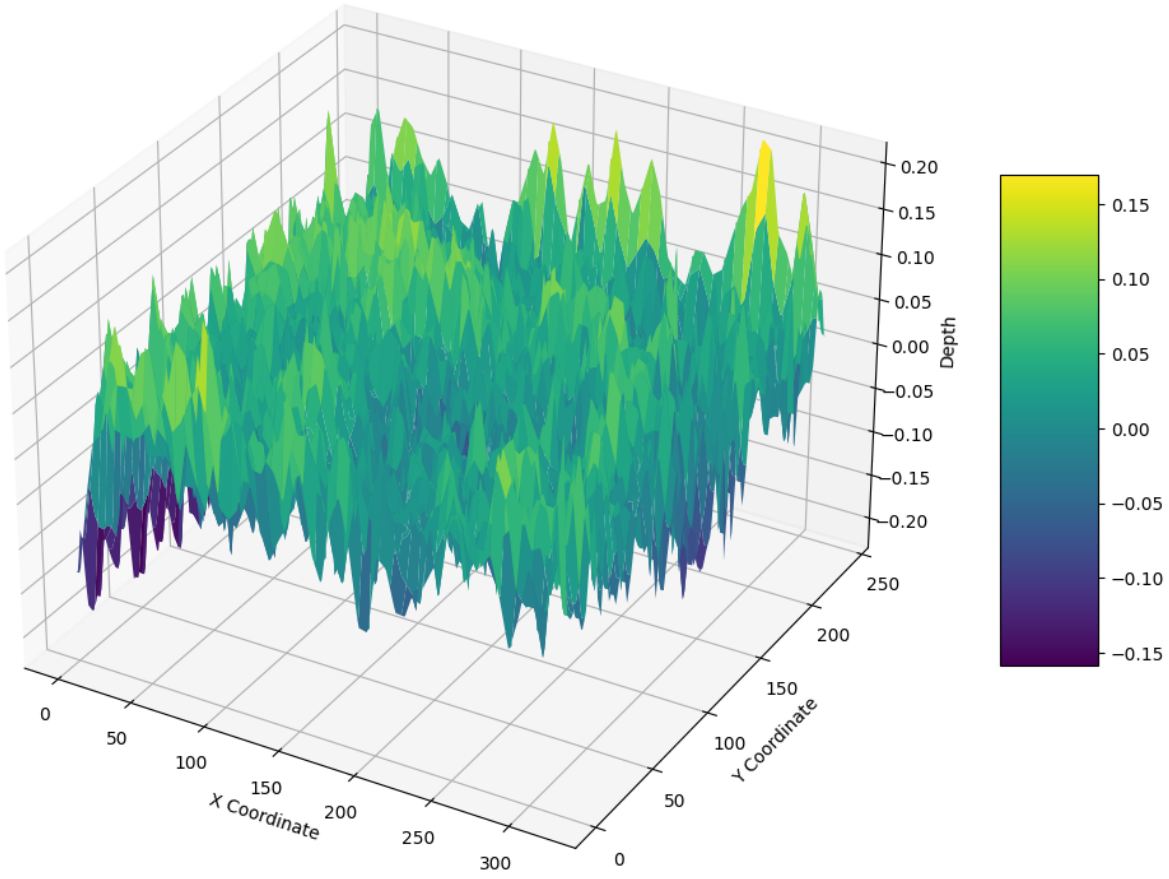
Predicted Contact

Predicted Depth

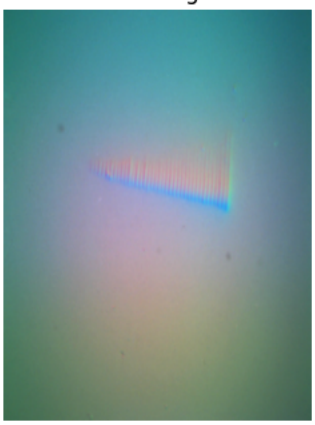


Predicted Depth

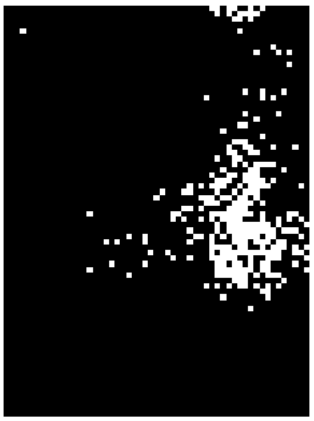




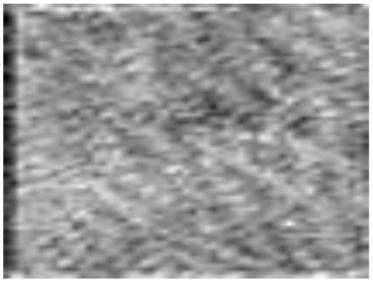
Tactile Image 33

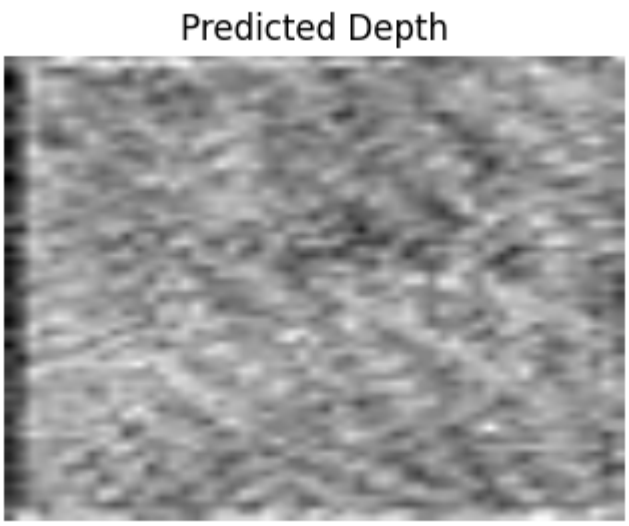


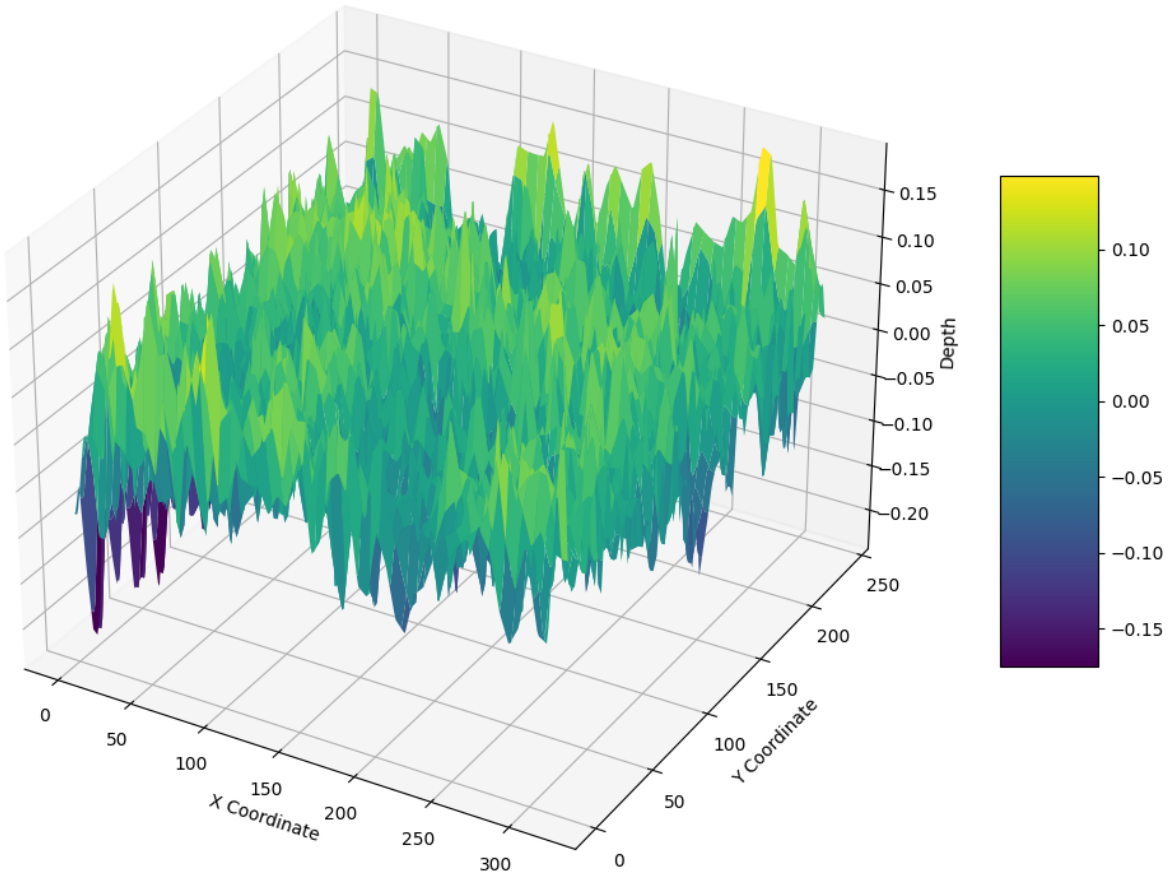
Predicted Contact



Predicted Depth



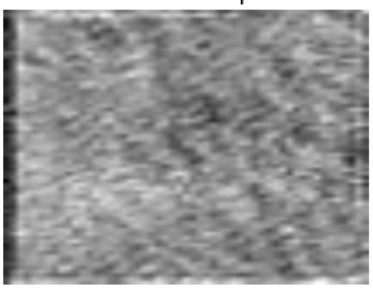

Predicted Depth


0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15
−0.20
Depth
0
50
100
150
200
250
300
X Coordinate
0
50
100
150
200
250
Y Coordinate
0.10
0.05
0.00
−0.05
−0.10
−0.15

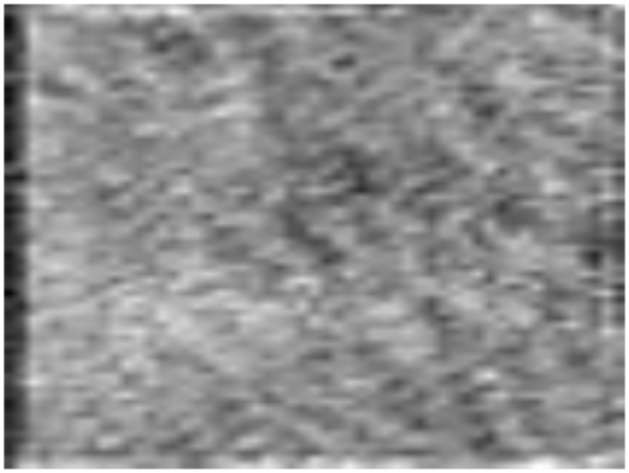
Tactile Image 34

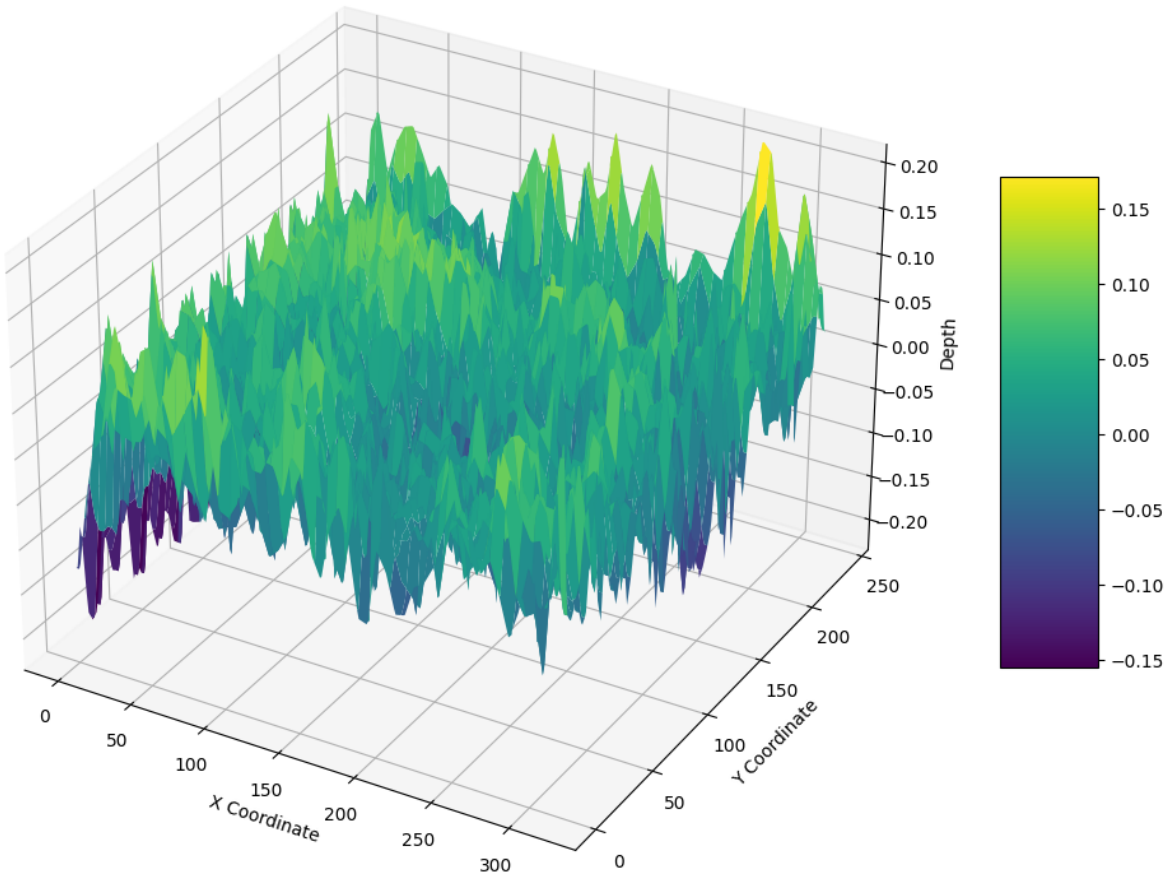
Predicted Contact

Predicted Depth



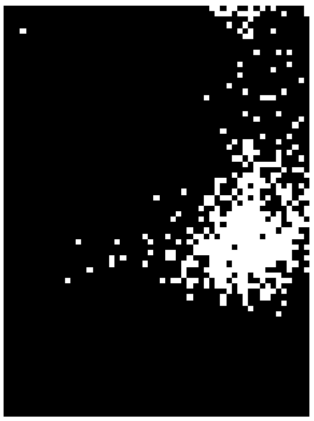
Predicted Depth



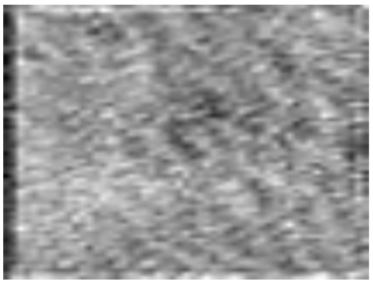


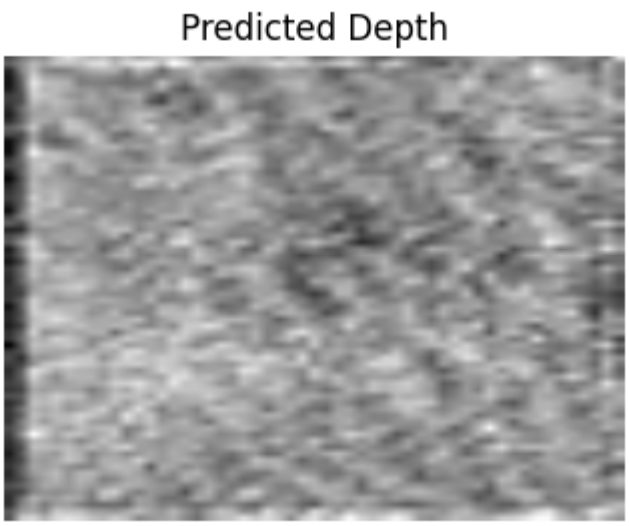
Tactile Image 35

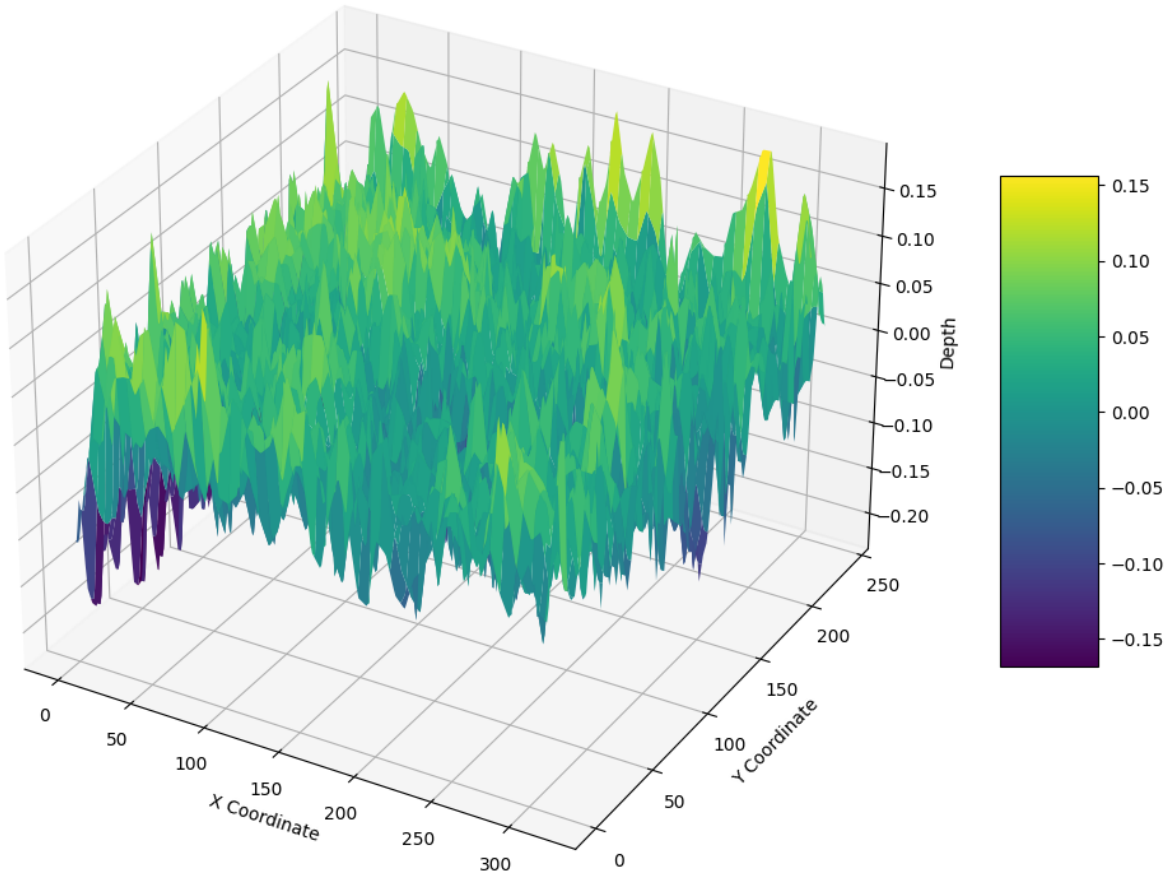
Predicted Contact



Predicted Depth



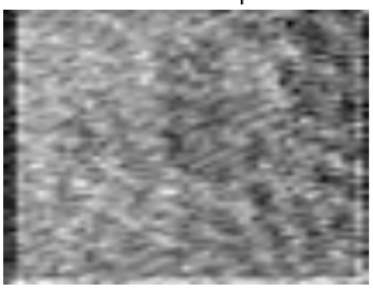

Predicted Depth


0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15
−0.20
Depth
0
50
100
150
200
250
300
X Coordinate
0
50
100
150
200
250
Y Coordinate
0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15

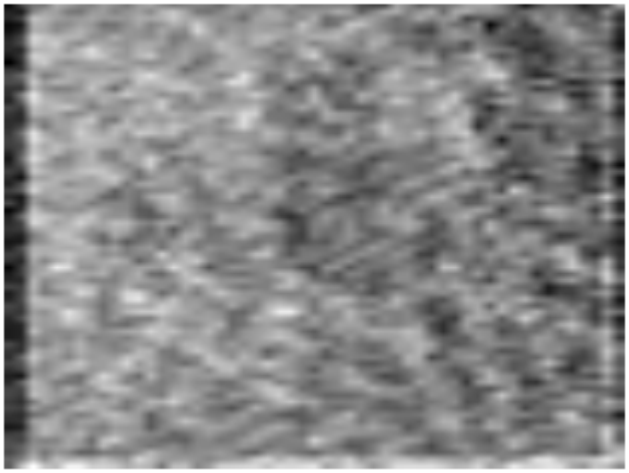
Tactile Image 36

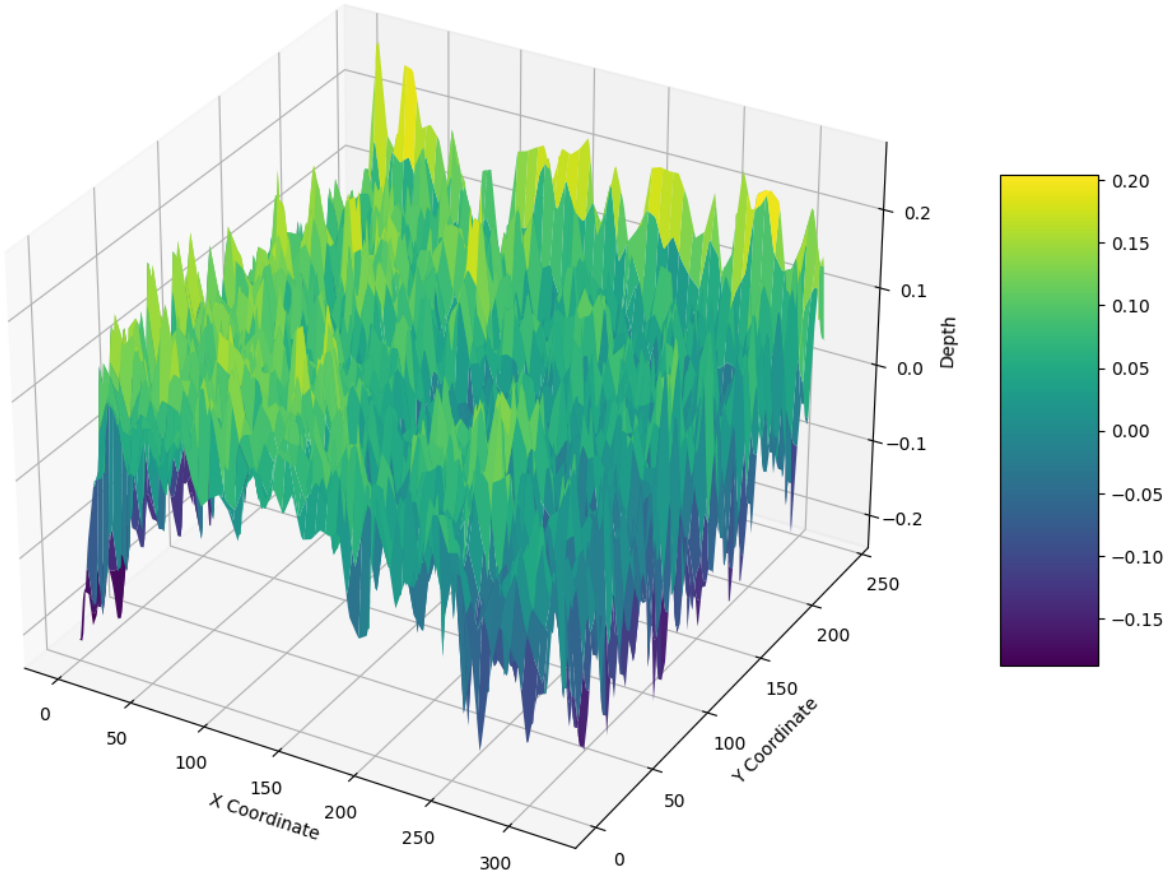
Predicted Contact

Predicted Depth



Predicted Depth

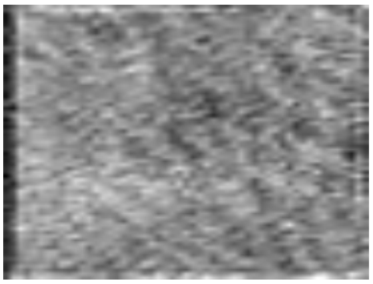


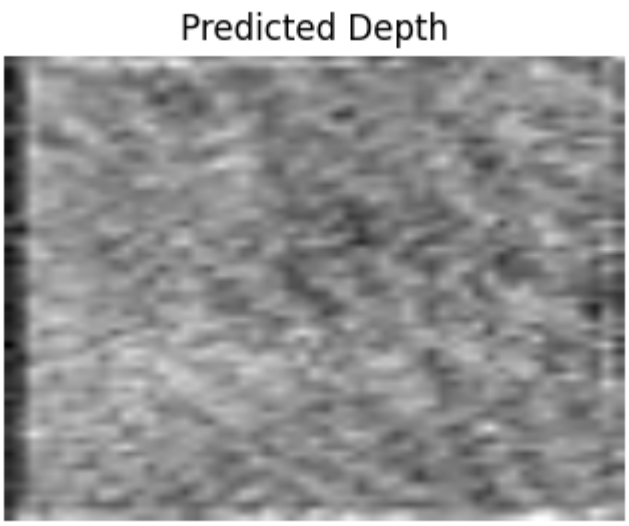


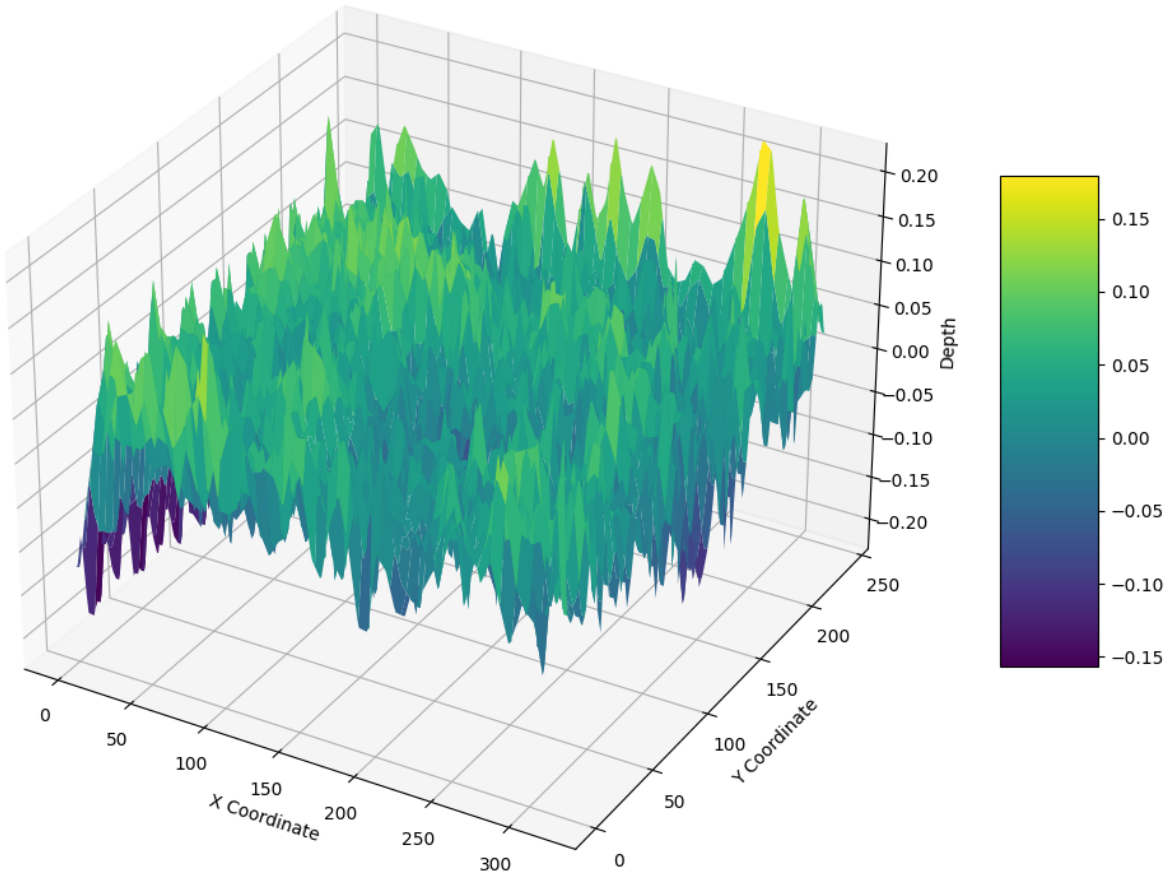
Tactile Image 37

Predicted Contact

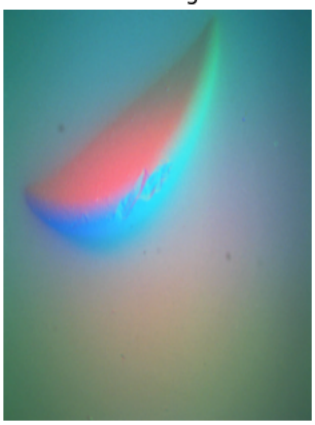
Predicted Depth



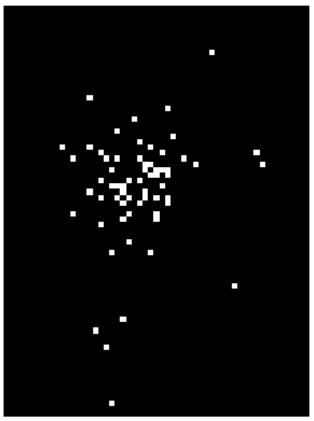

Predicted Depth


0.20
0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15
Depth
0
50
100
150
200
250
300
X Coordinate
0
50
100
150
200
250
Y Coordinate
0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15

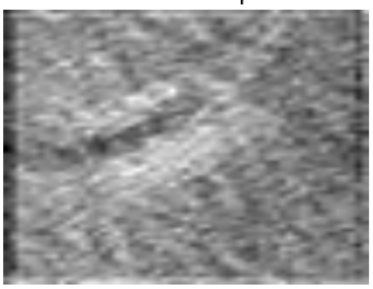
Tactile Image 38



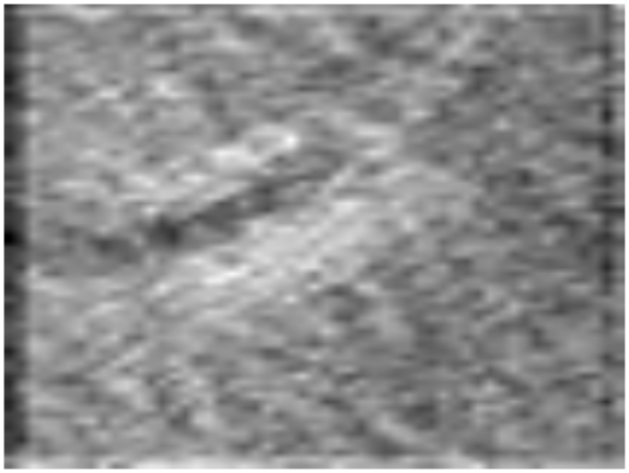
Predicted Contact

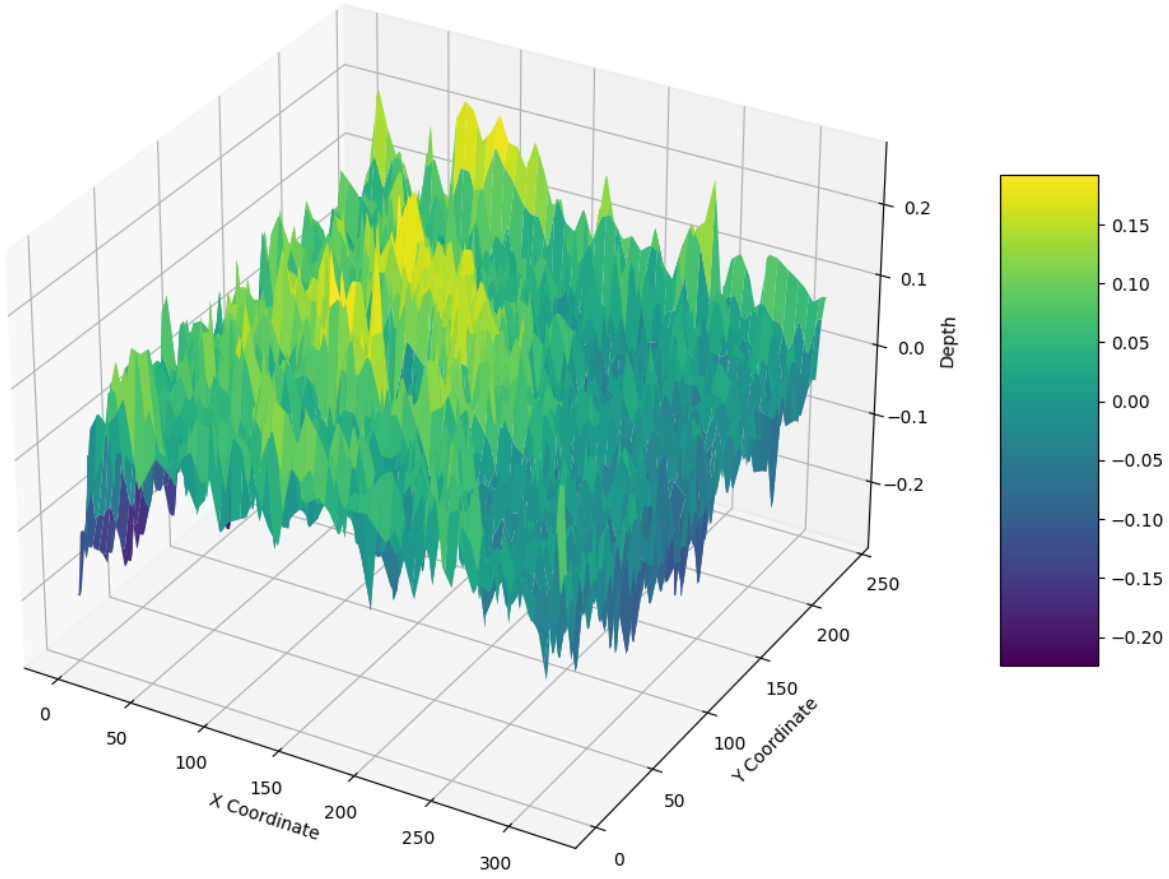


Predicted Depth

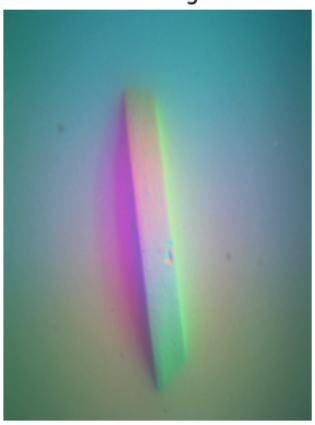


Predicted Depth

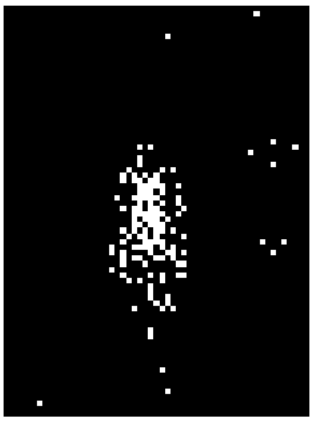




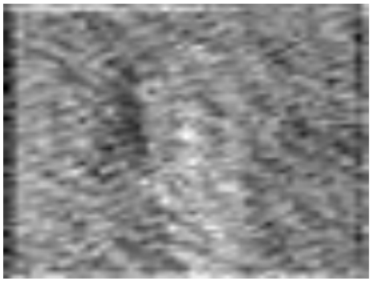
Tactile Image 39

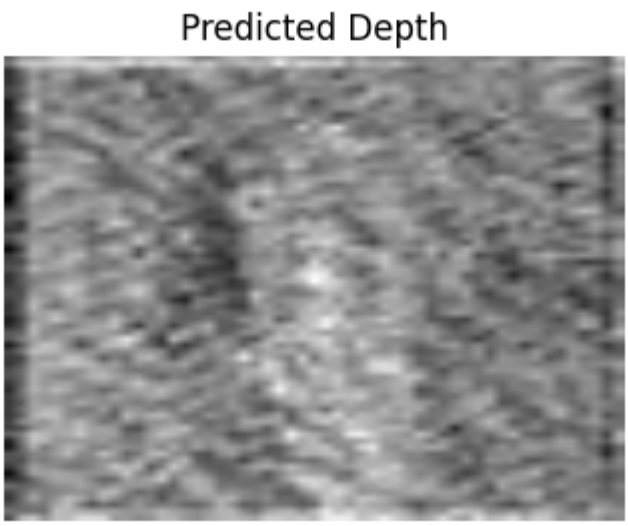


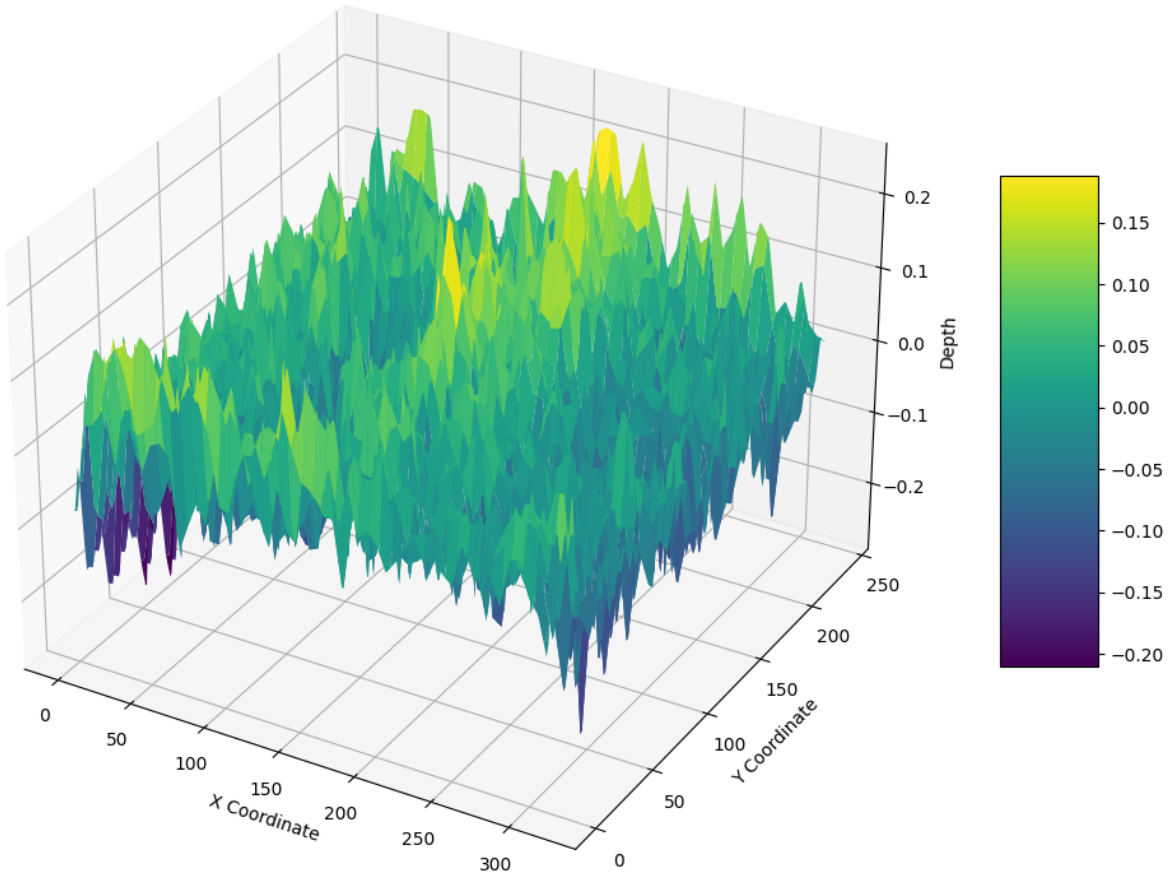
Predicted Contact



Predicted Depth



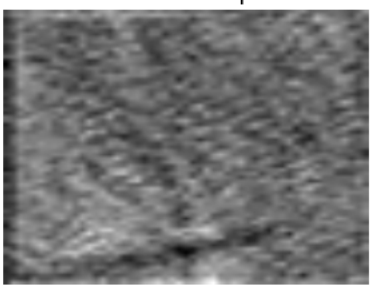

Predicted Depth


0.2
0.1
0.0
−0.1
−0.2
Depth
0
50
100
150
200
250
300
X Coordinate
0
50
100
150
200
250
Y Coordinate
0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15
−0.20

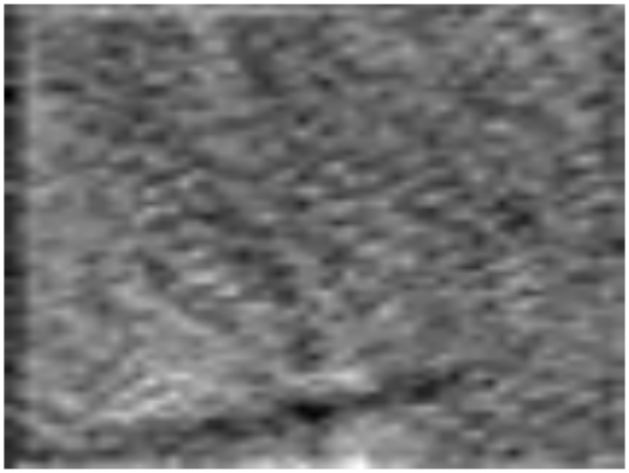
Tactile Image 40

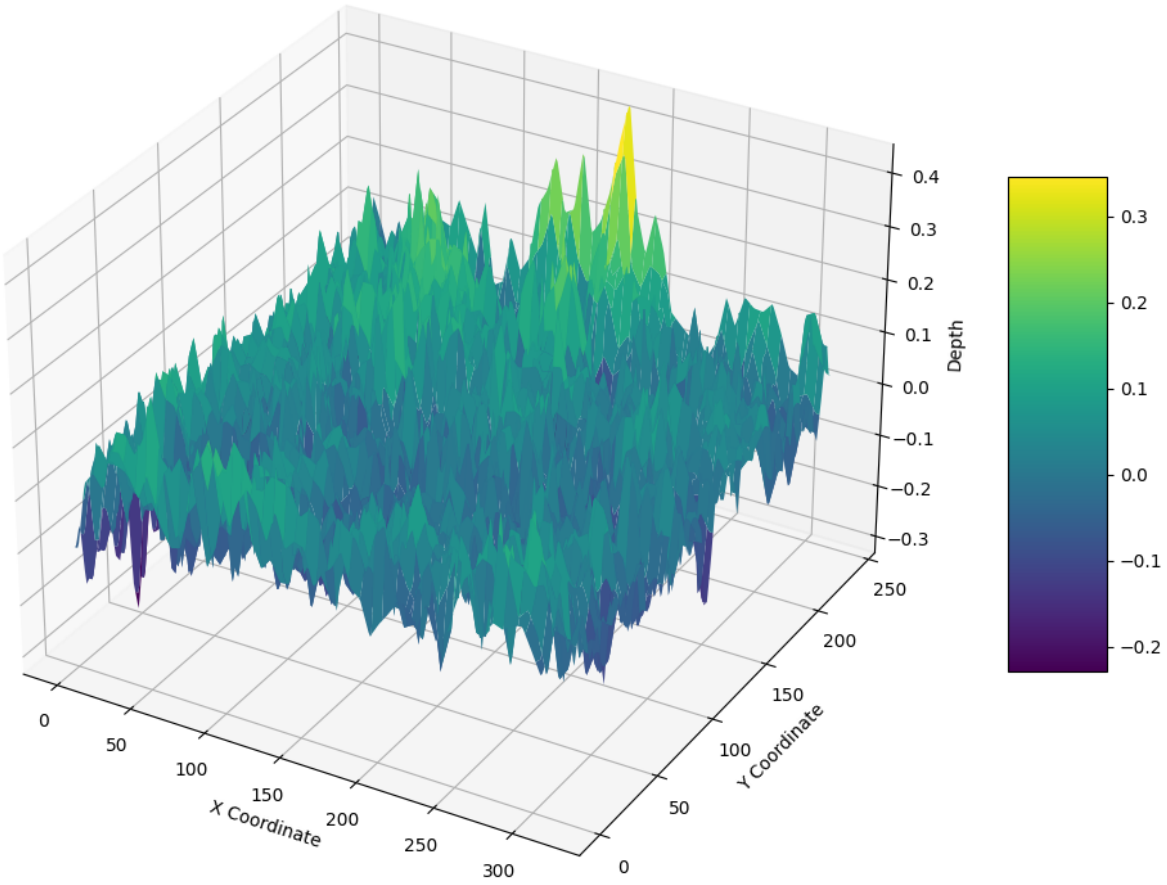
Predicted Contact

Predicted Depth



Predicted Depth

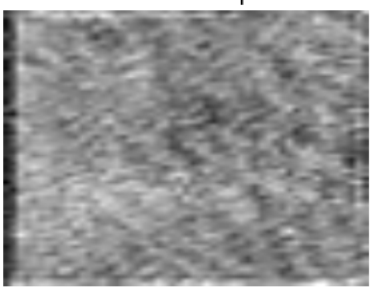


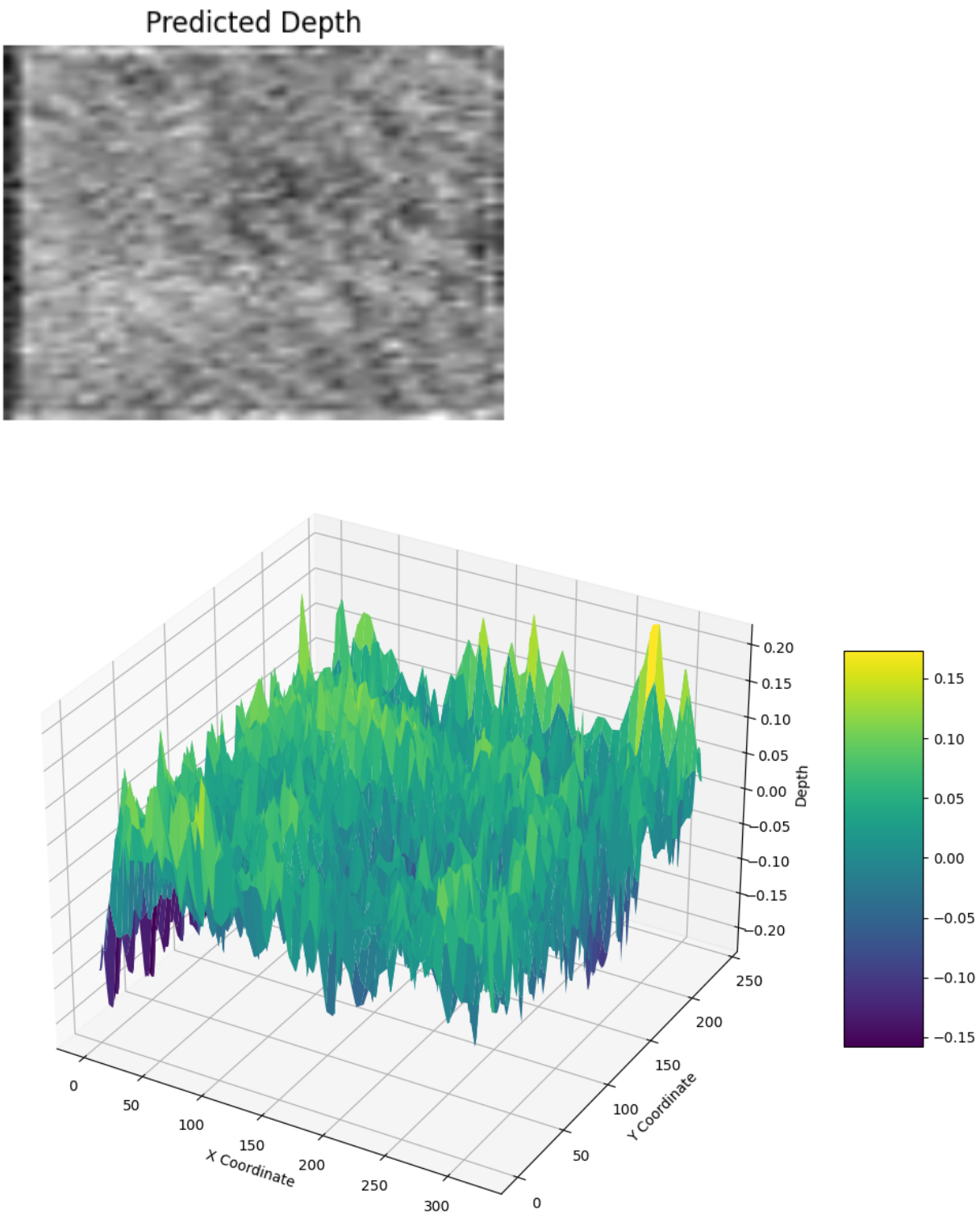


Tactile Image 41

Predicted Contact

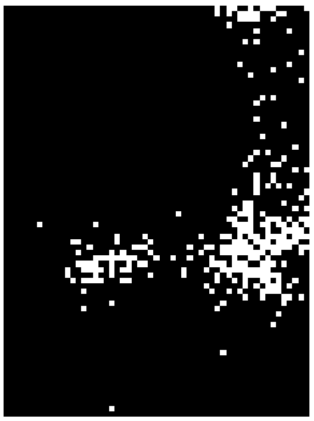
Predicted Depth



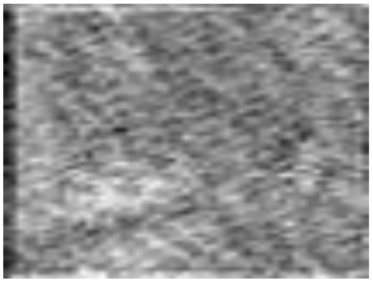

Predicted Depth
0.20
0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15
−0.20
Depth
0
50
100
150
200
250
300
X Coordinate
0
50
100
150
200
250
Y Coordinate
0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15

Tactile Image 42

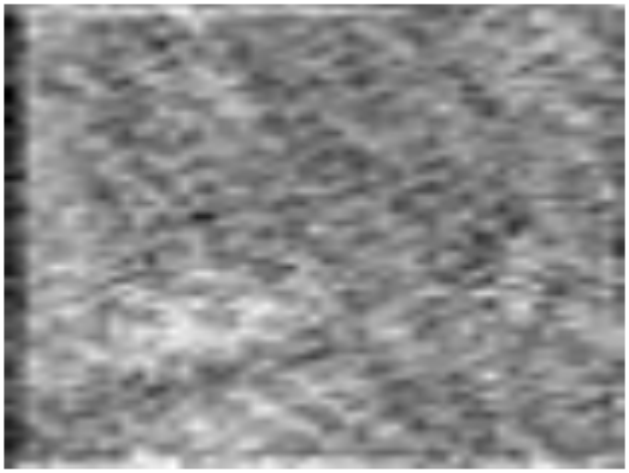
Predicted Contact

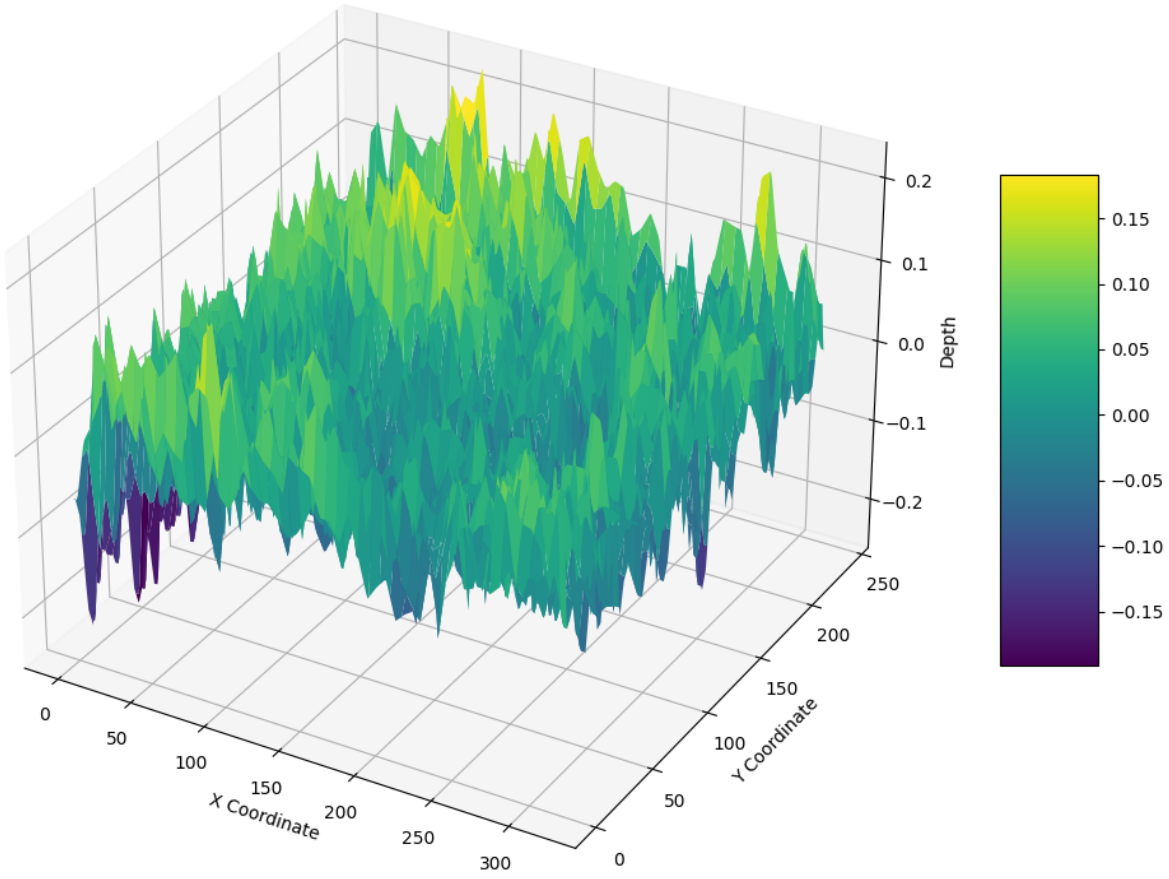


Predicted Depth



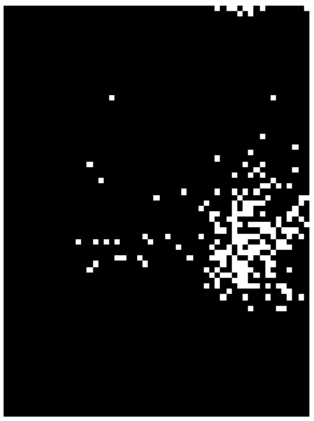
Predicted Depth



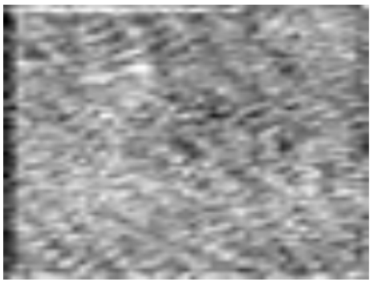


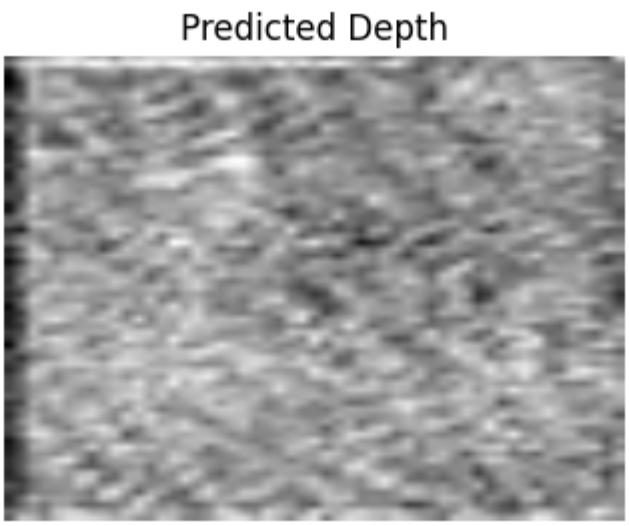
Tactile Image 43

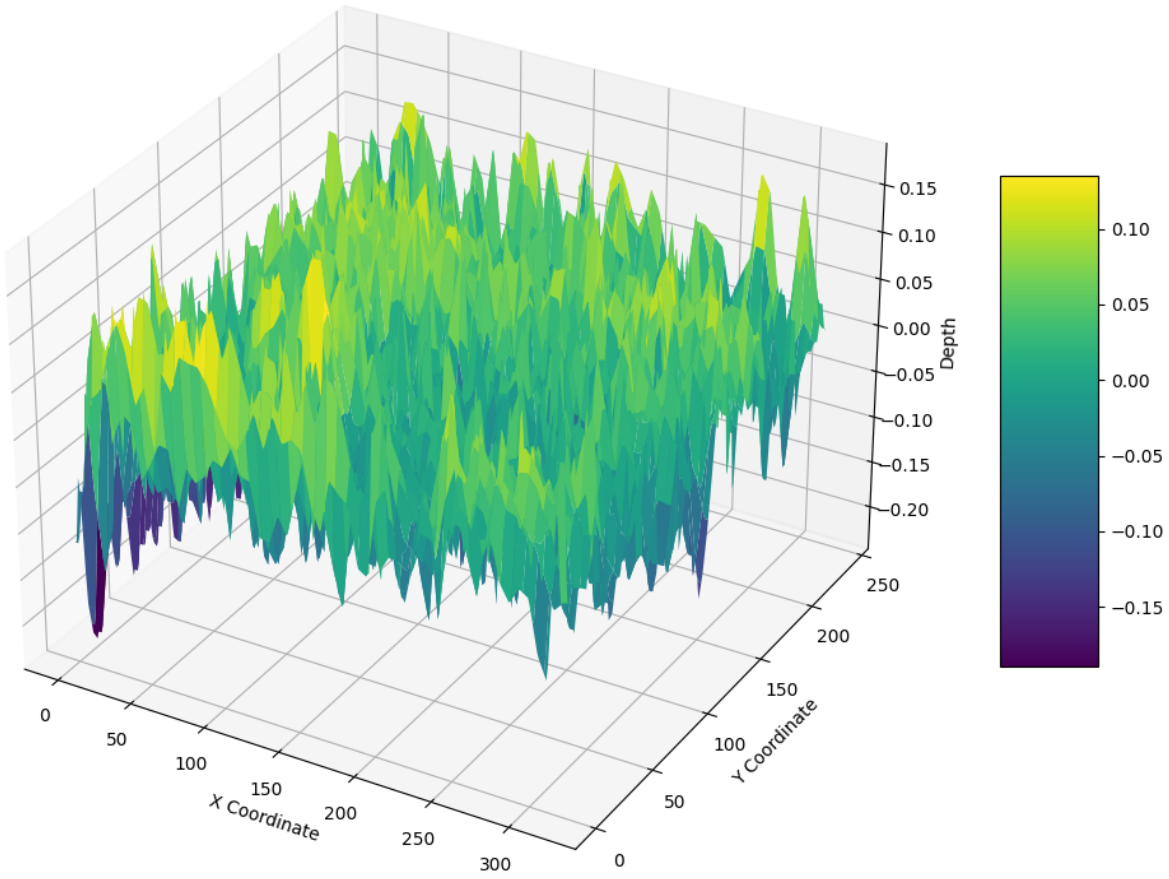
Predicted Contact



Predicted Depth

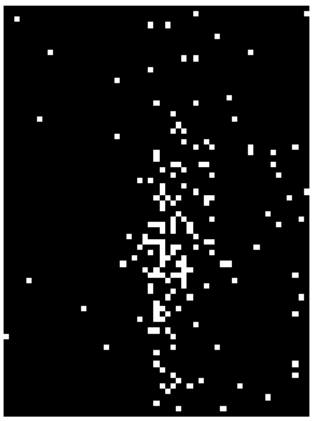



Predicted Depth

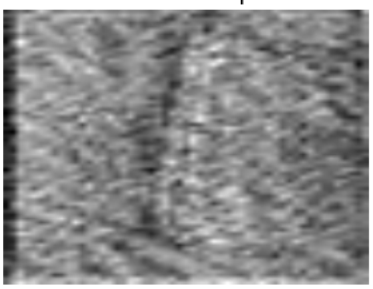

0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15
−0.20
Depth
0
50
100
150
200
250
300
X Coordinate
0
50
100
150
200
250
Y Coordinate
0.10
0.05
0.00
−0.05
−0.10
−0.15

Tactile Image 44

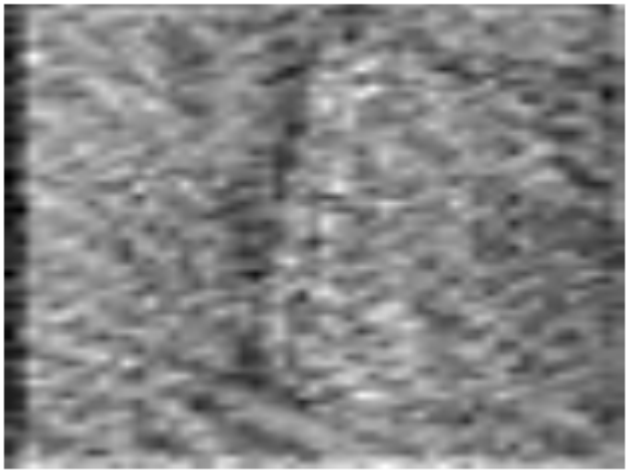
Predicted Contact

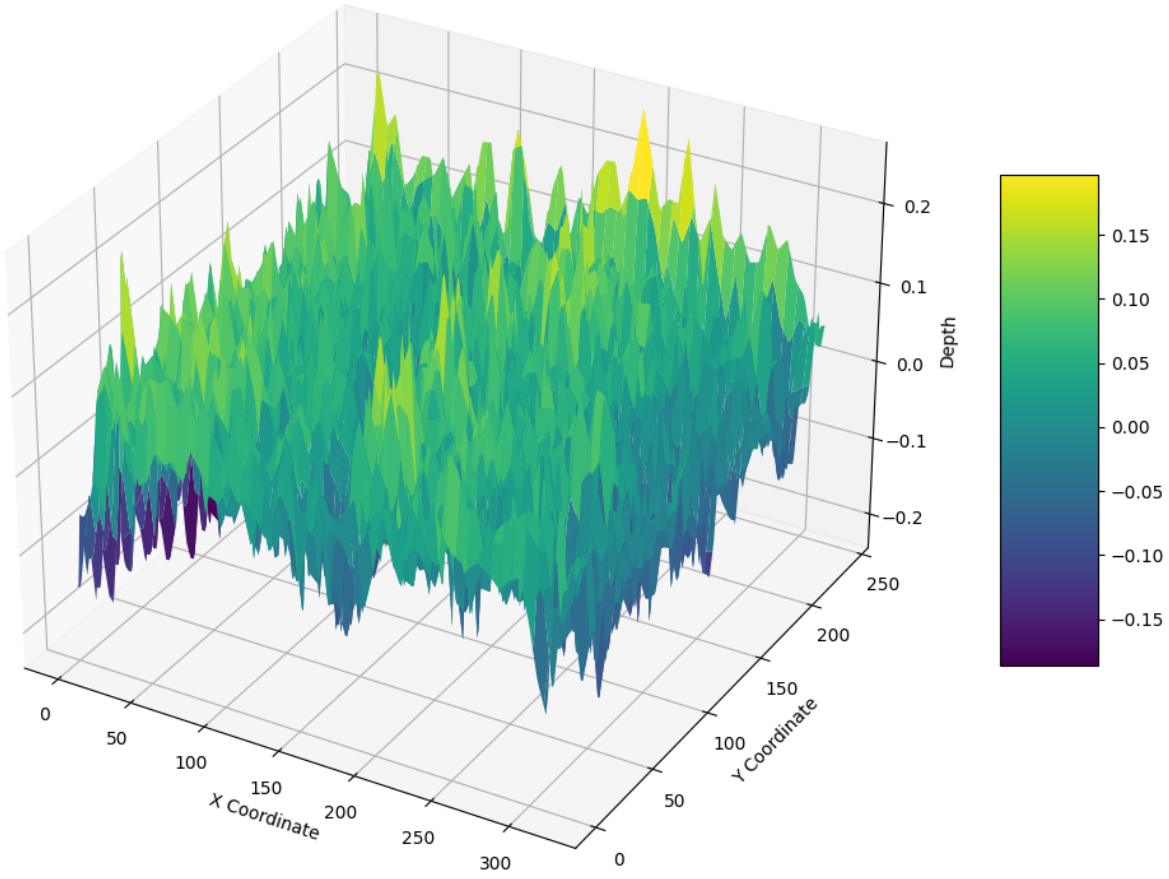


Predicted Depth



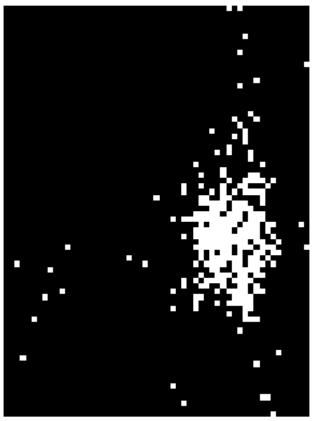
Predicted Depth





Tactile Image 45

Predicted Contact



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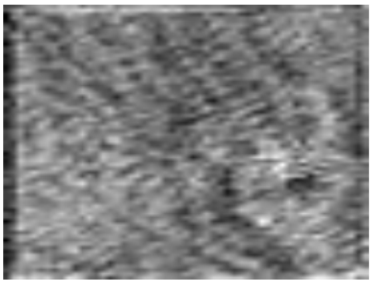

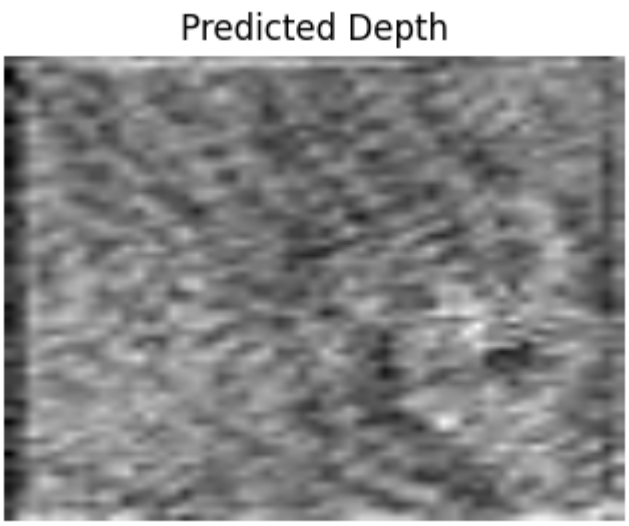
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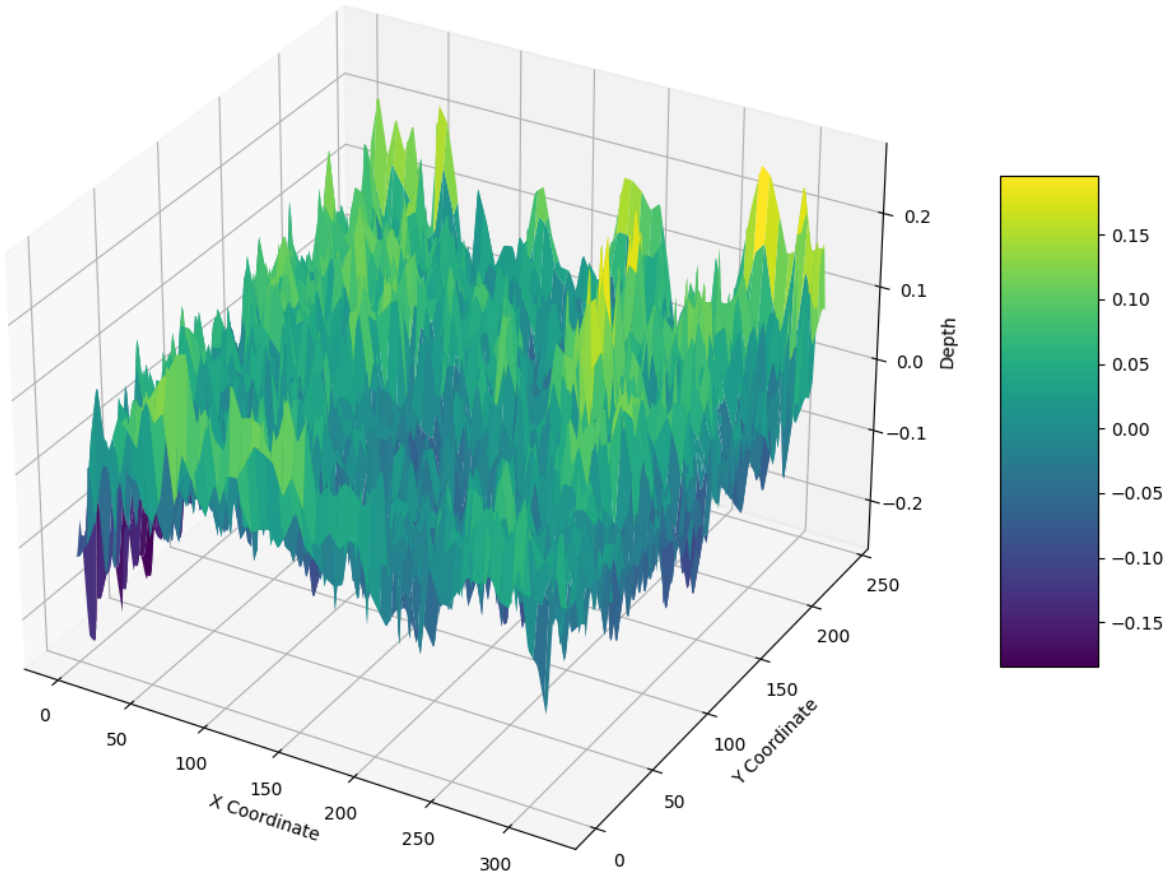
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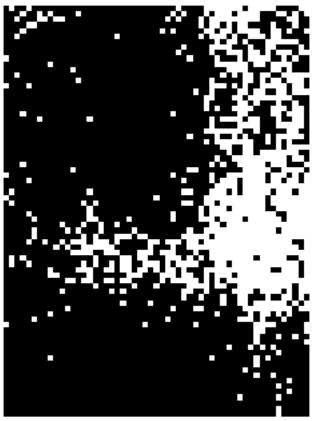
−0.15

Tactile Image 46

Predicted Contact



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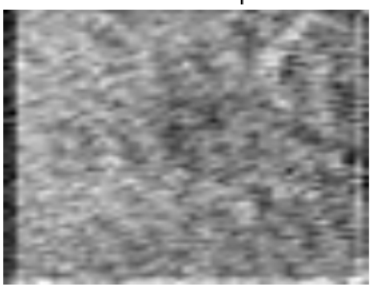

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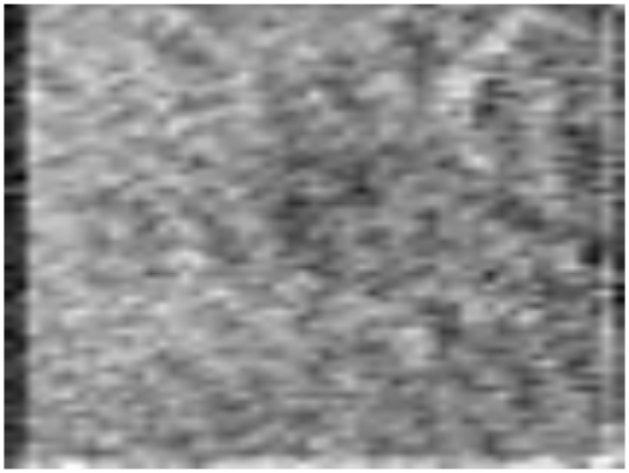
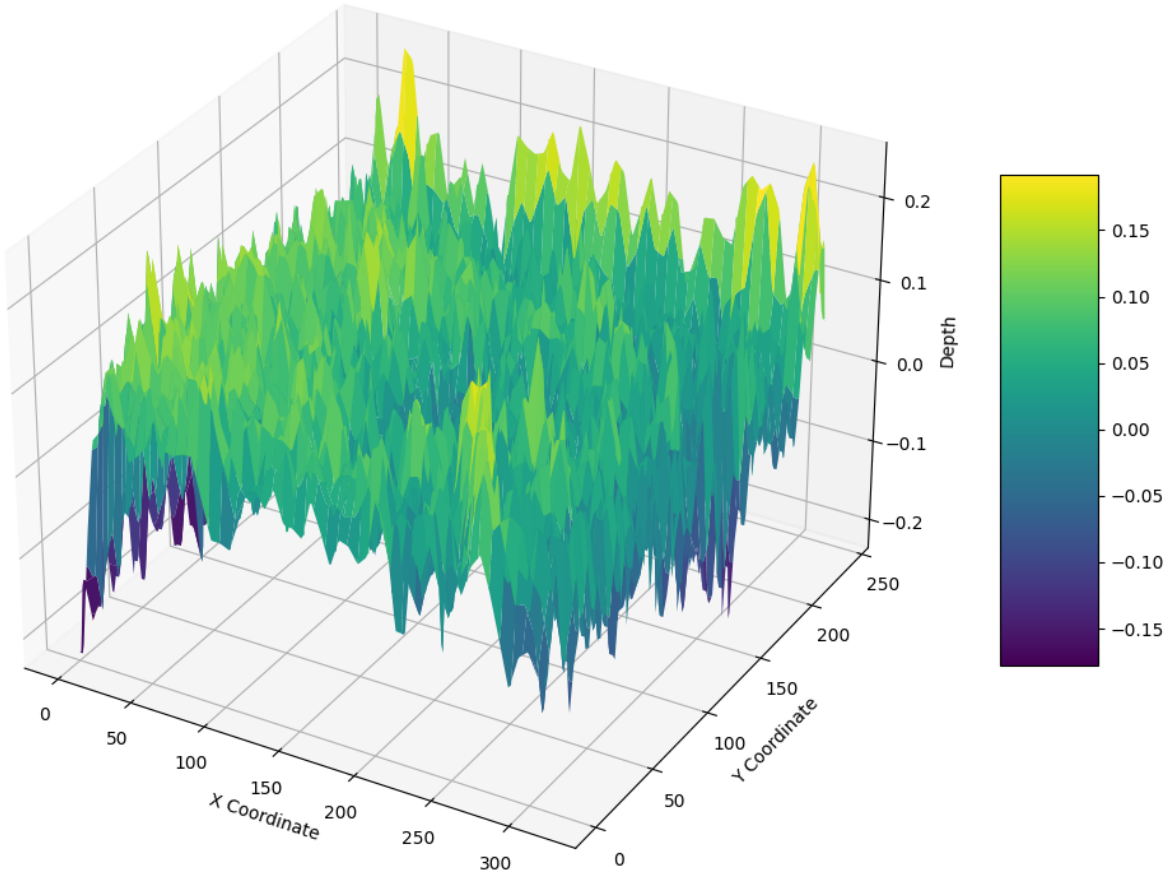
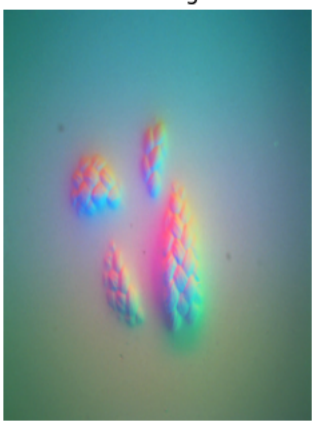




Tactile Image 47



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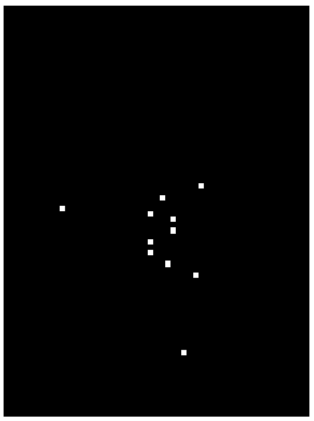

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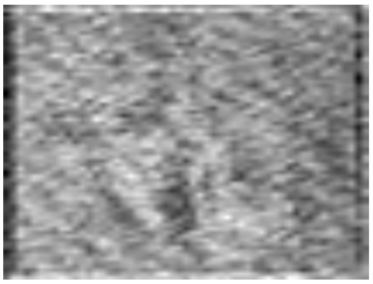

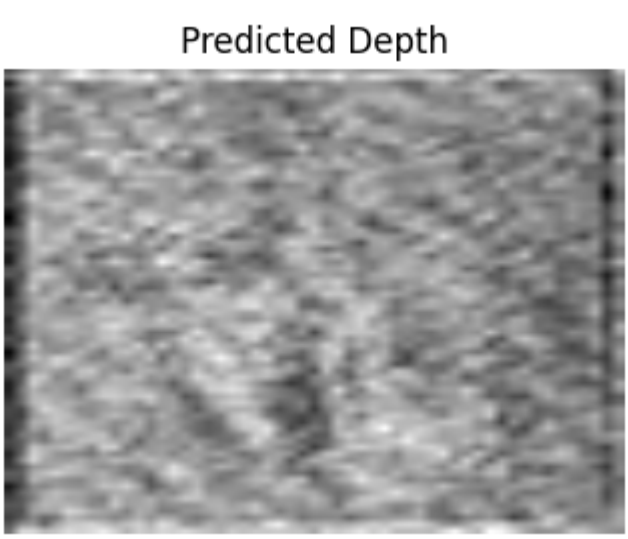
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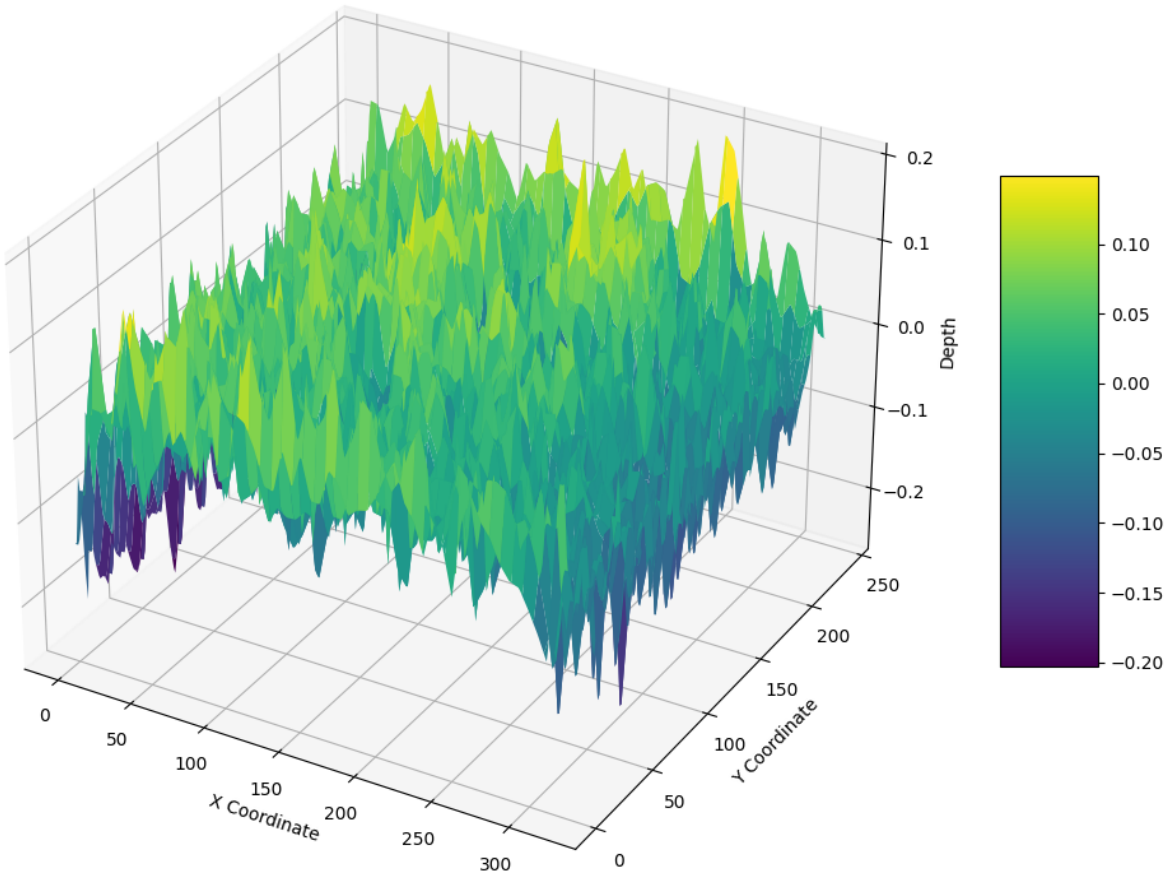
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Y Coordinate
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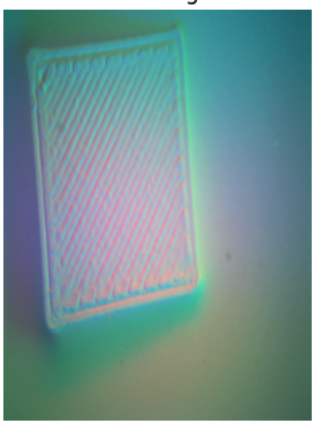
−0.20

Tactile Image 48



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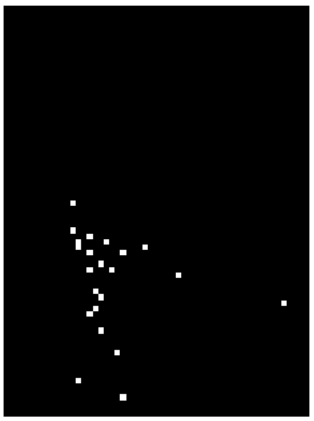

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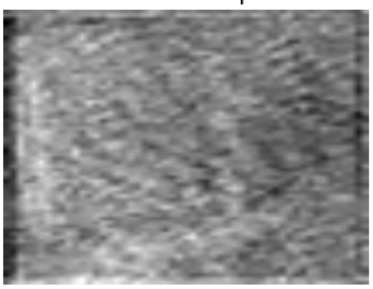

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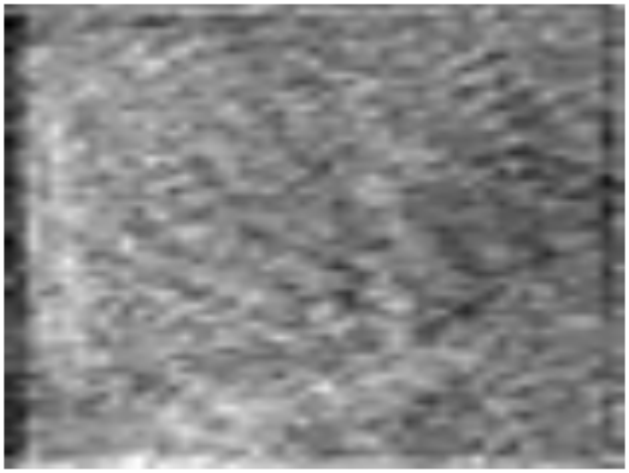
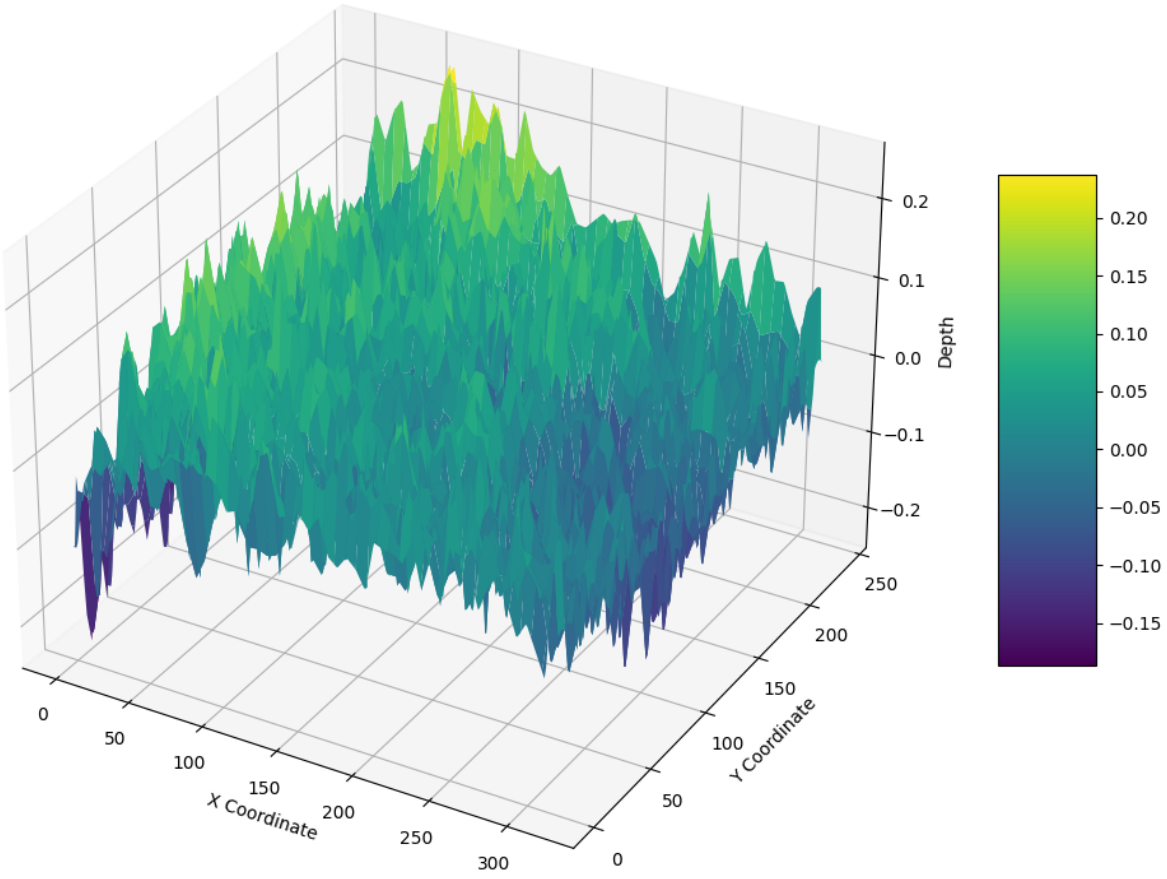
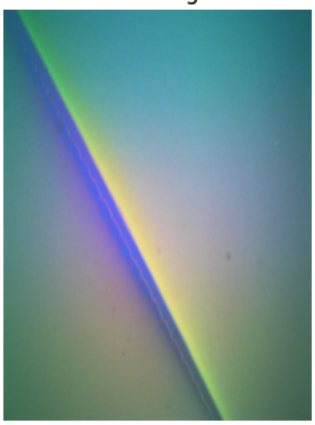




Tactile Image 49



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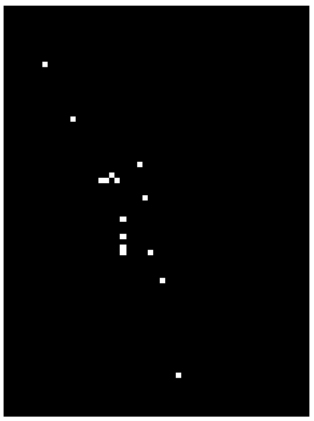

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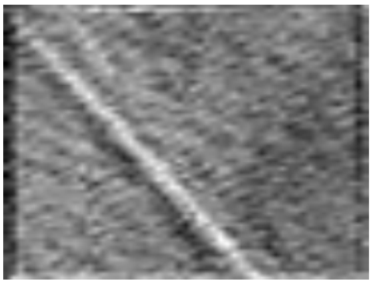

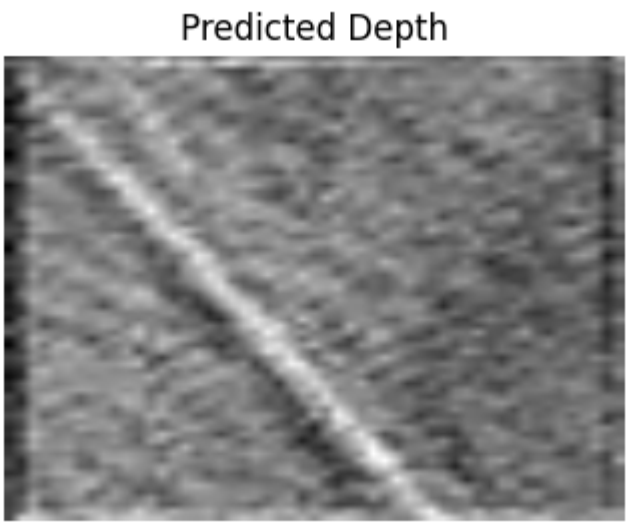
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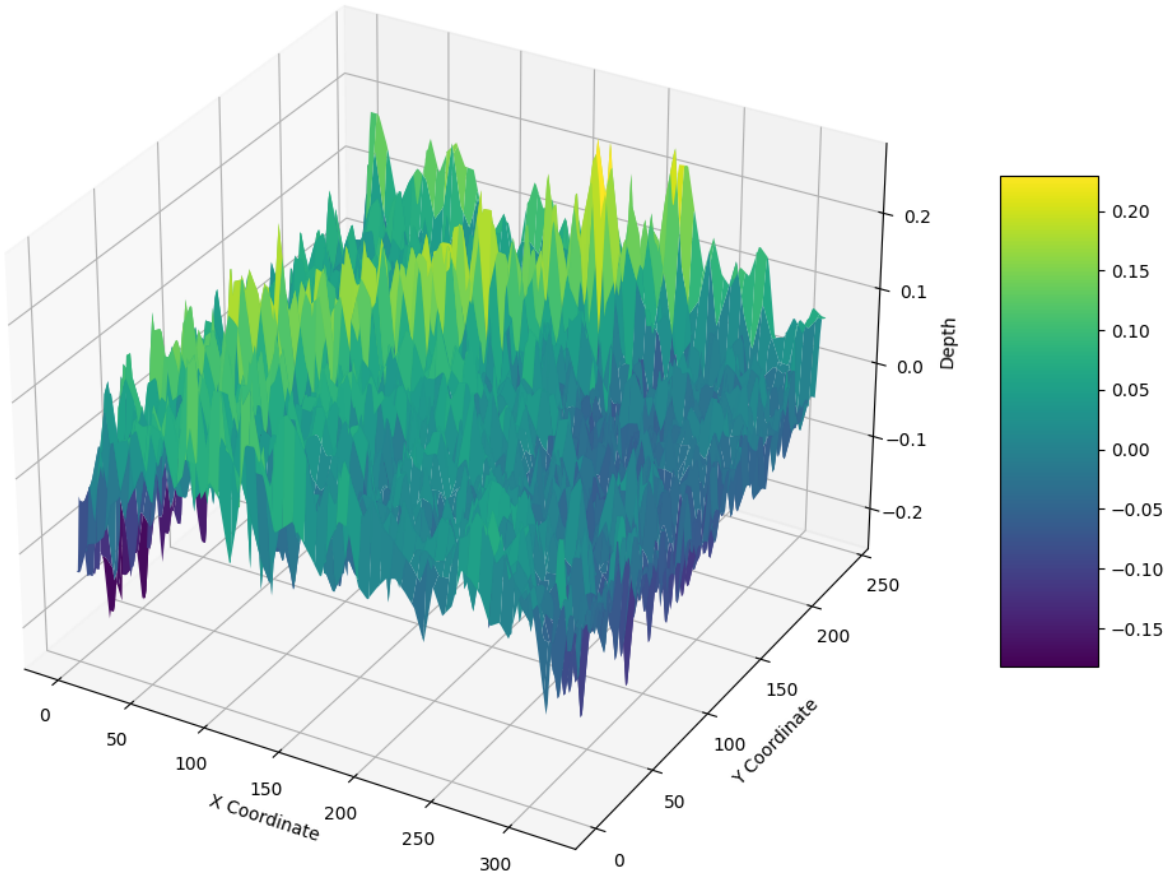
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Y Coordinate
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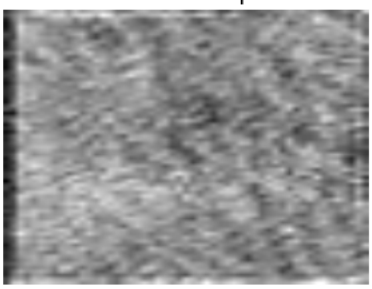
−0.15

Tactile Image 50

Predicted Contact

Predicted Depth



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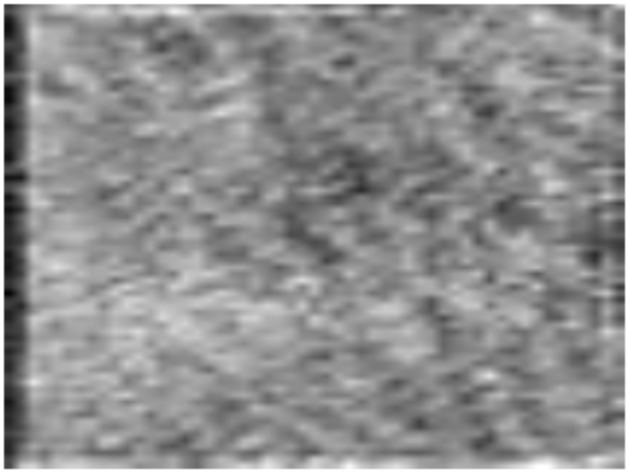
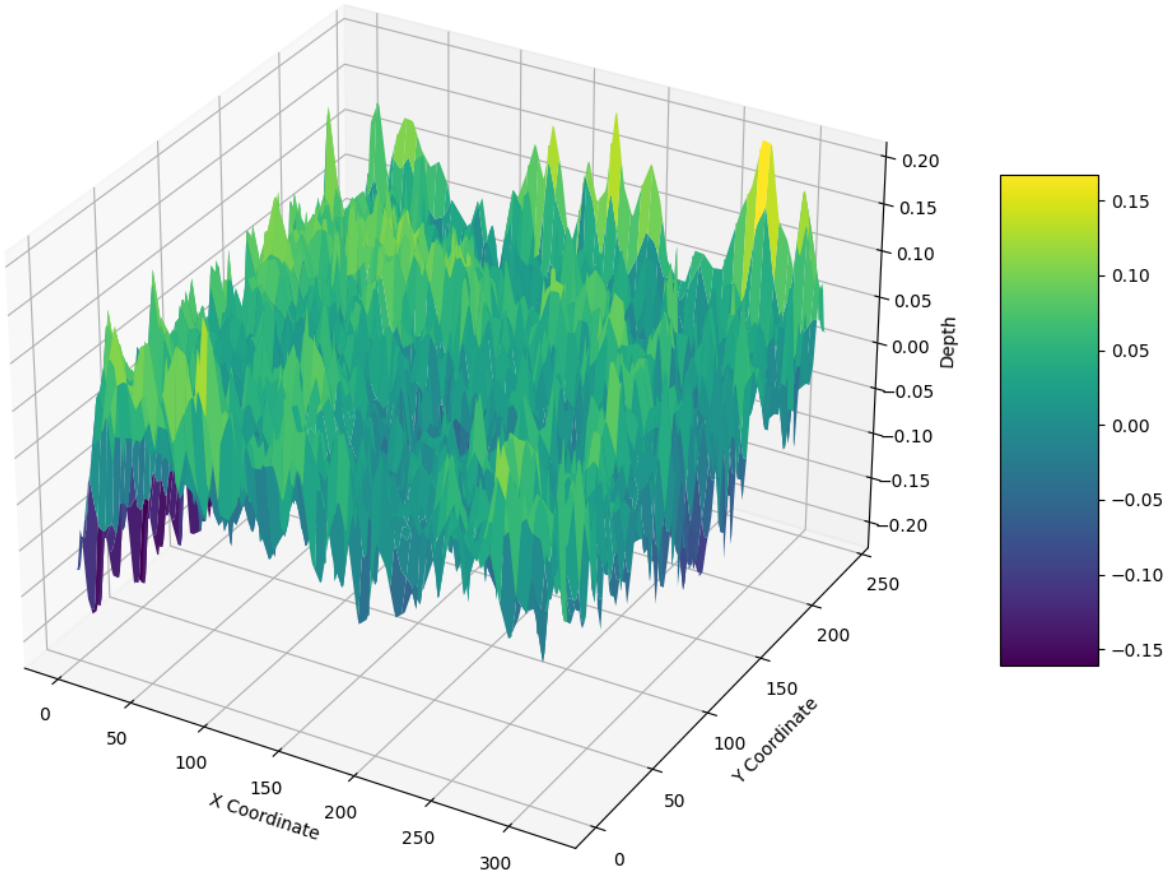
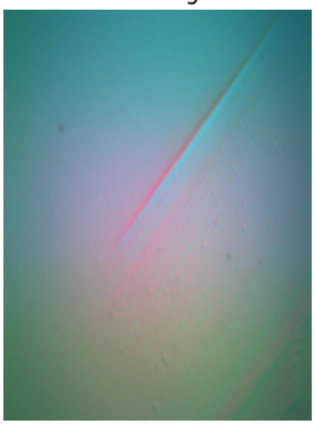




Tactile Image 51



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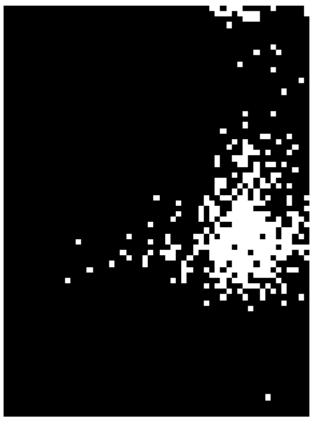

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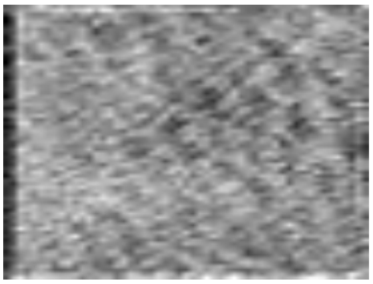

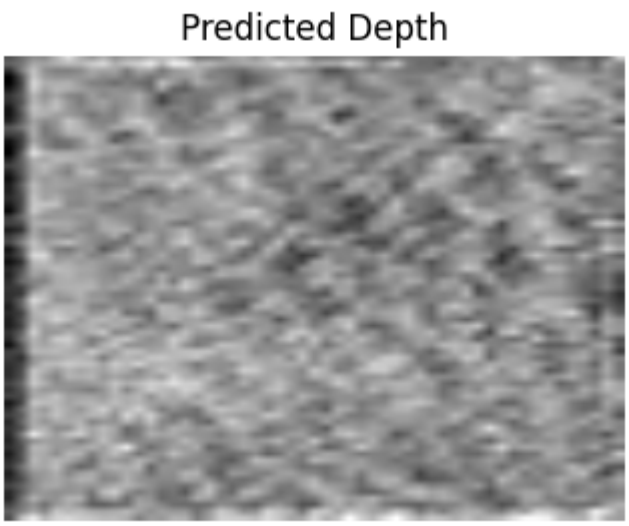
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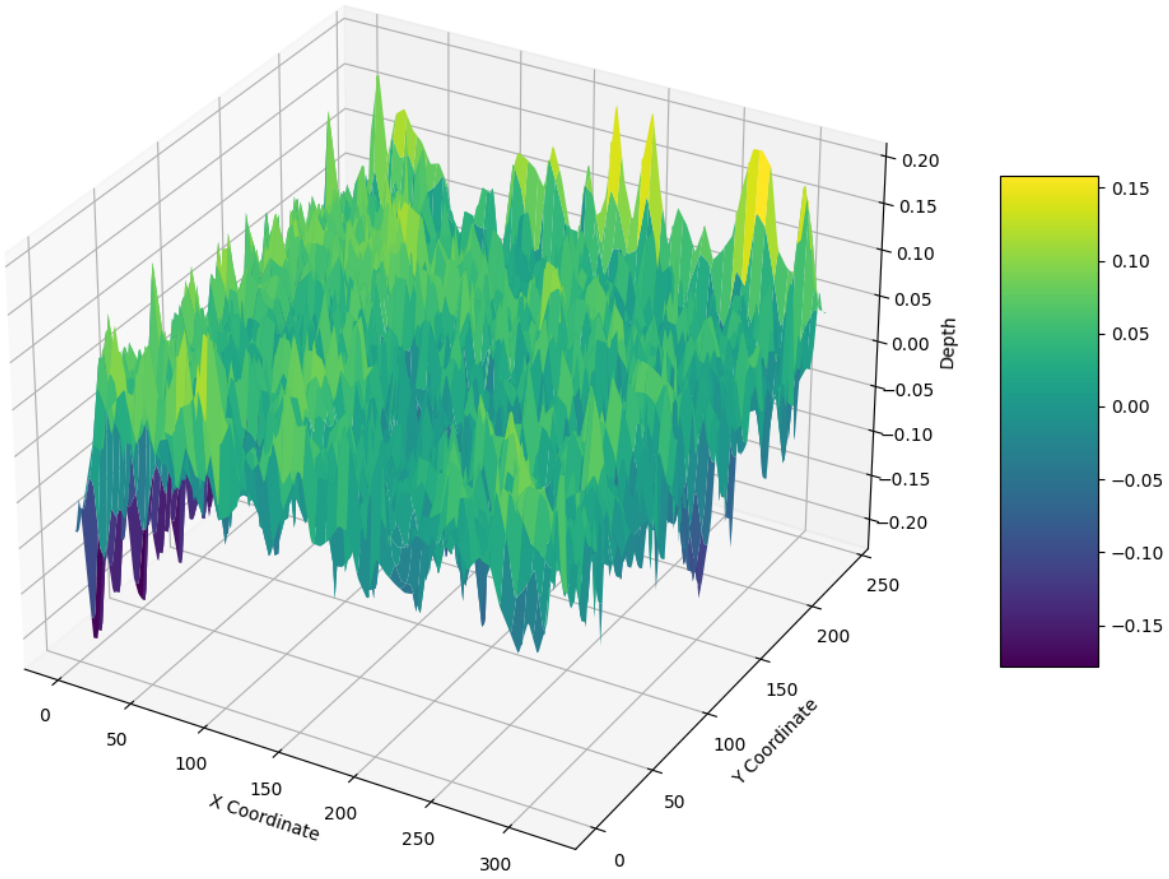
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X Coordinate
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Y Coordinate
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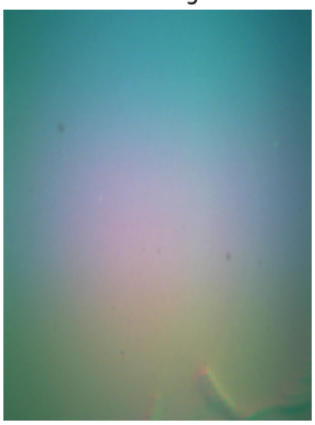
Tactile Image 52



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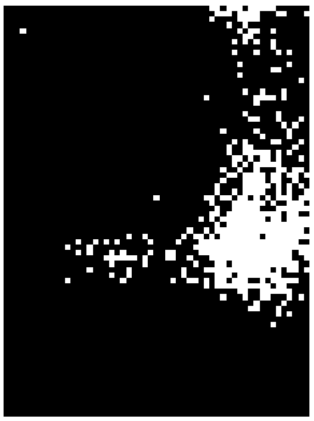

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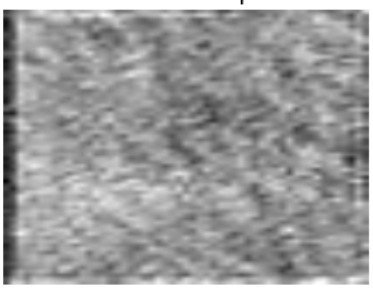

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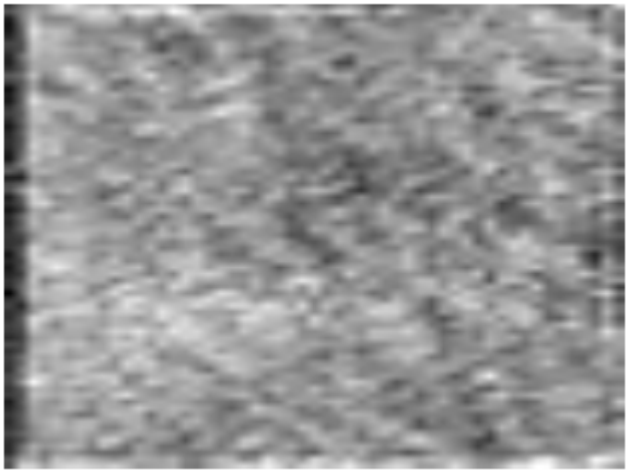
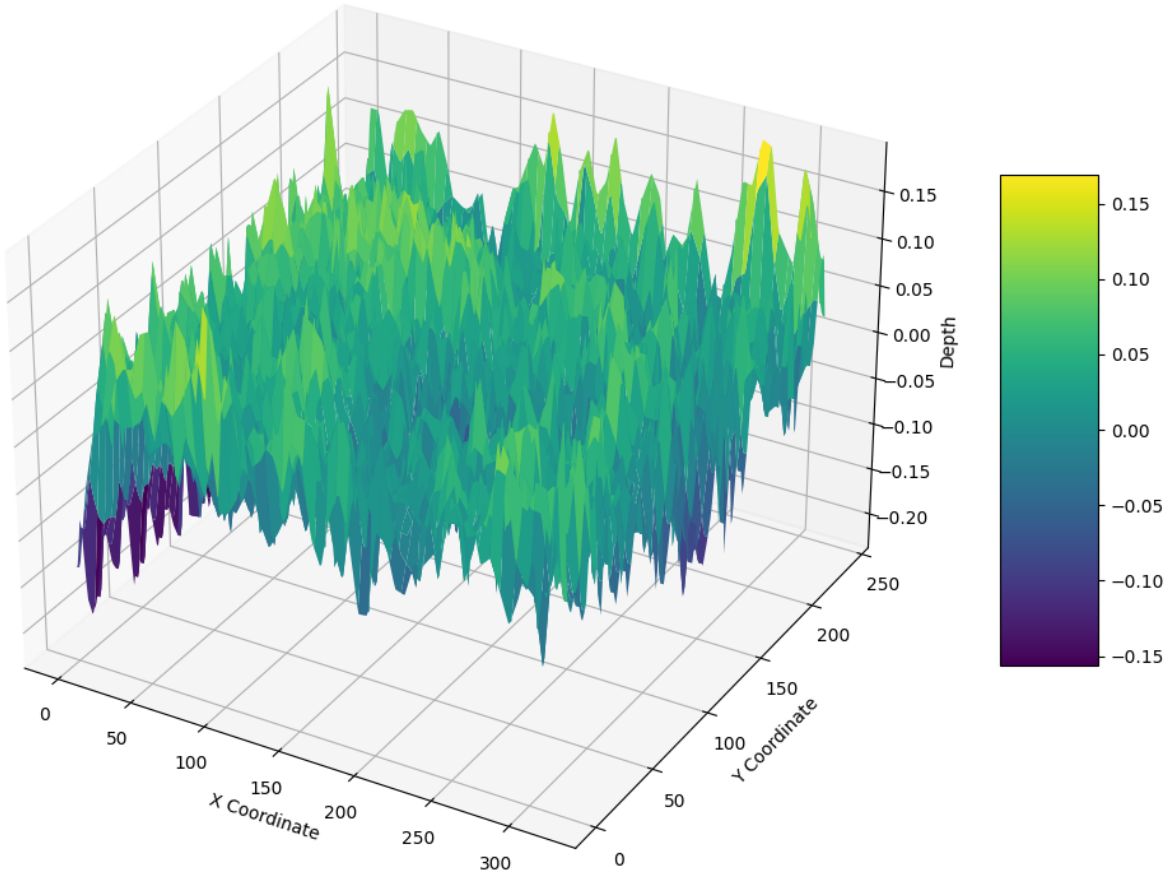
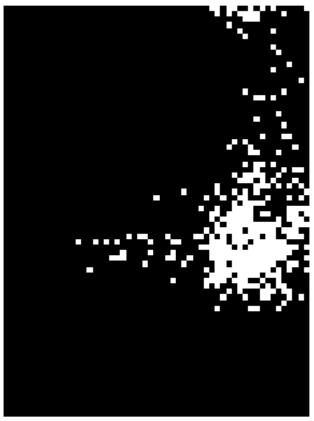




Tactile Image 53

Predicted Contact



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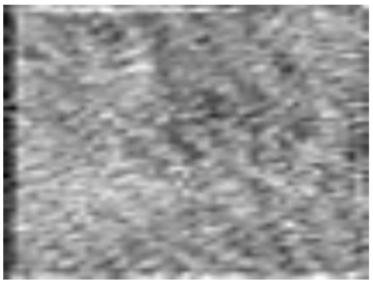

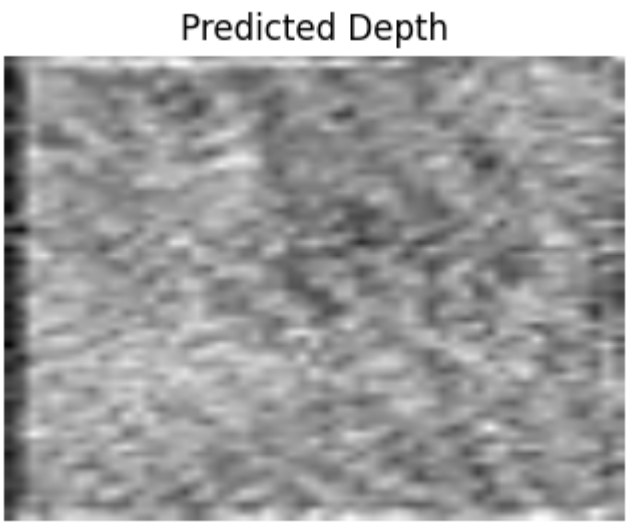
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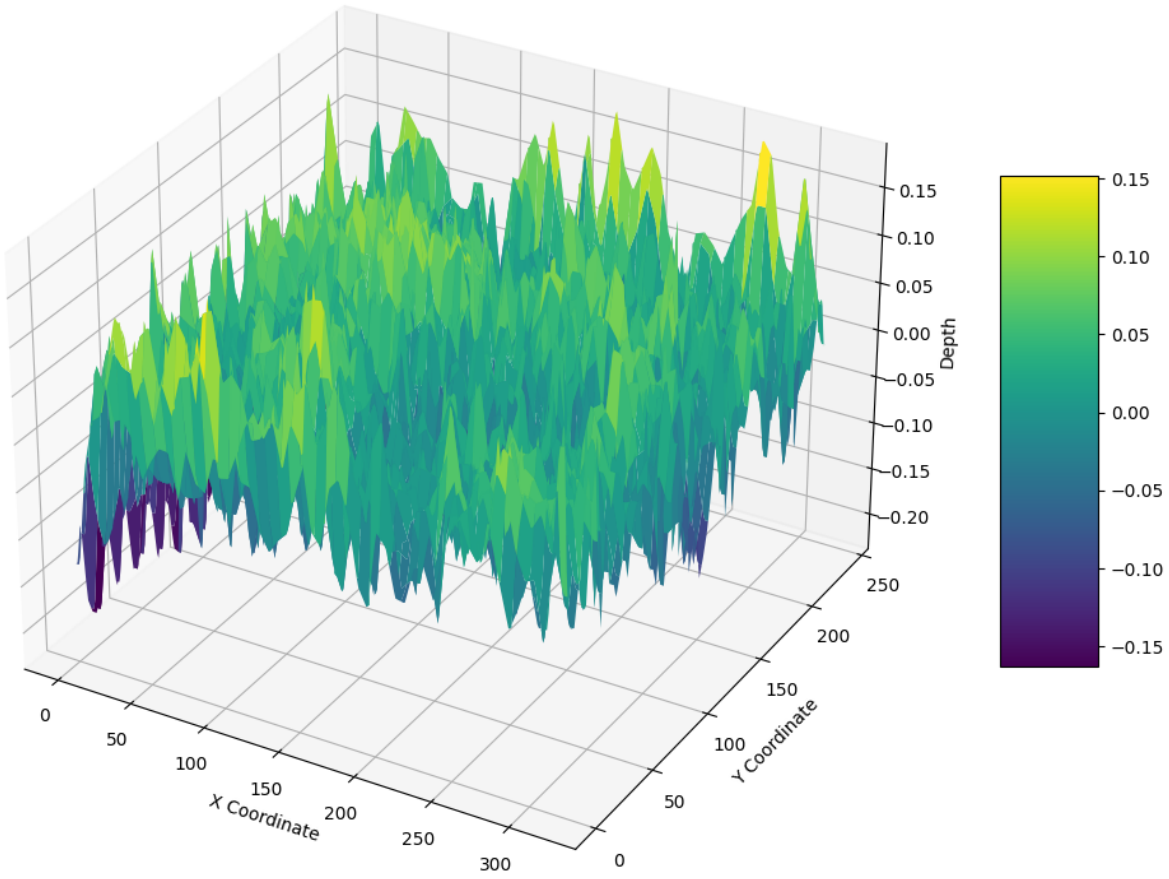
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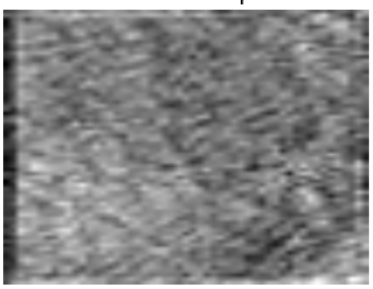
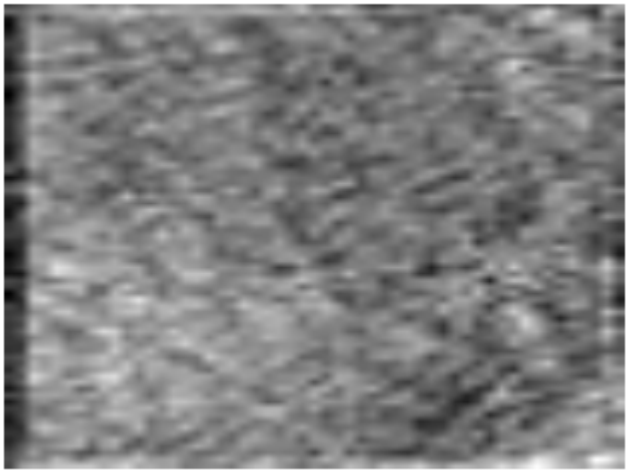
Tactile Image 54

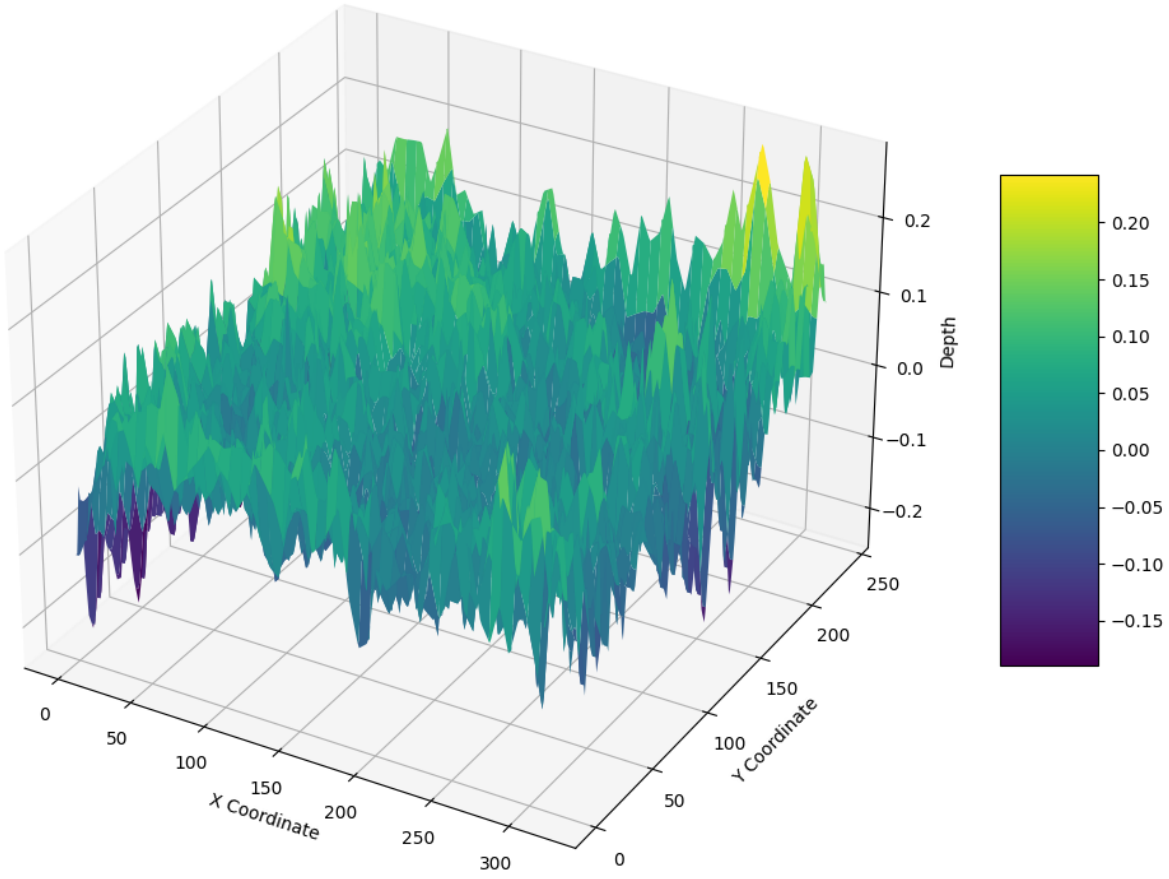
Predicted Contact

Predicted Depth

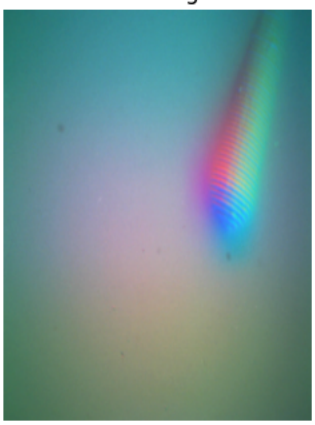


Predicted Depth

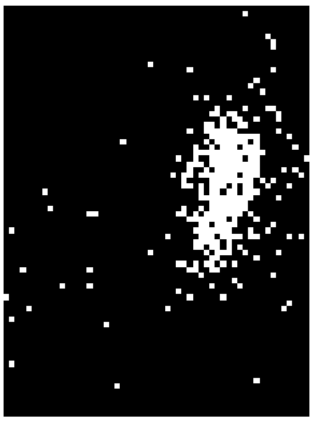




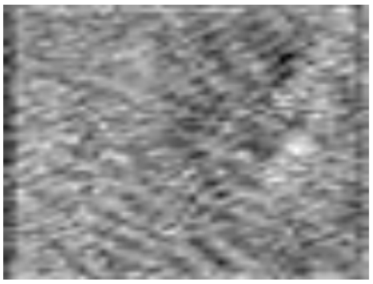
Tactile Image 55

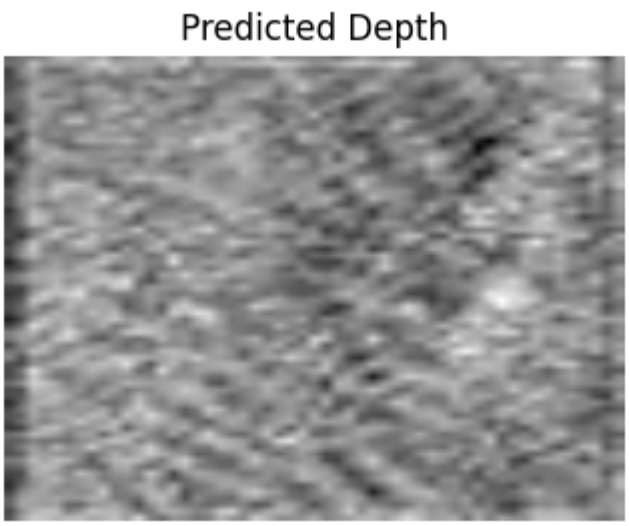


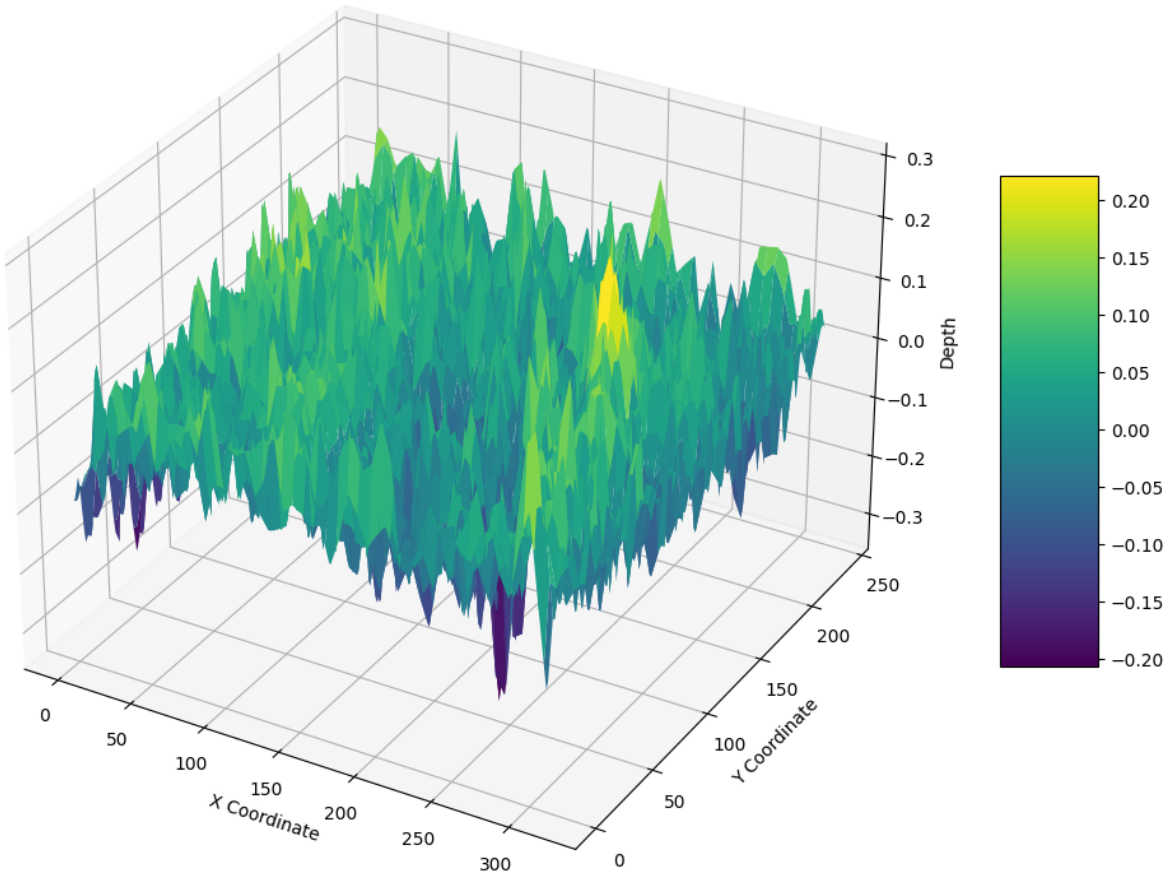
Predicted Contact



Predicted Depth




Predicted Depth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0.0
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−0.2
−0.3
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X Coordinate
0
50
100
150
200
250
Y Coordinate
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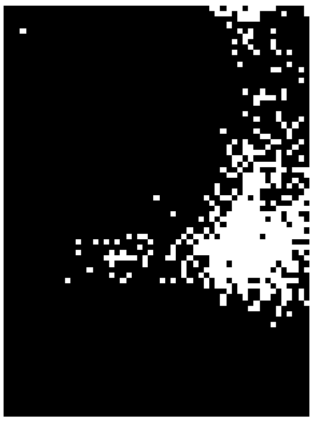
0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15
−0.20

Tactile Image 56

Predicted Contact



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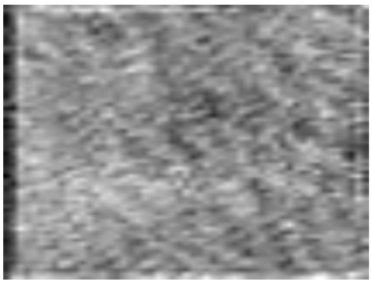
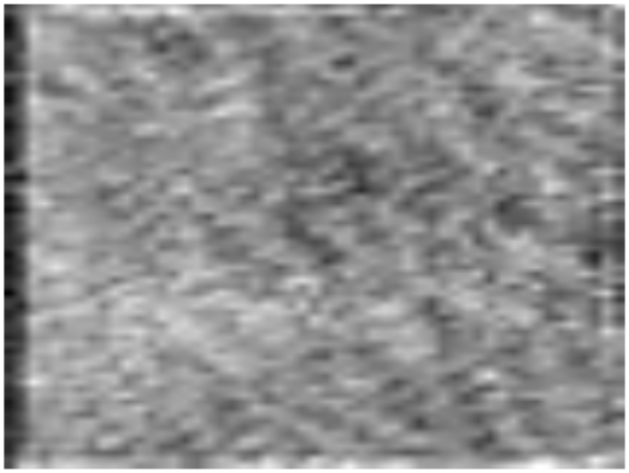
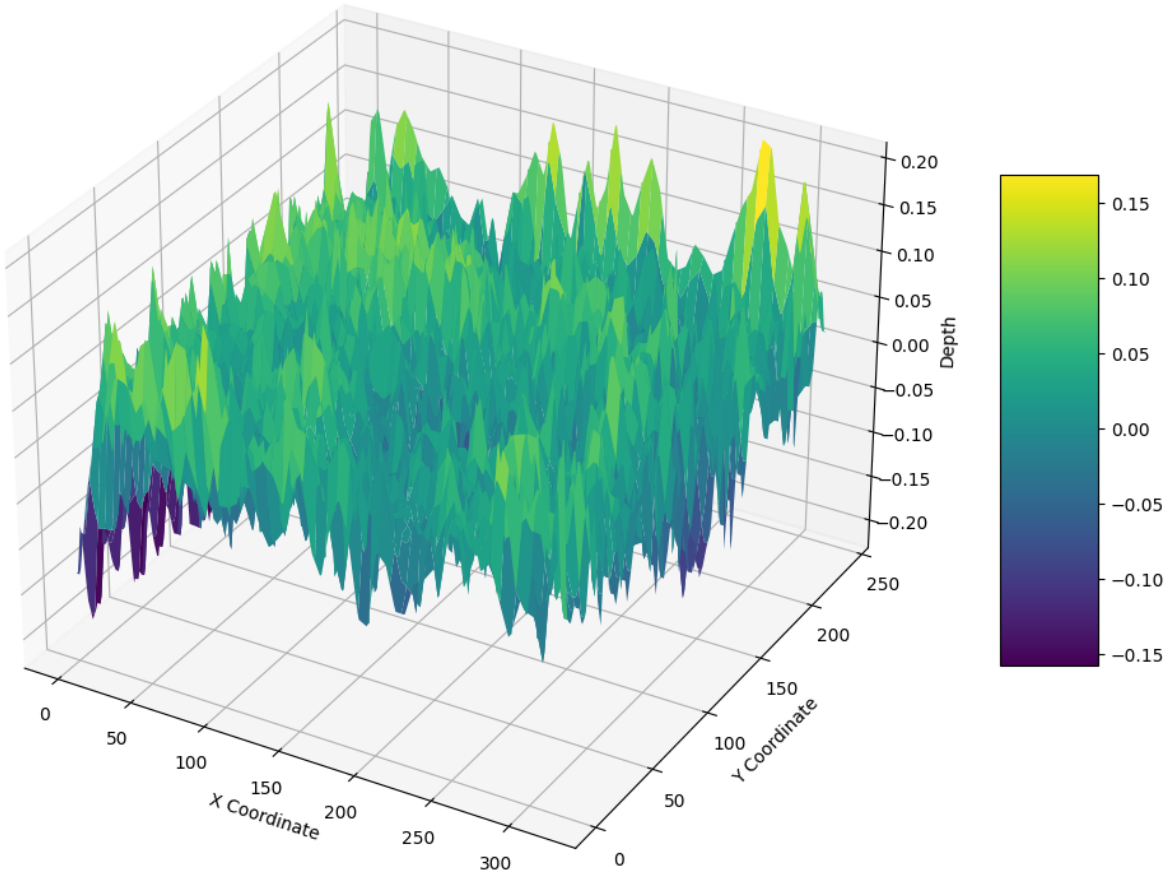


Predicted Depth

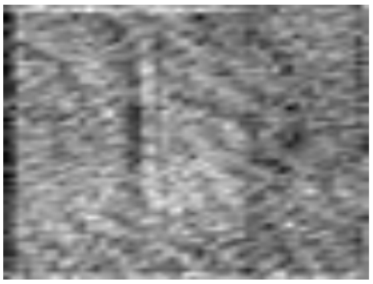




Tactile Image 57

Predicted Contact

Predicted Depth



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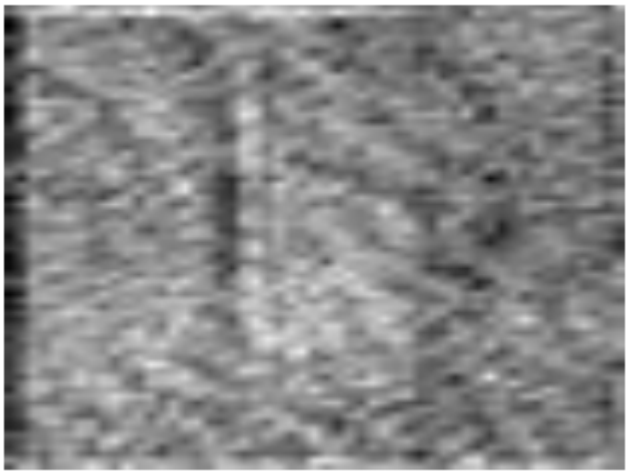
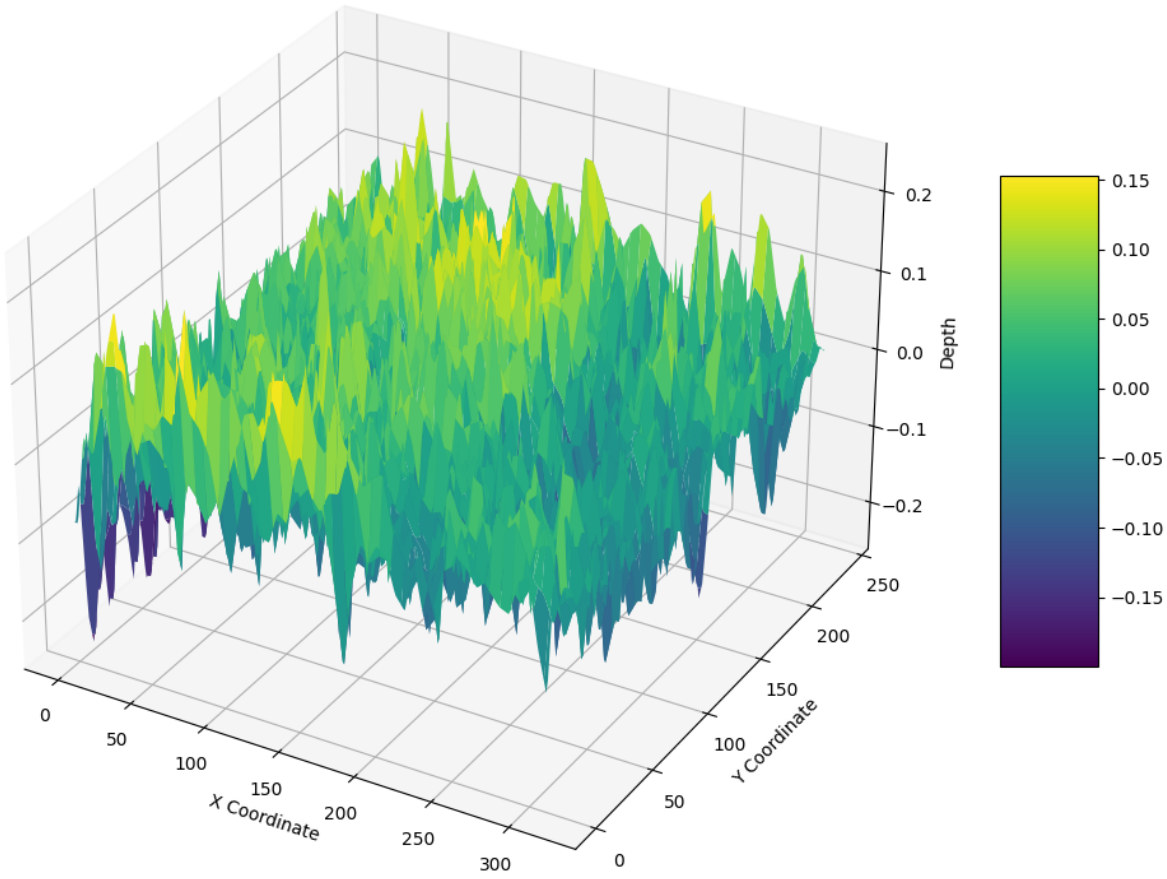
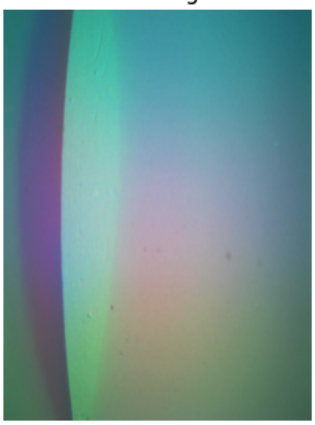




Tactile Image 58



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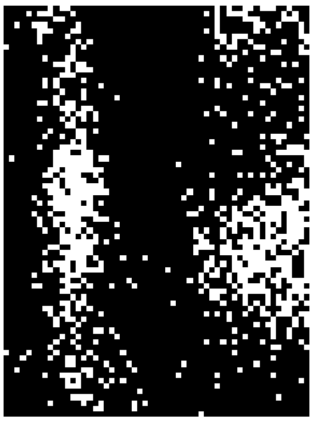

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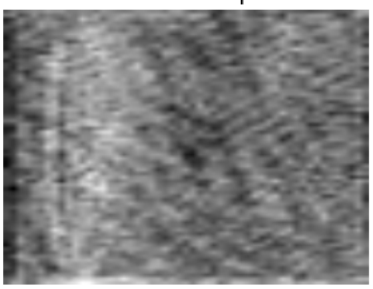

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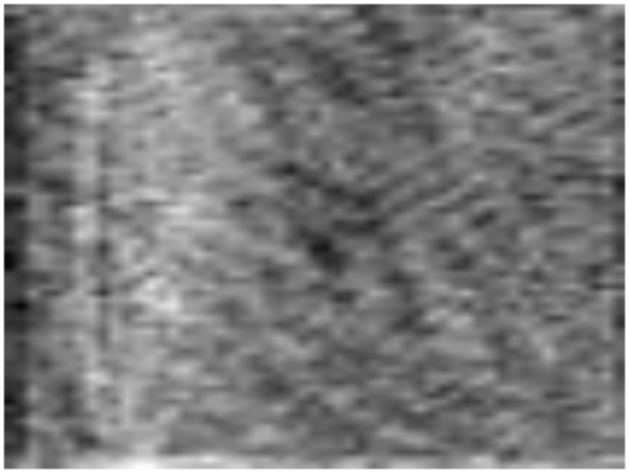
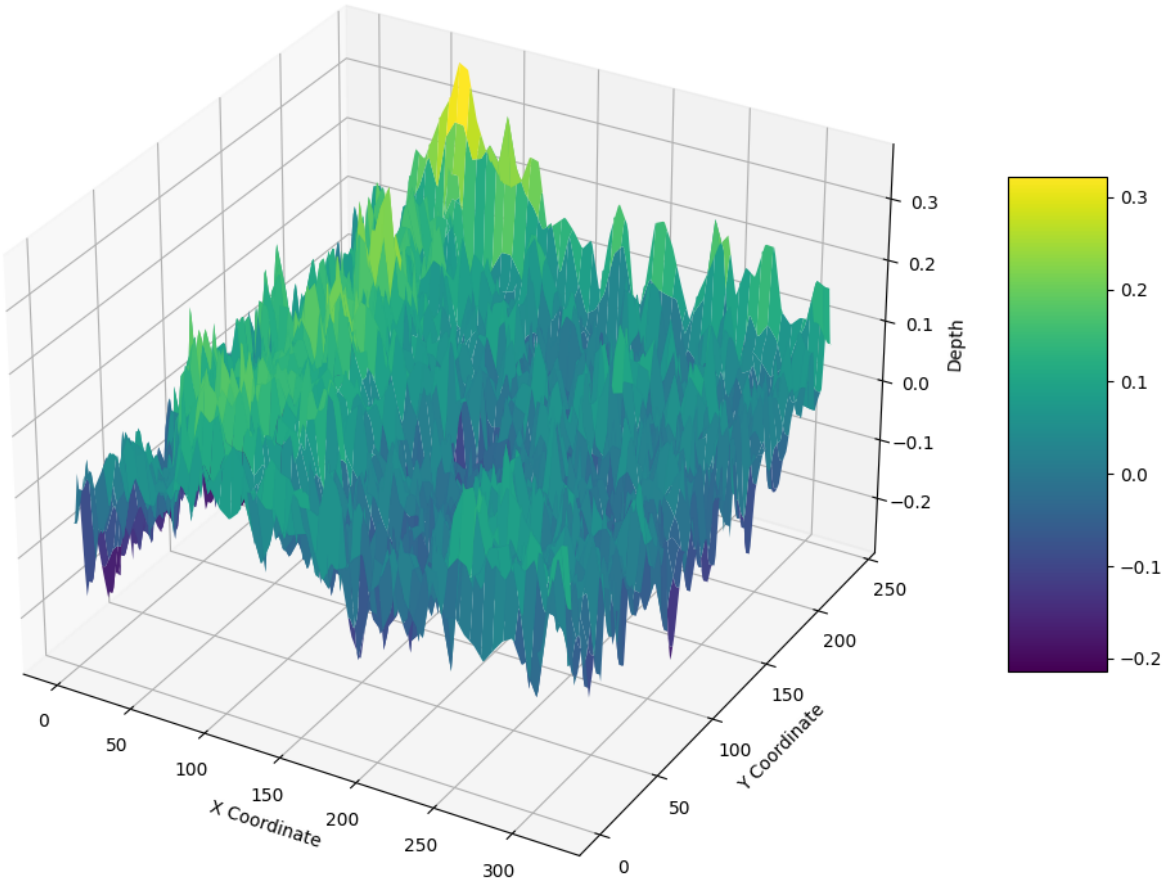
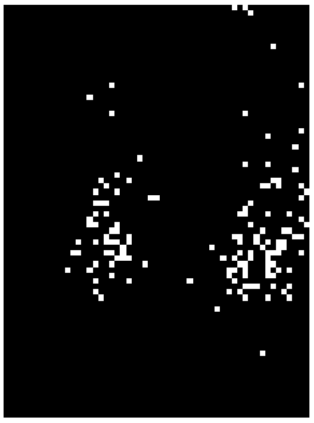


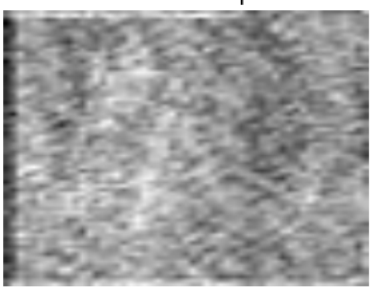


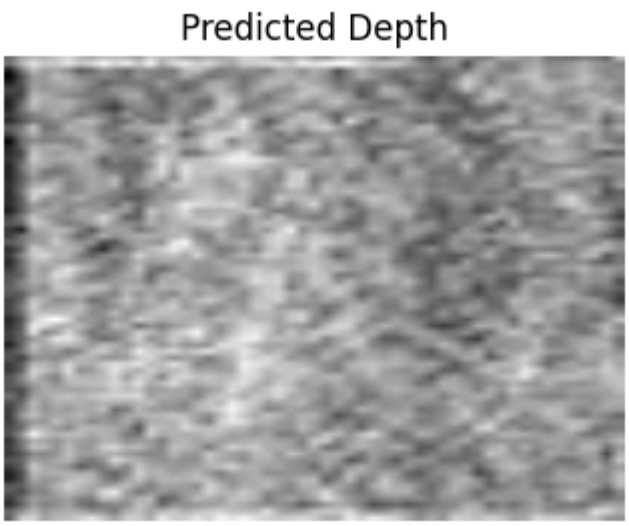
Tactile Image 59

Predicted Contact



Predicted Depth

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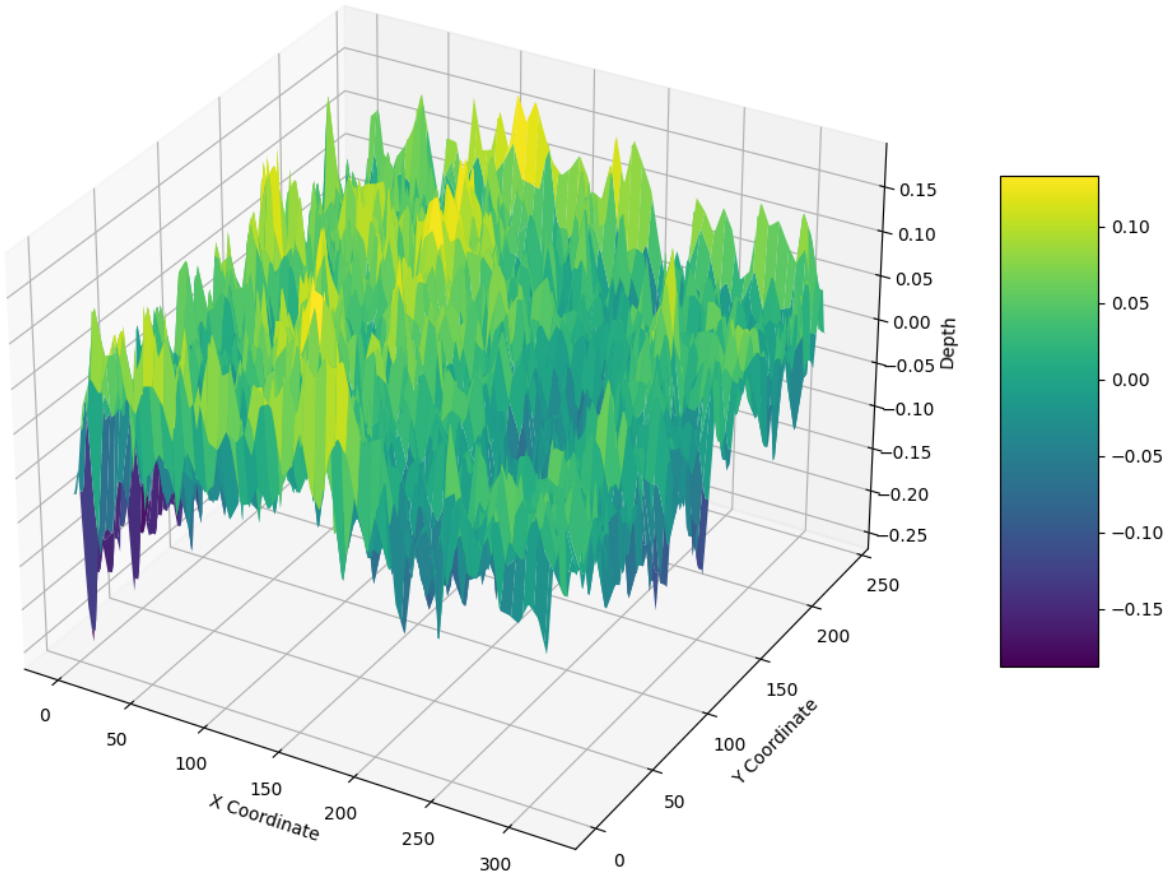
0.15
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0.05
0.00
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−0.20
−0.25
Depth
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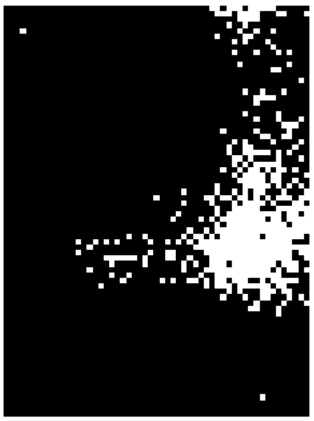
50
100
150
200
250
300
X Coordinate
0
50
100
150
200
250
Y Coordinate
0.10
0.05
0.00
−0.05
−0.10
−0.15

Tactile Image 60

Predicted Contact



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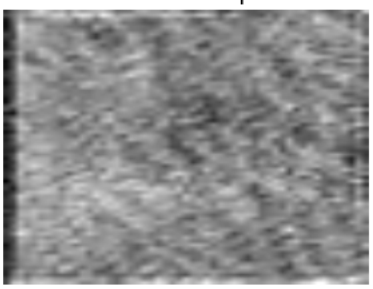
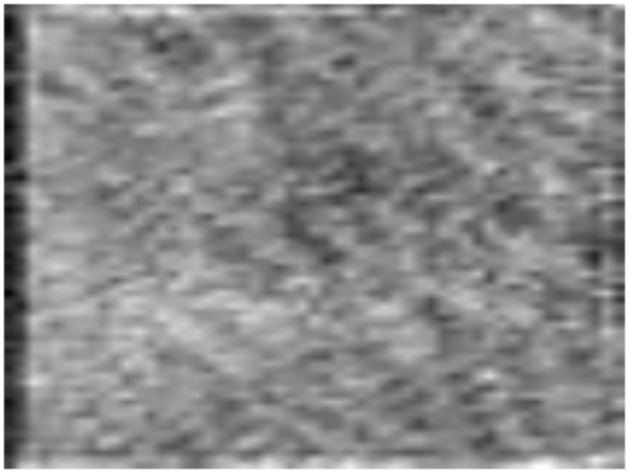
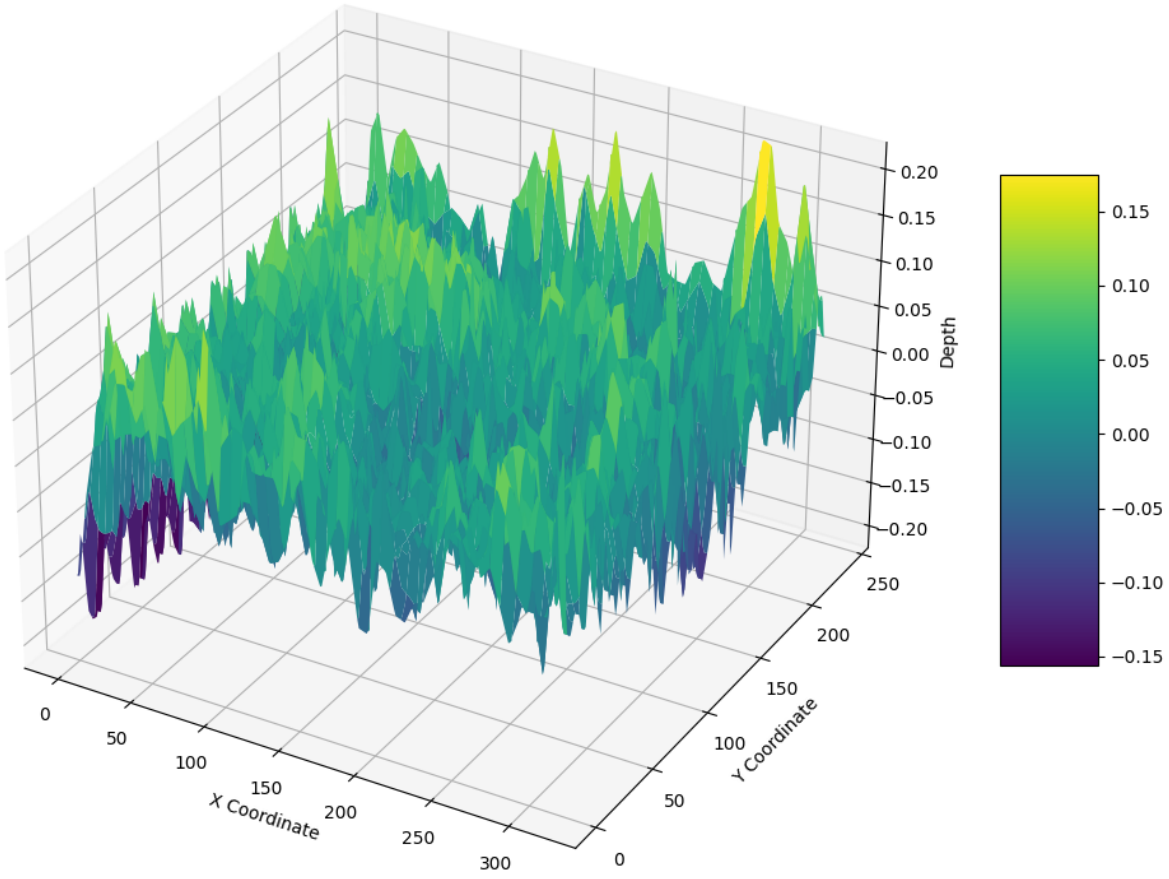


Predicted Depth

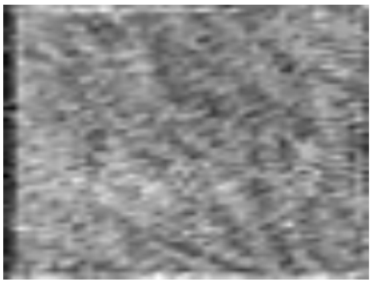


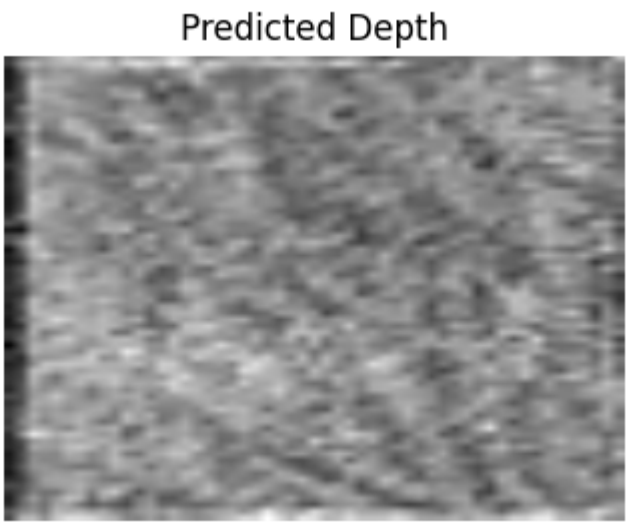


Tactile Image 61

Predicted Contact

Predicted Depth

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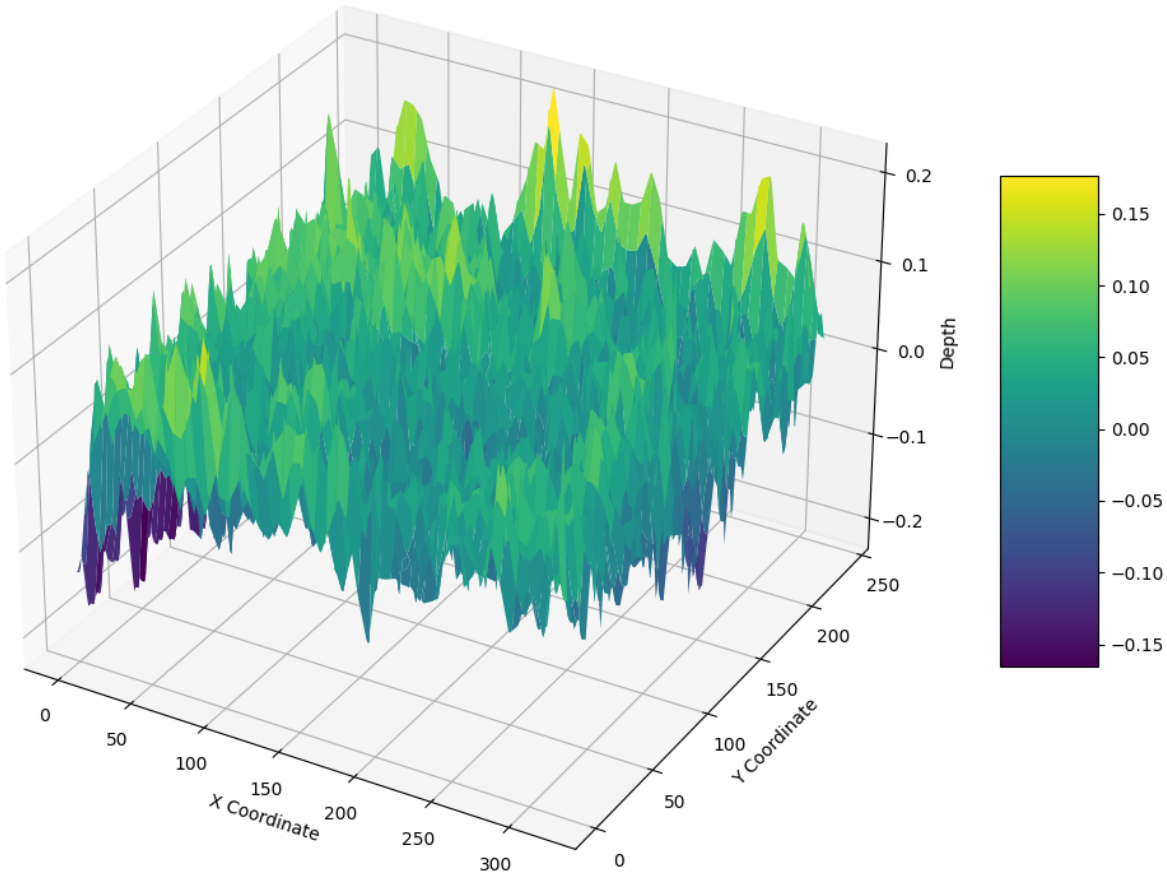
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200
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X Coordinate
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100
150
200
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Y Coordinate
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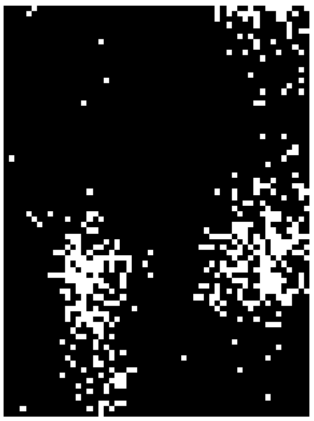
0.05
0.00
−0.05
−0.10
−0.15

Tactile Image 62

Predicted Contact



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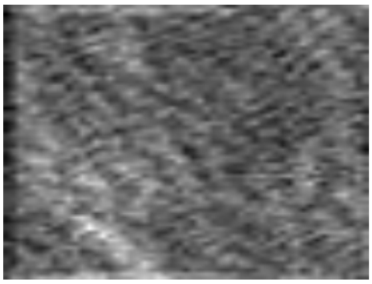
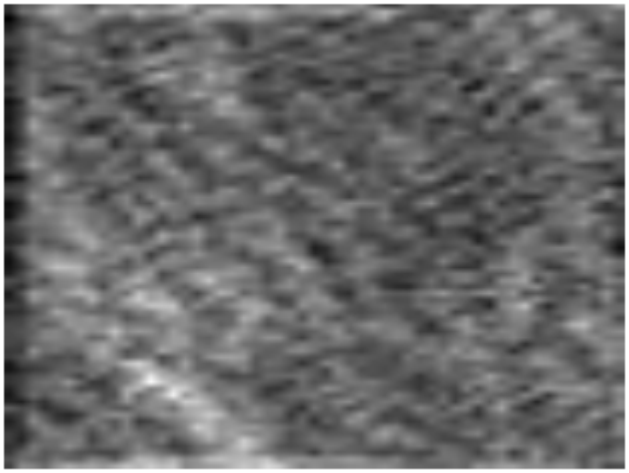
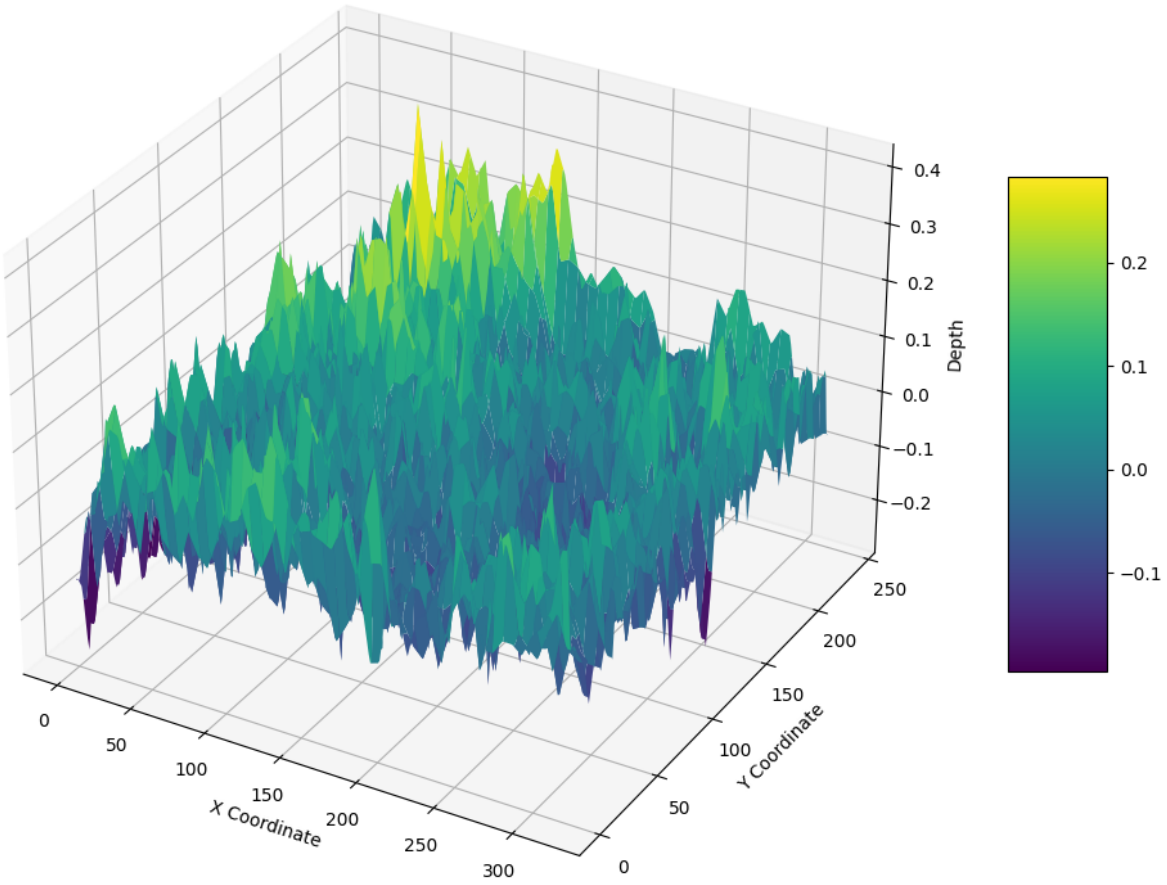
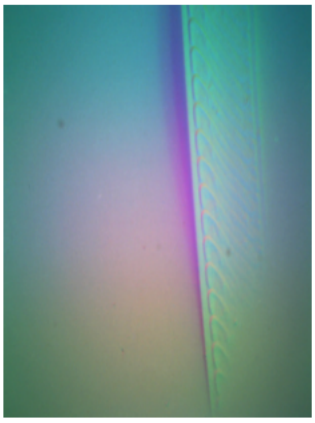


Predicted Depth

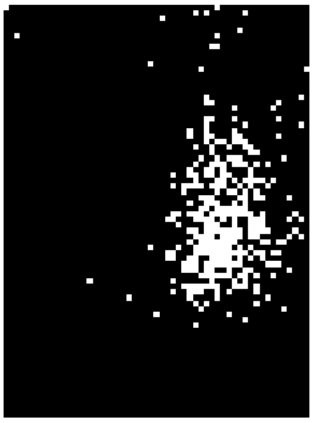




Tactile Image 63



Predicted Contact



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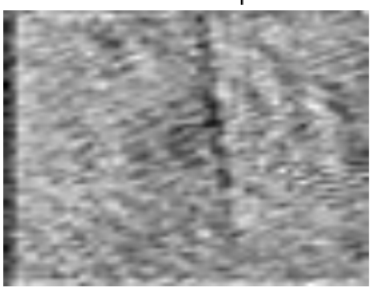
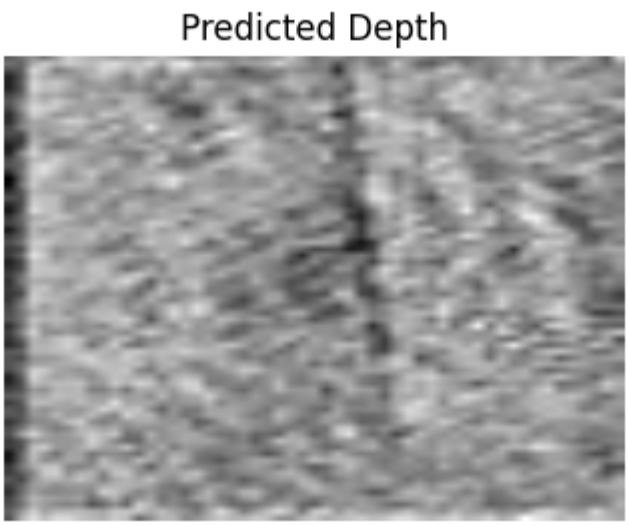
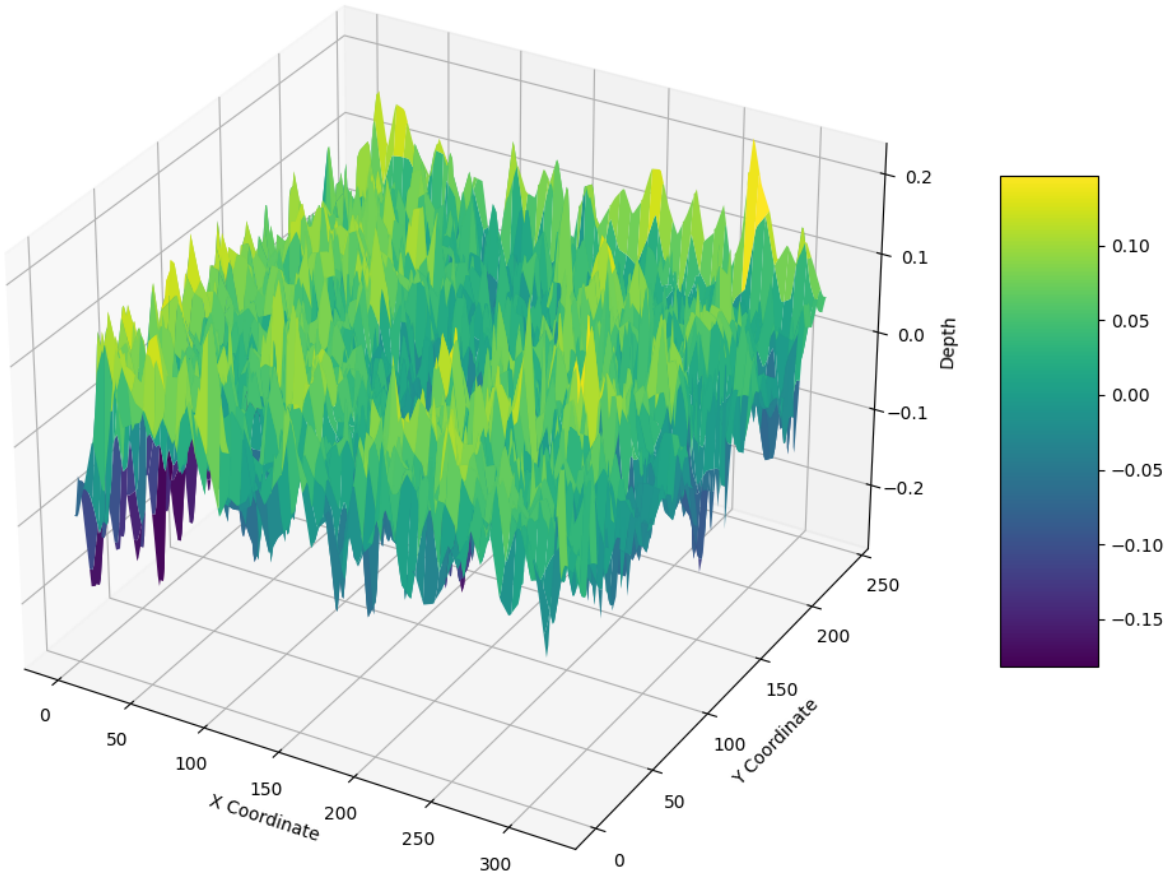



Predicted Depth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Depth
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X Coordinate
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100
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200
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Y Coordinate
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0.00
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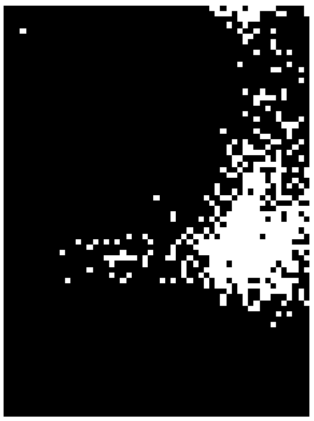
−0.15

Tactile Image 64

Predicted Contact



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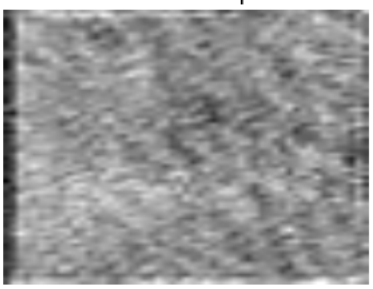

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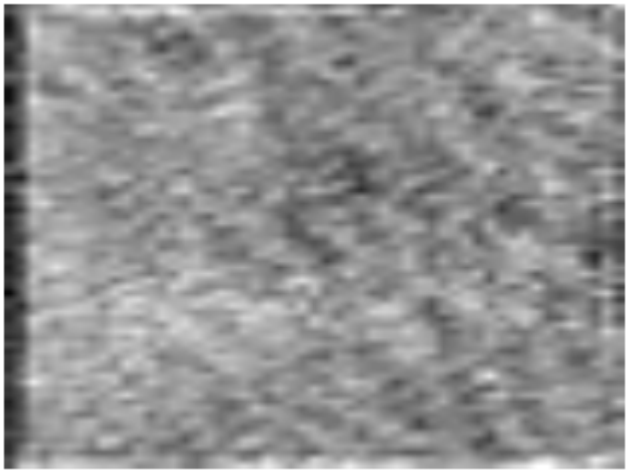
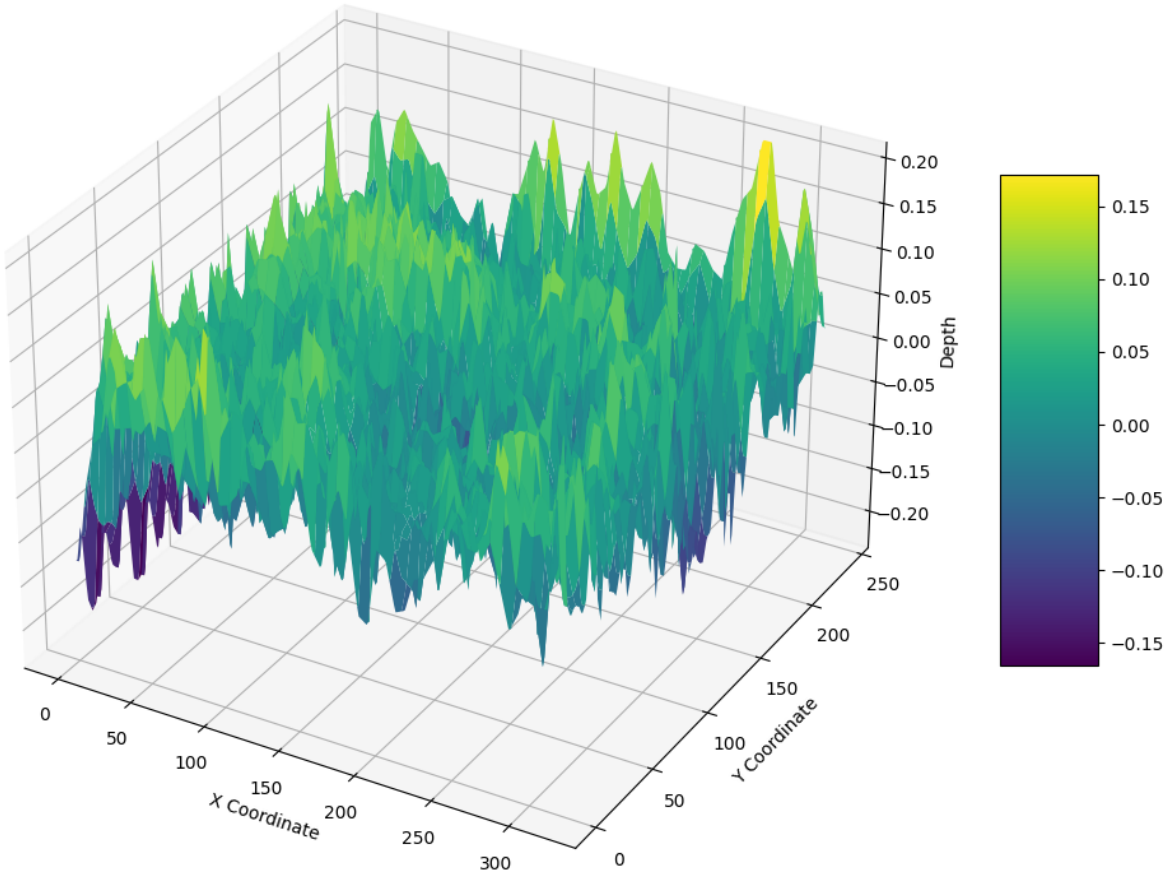
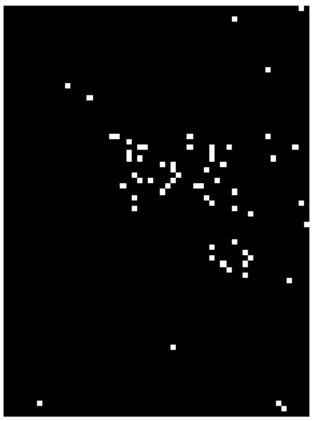


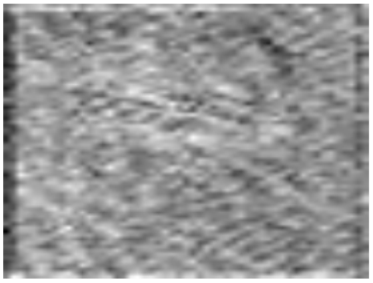


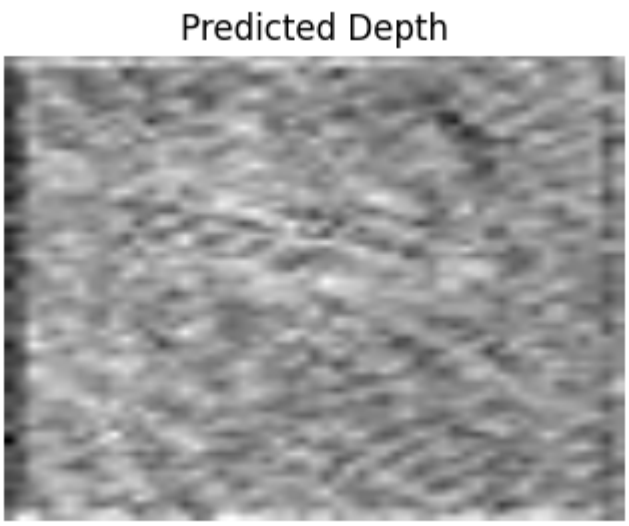
Tactile Image 65

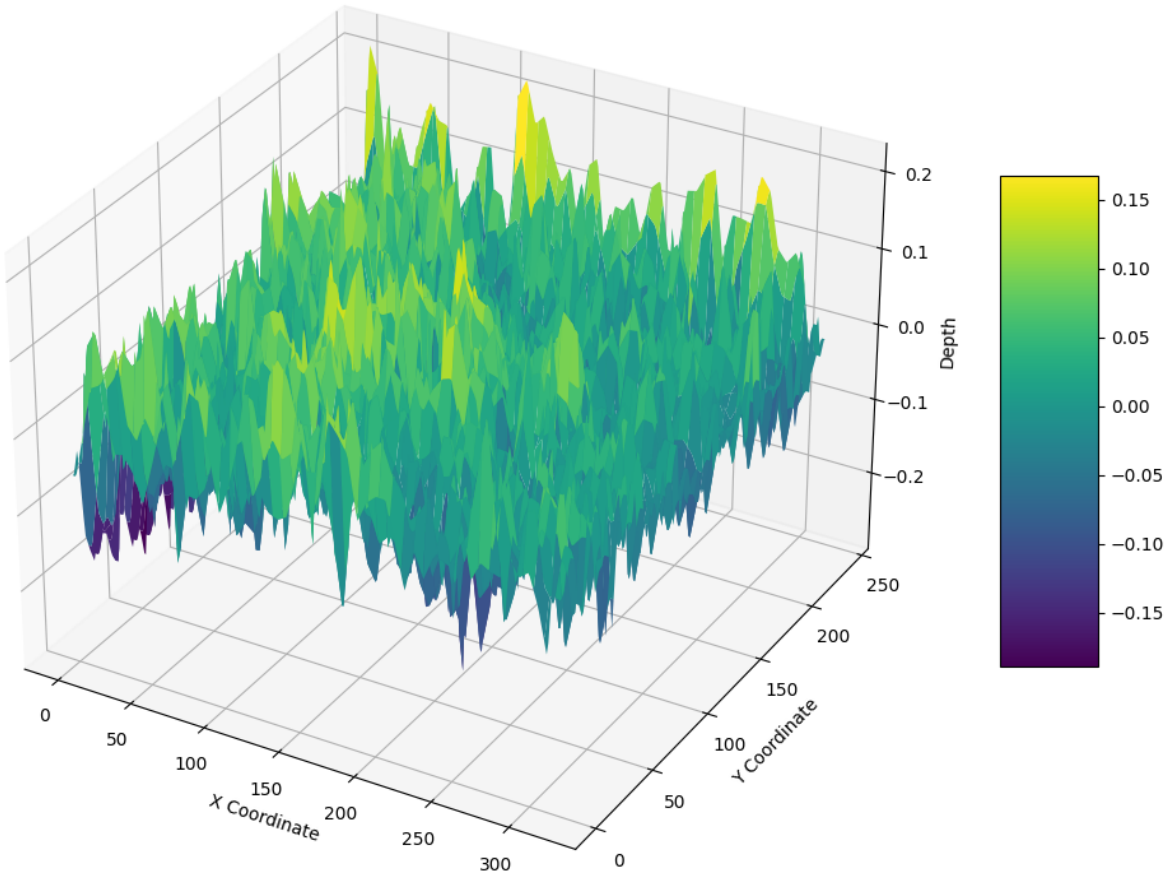
Predicted Contact



Predicted Depth




Predicted Depth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X Coordinate
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100
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Y Coordinate
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0.00
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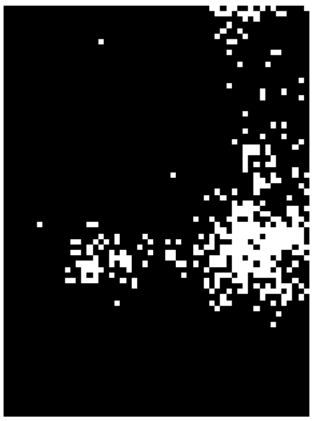
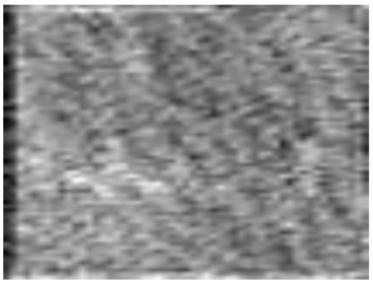
−0.10
−0.15

Tactile Image 66

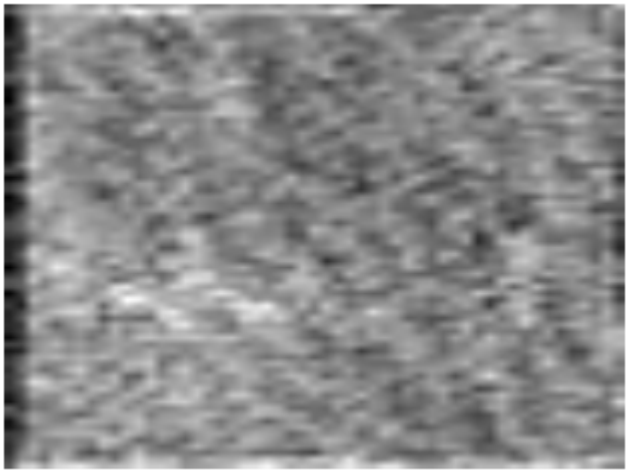
Predicted Contact

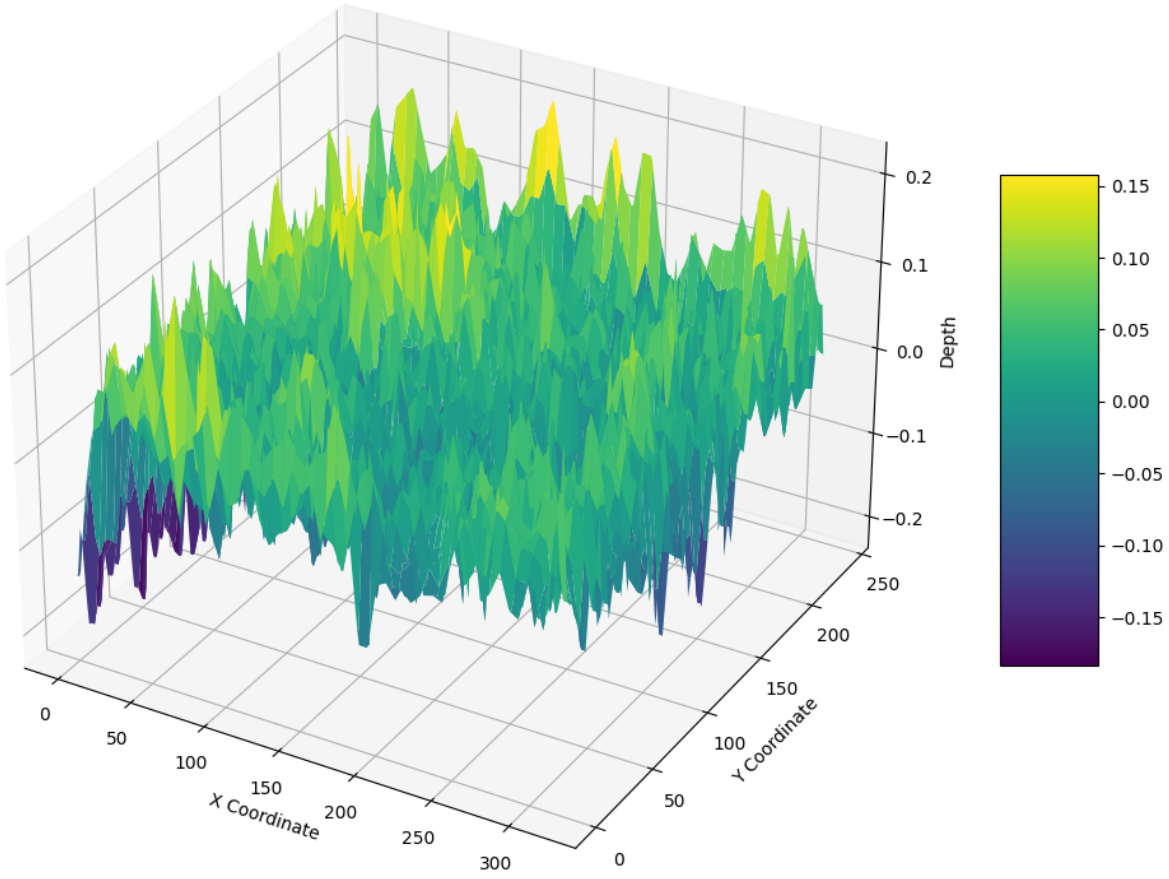


Predicted Depth

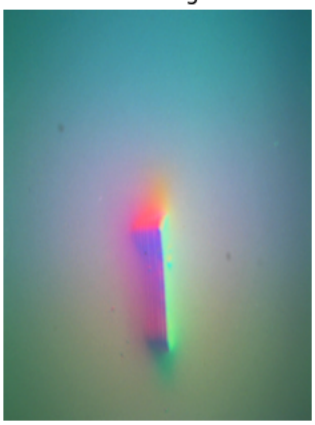


Predicted Depth

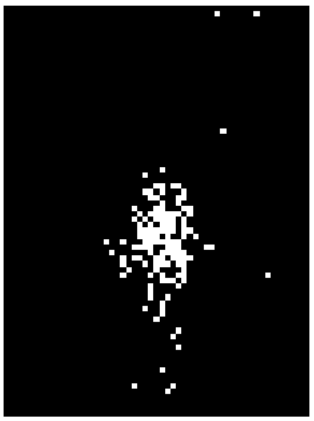




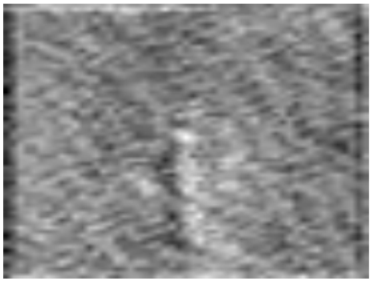
Tactile Image 67

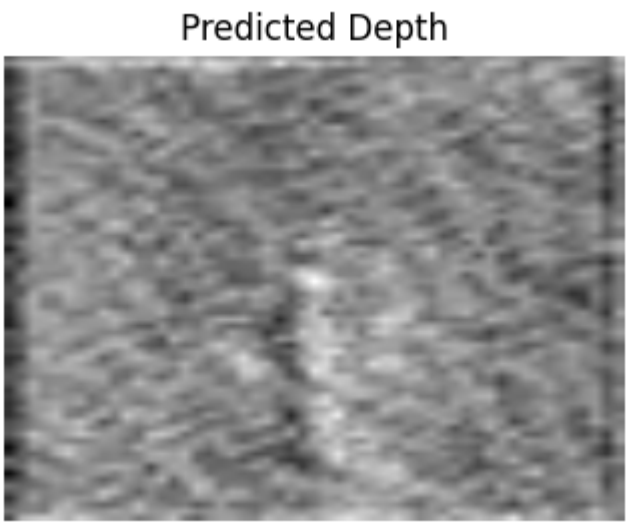


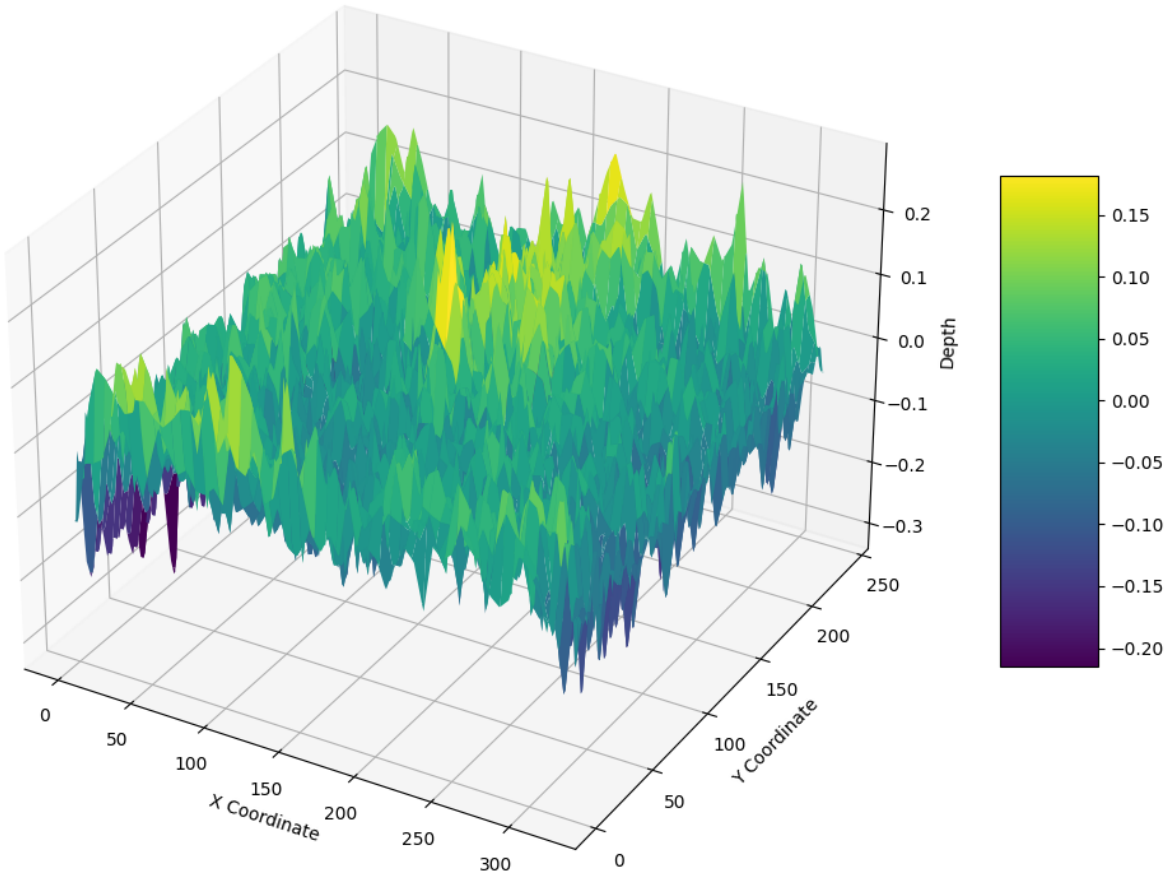
Predicted Contact



Predicted Depth




Predicted Depth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50
100
150
200
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Y Coordinate
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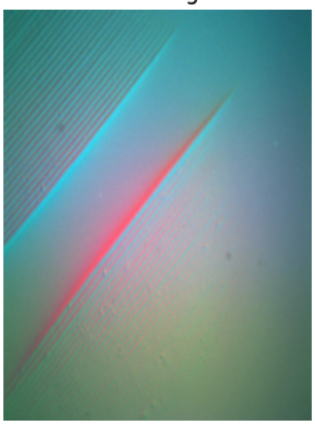
−0.10
−0.15
−0.20

Tactile Image 68



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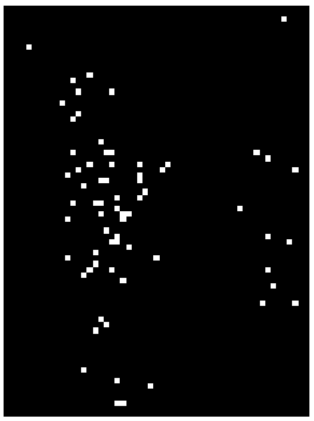

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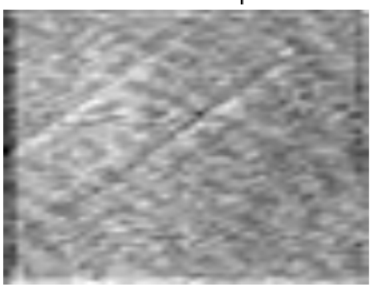

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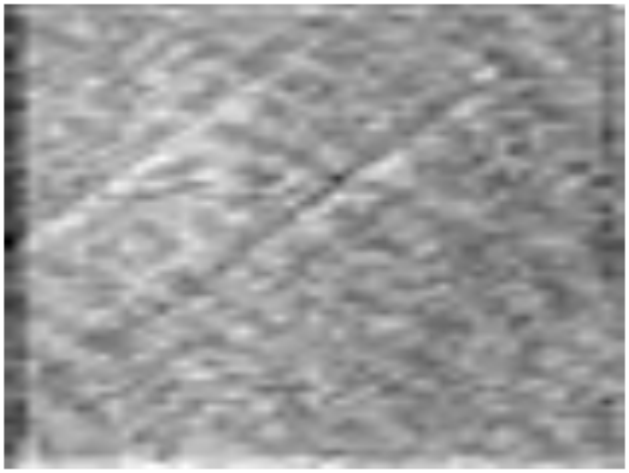
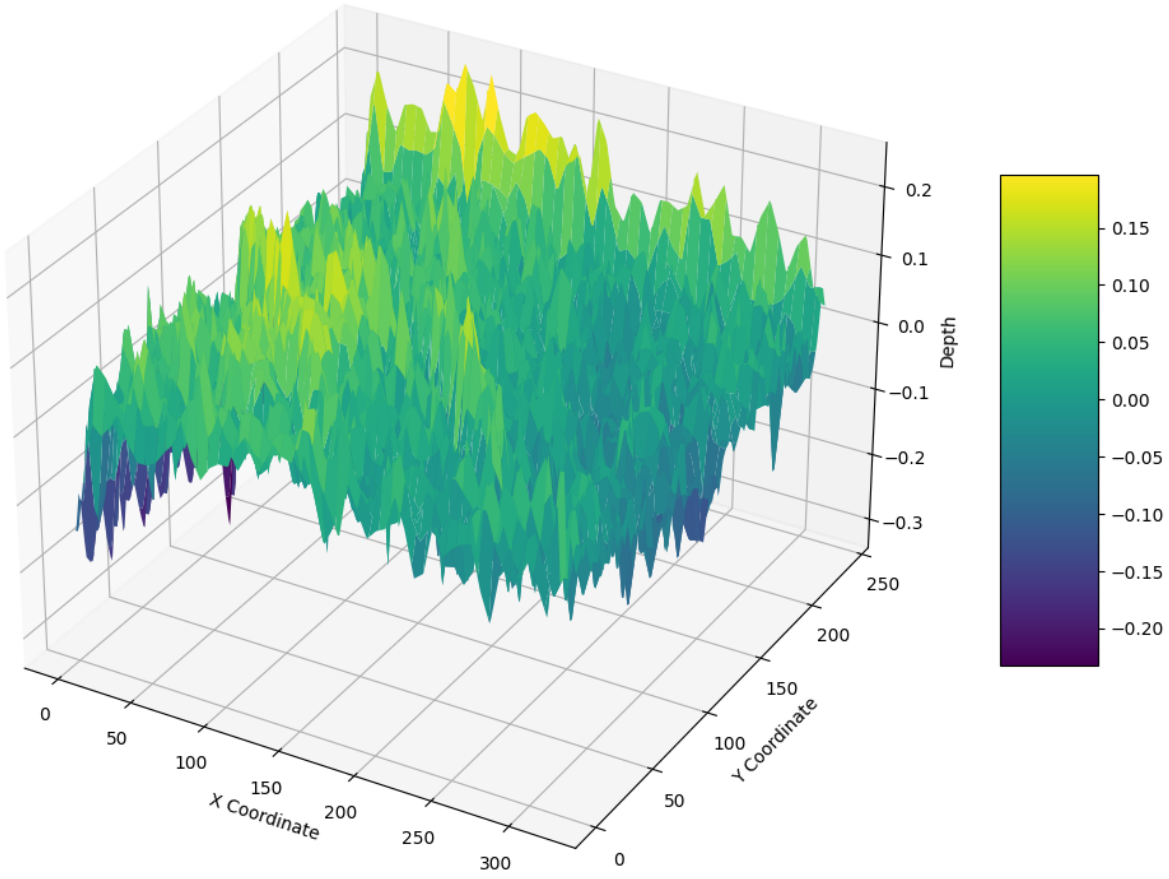
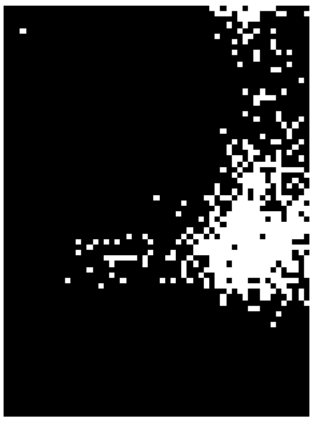


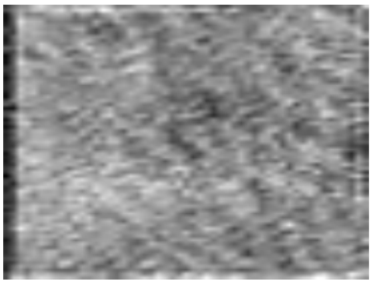


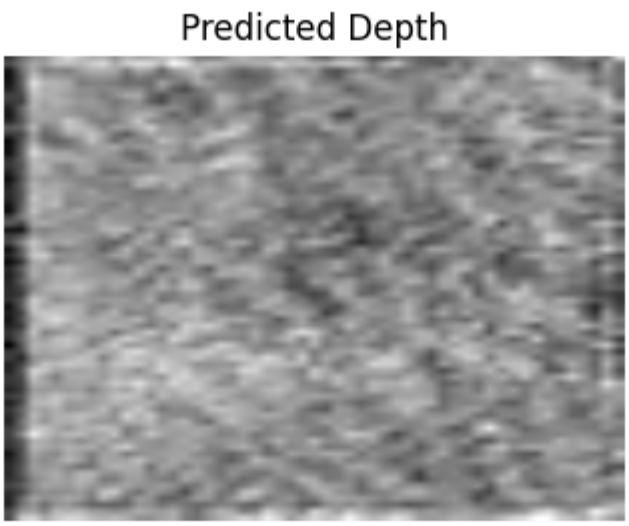
Tactile Image 69

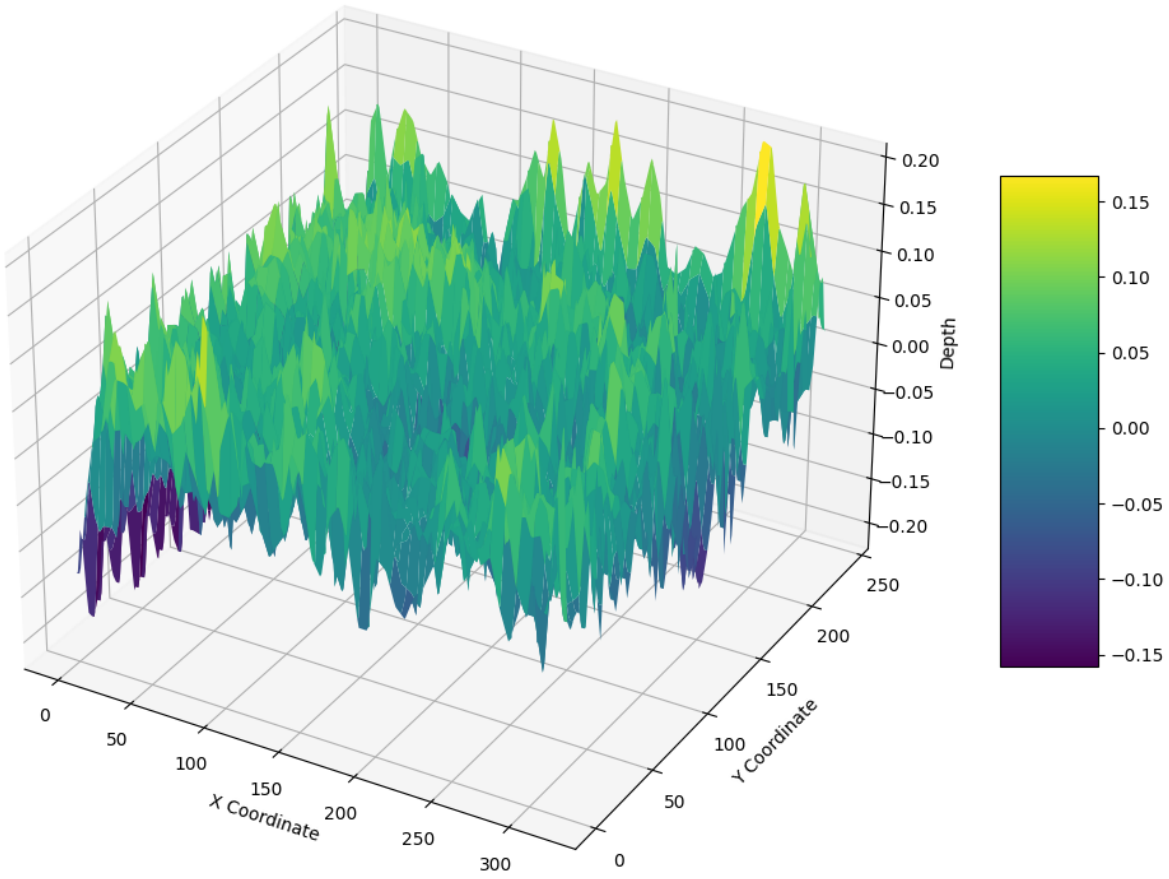
Predicted Contact



Predicted Depth




Predicted Depth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0.10
0.05
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−0.15
−0.20
Depth
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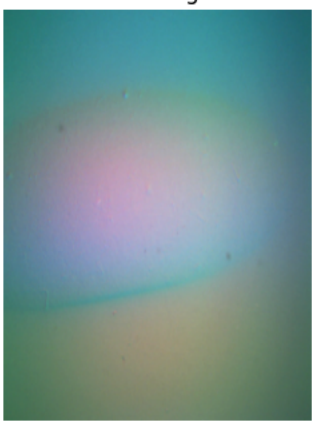
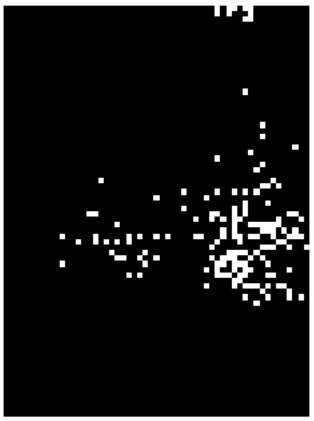
50
100
150
200
250
300
X Coordinate
0
50
100
150
200
250
Y Coordinate
0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15

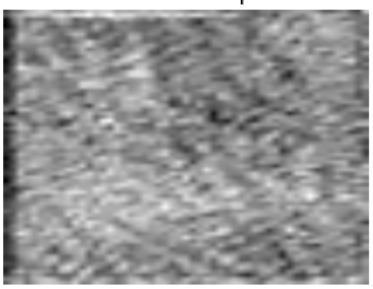
Tactile Image 70



Predicted Contact



Predicted Depth



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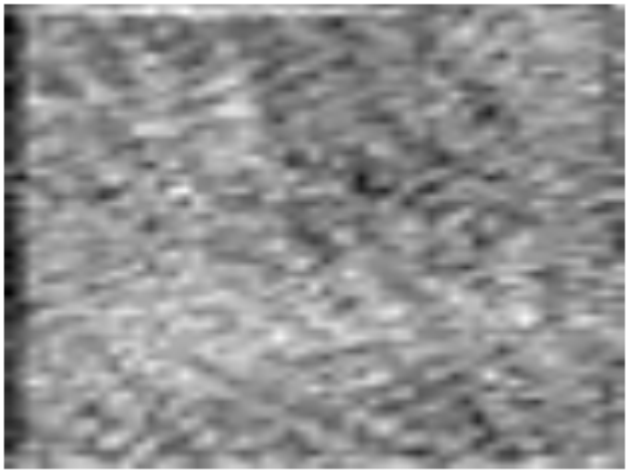
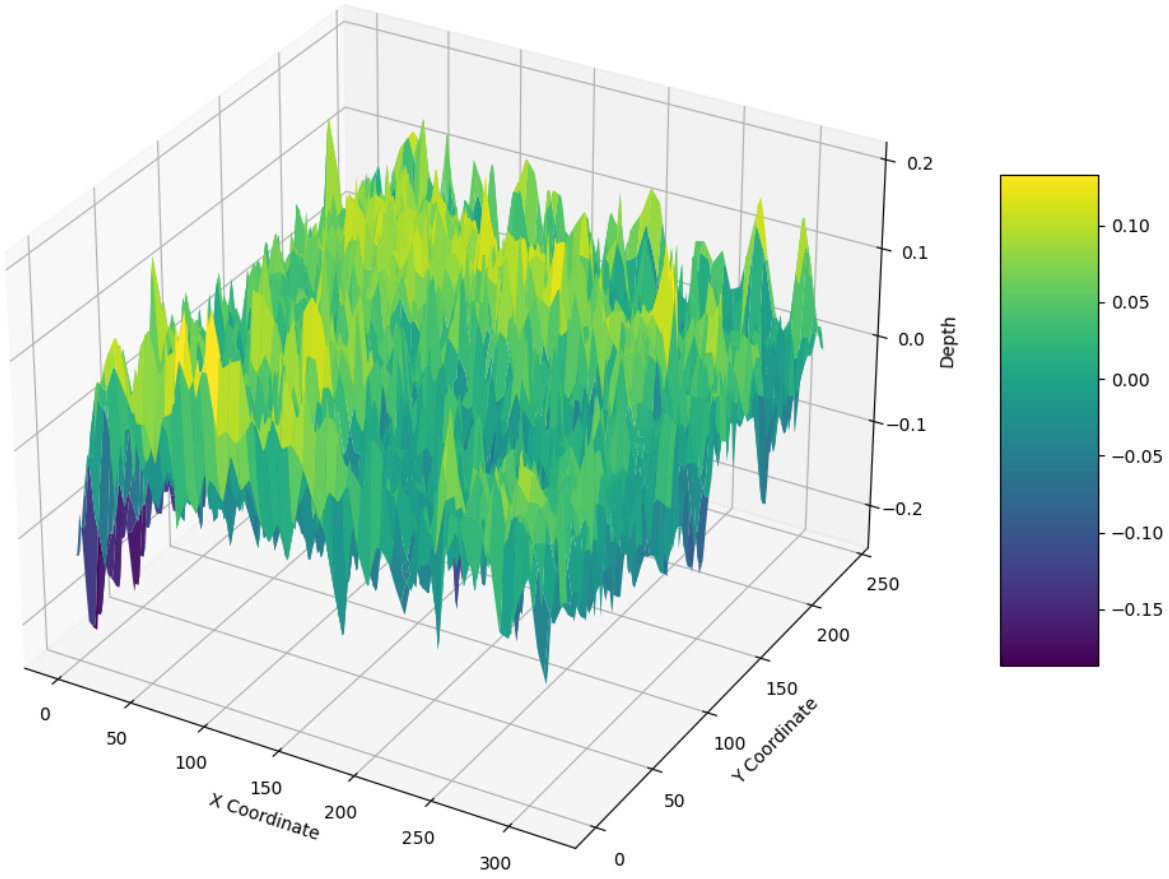
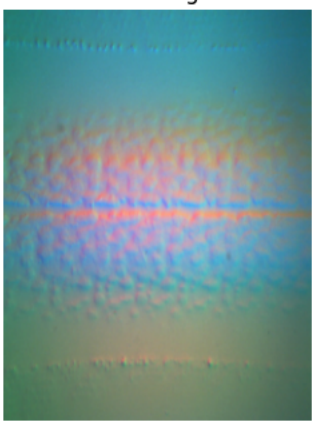




Tactile Image 71



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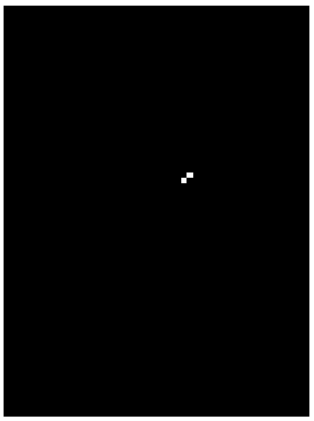
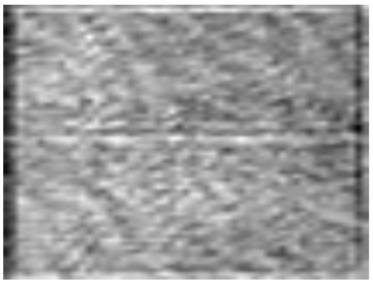
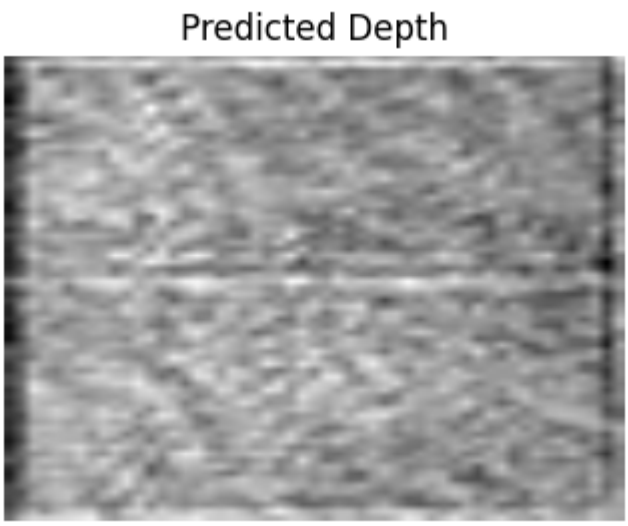
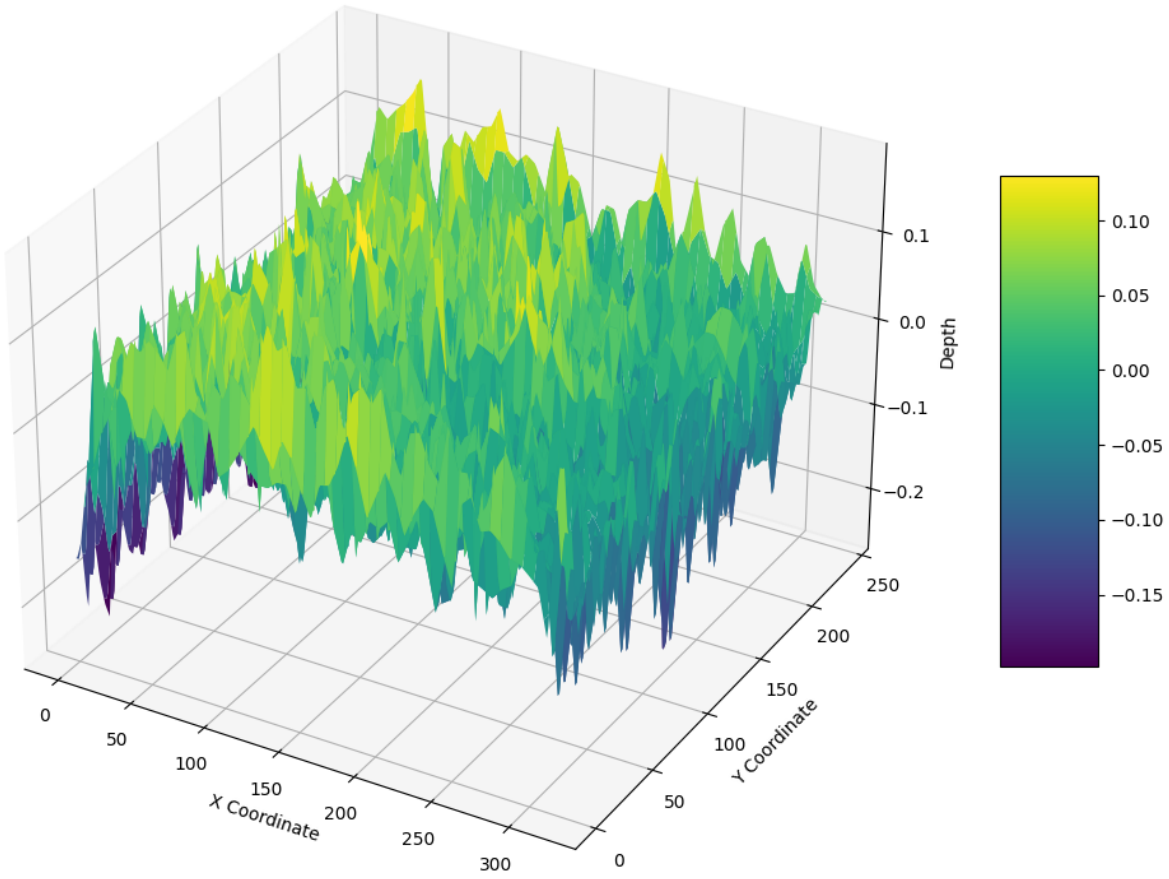


Predicted Depth




Predicted Depth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X Coordinate
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50
100
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200
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Y Coordinate
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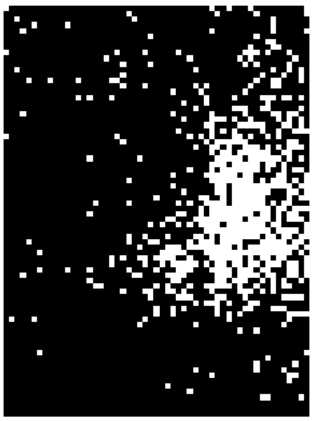
0.00
−0.05
−0.10
−0.15

Tactile Image 72

Predicted Contact



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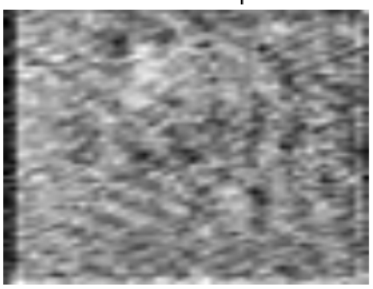
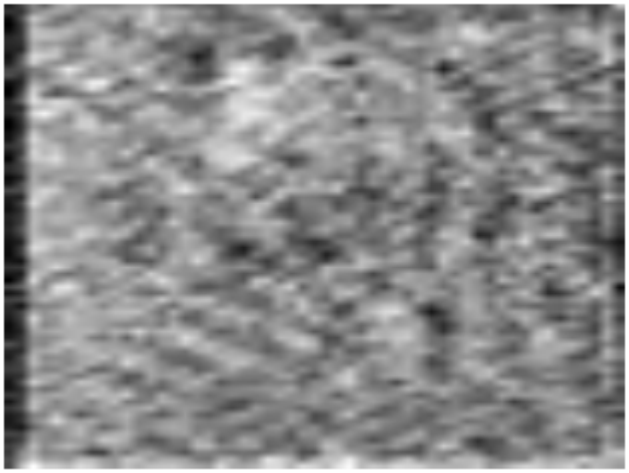
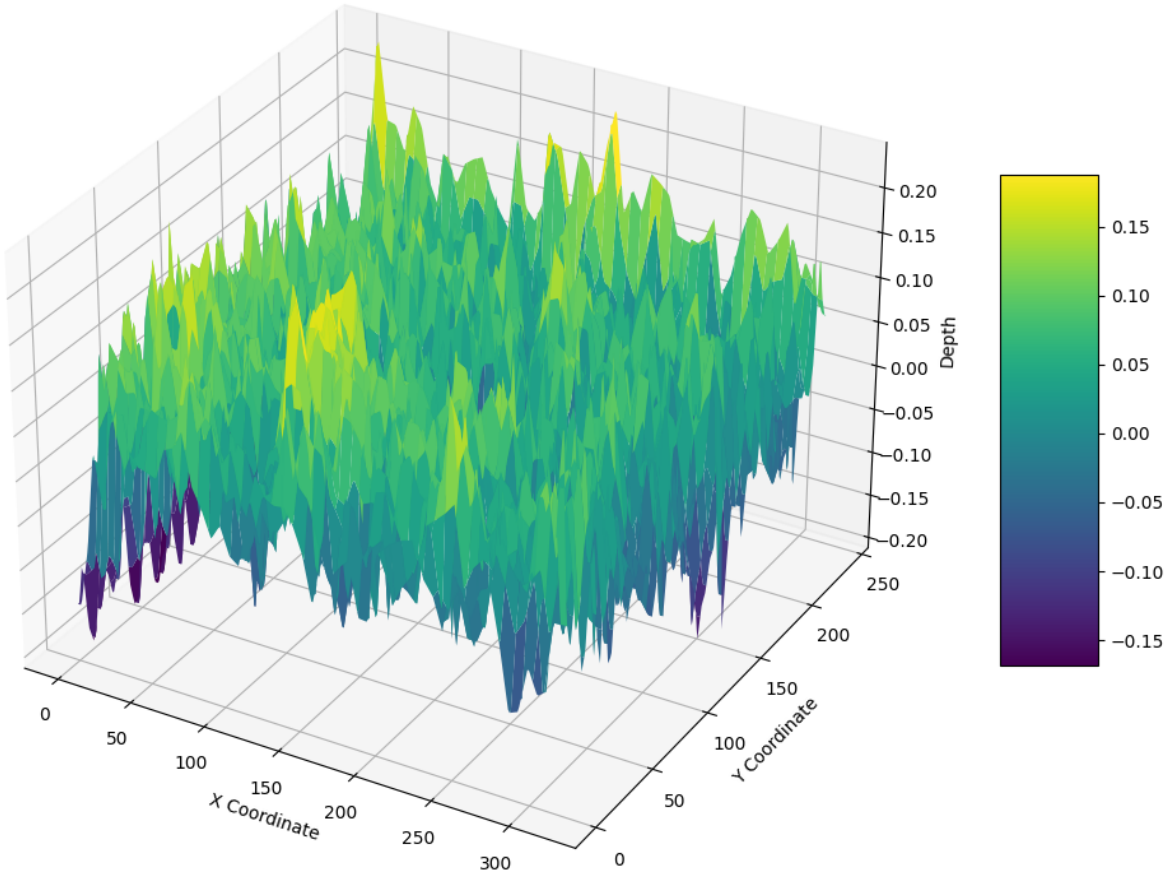


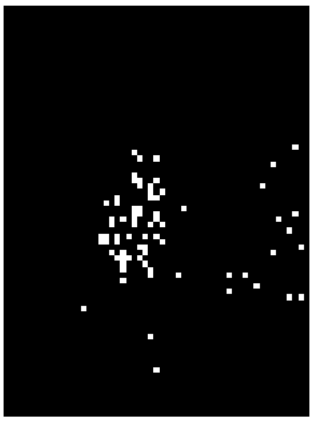
Predicted Depth



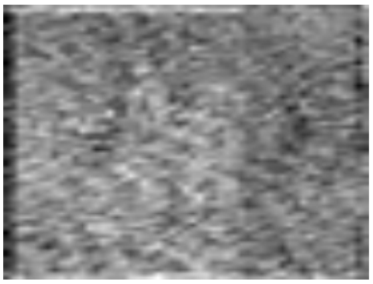


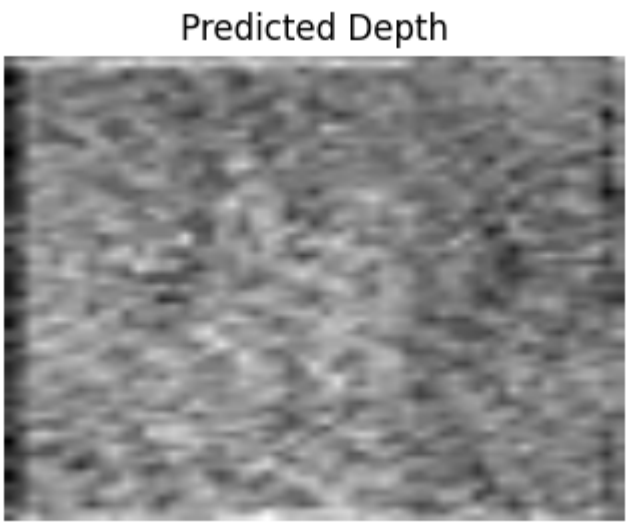
Tactile Image 73

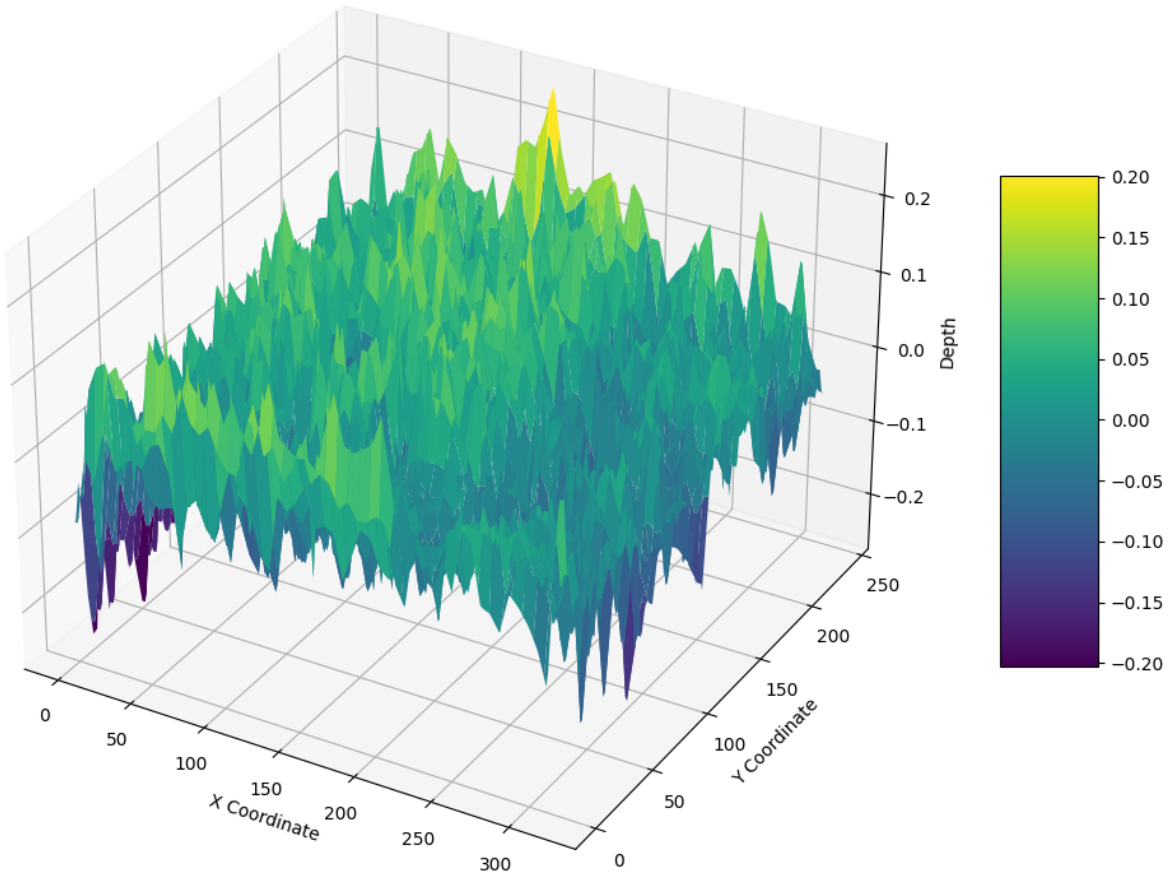
Predicted Contact



Predicted Depth




Predicted Depth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300
X Coordinate
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100
150
200
250
Y Coordinate
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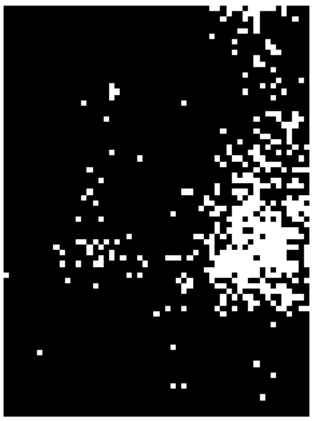
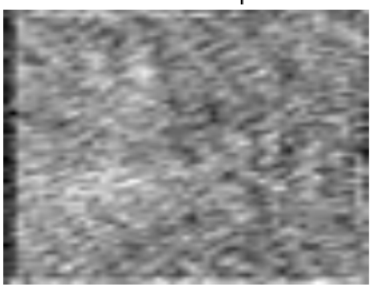
−0.15
−0.20

Tactile Image 74

Predicted Contact



Predicted Depth



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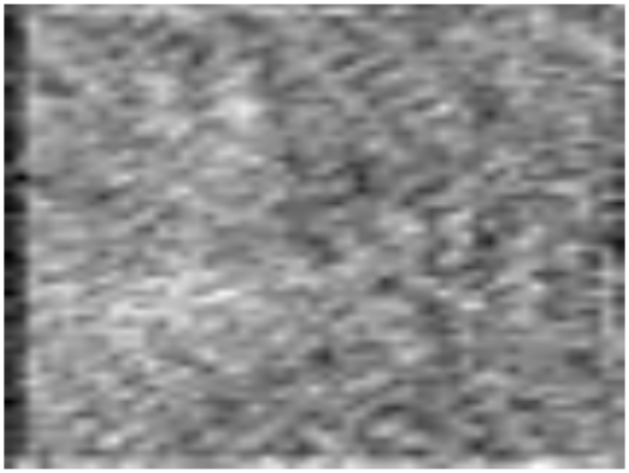
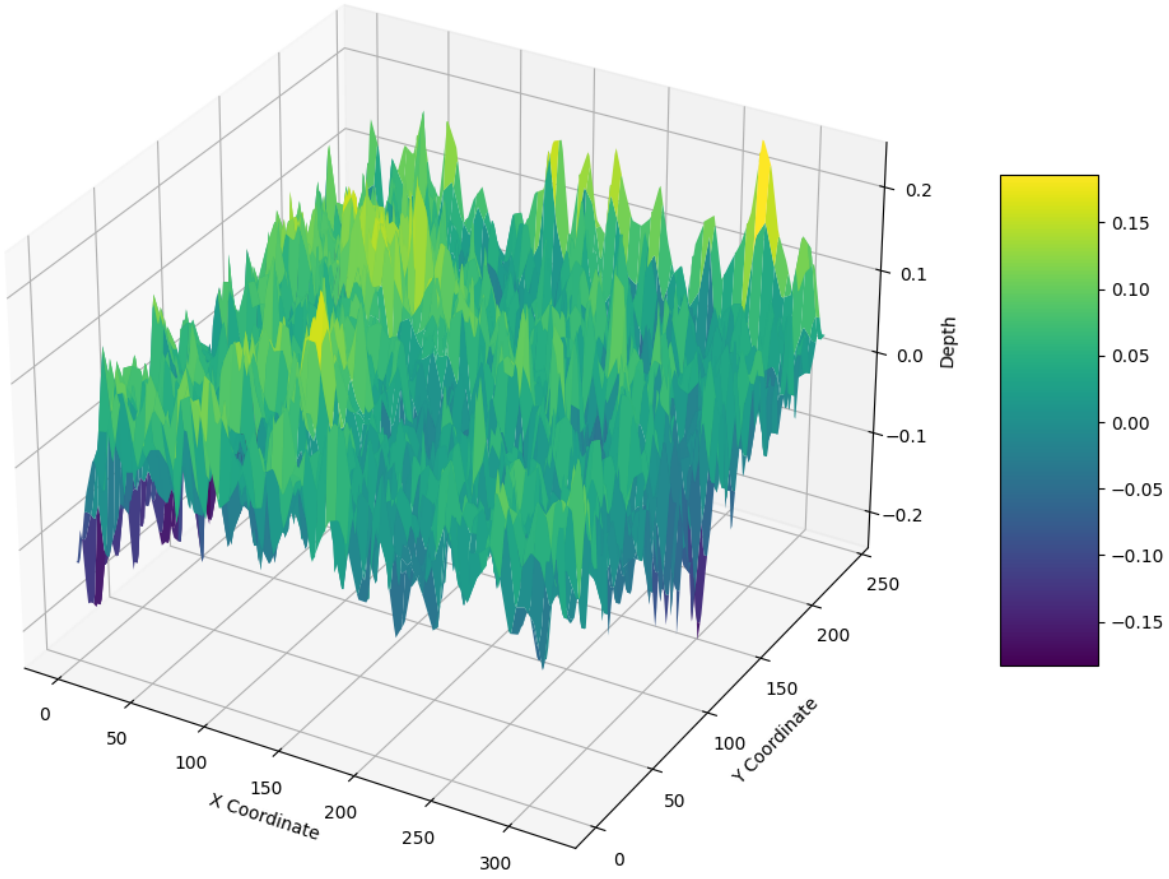
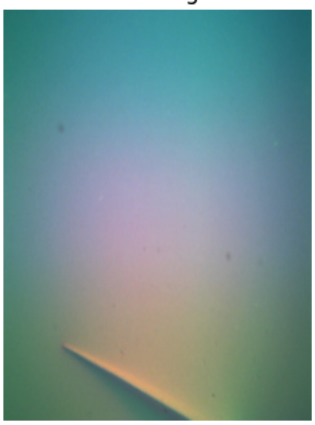
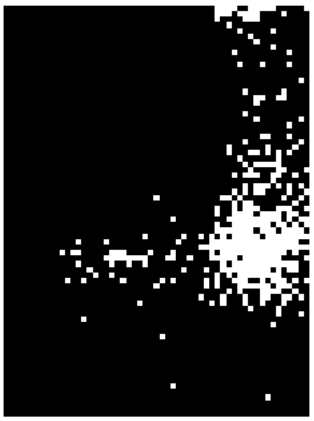




Tactile Image 75



Predicted Contact



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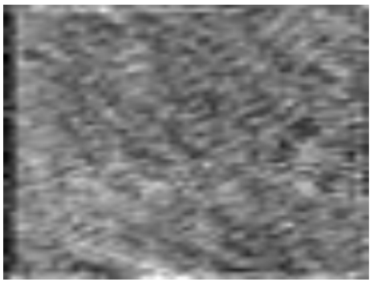
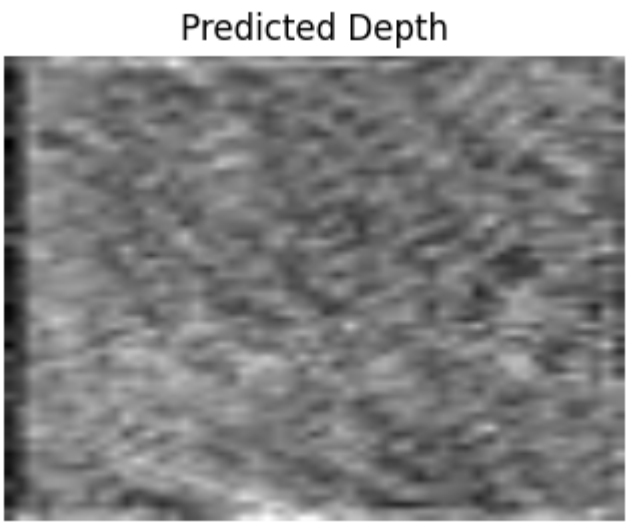
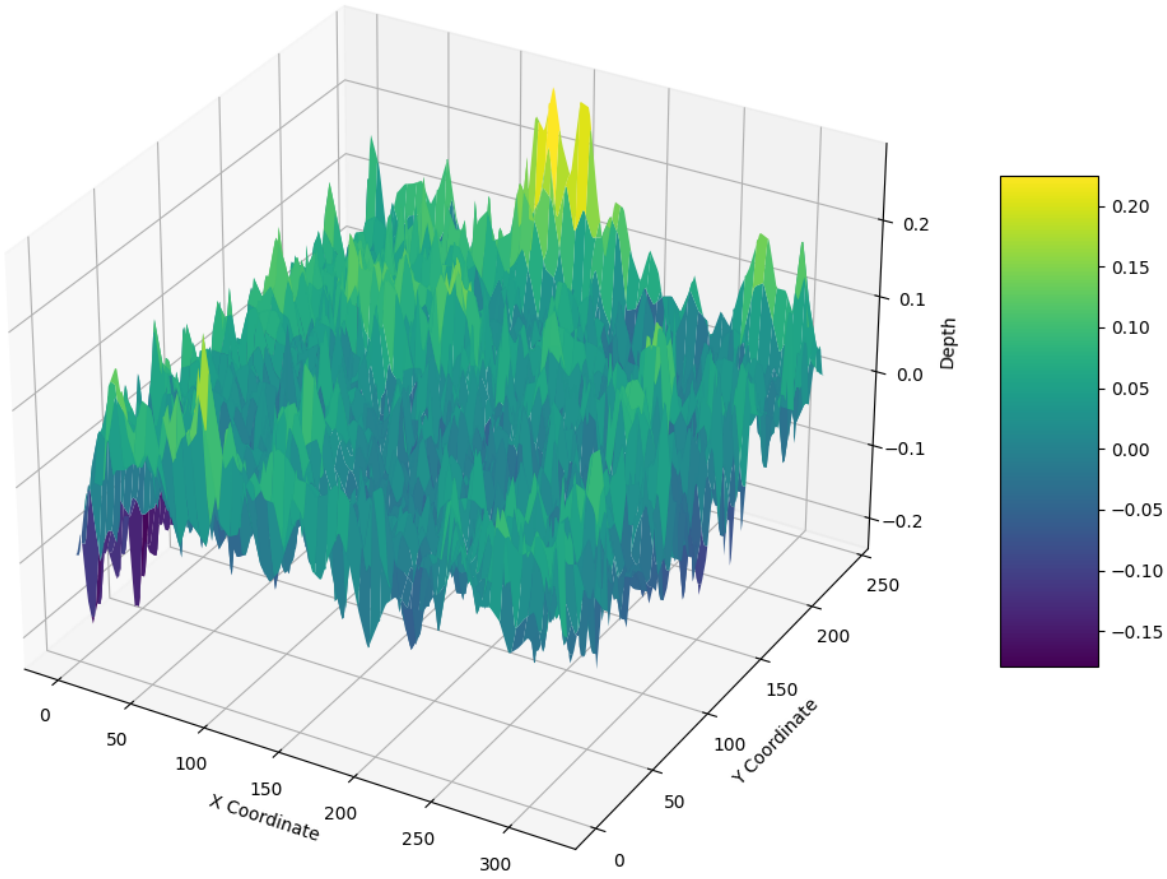



Predicted Depth


0.2
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Depth
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300
X Coordinate
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100
150
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Y Coordinate
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0.15
0.10
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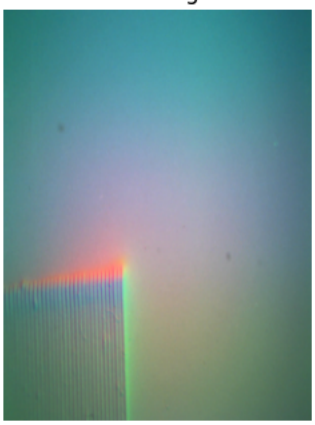
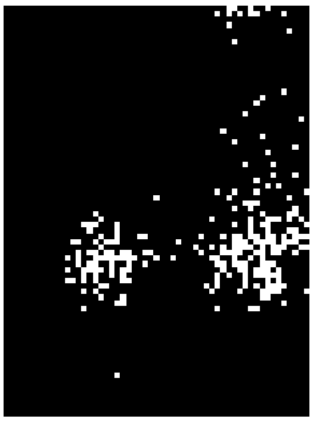
−0.15

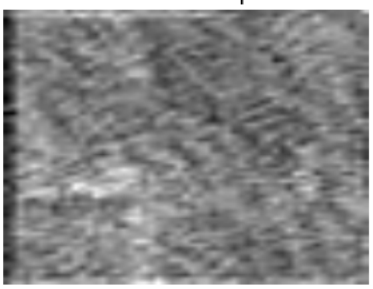
Tactile Image 76



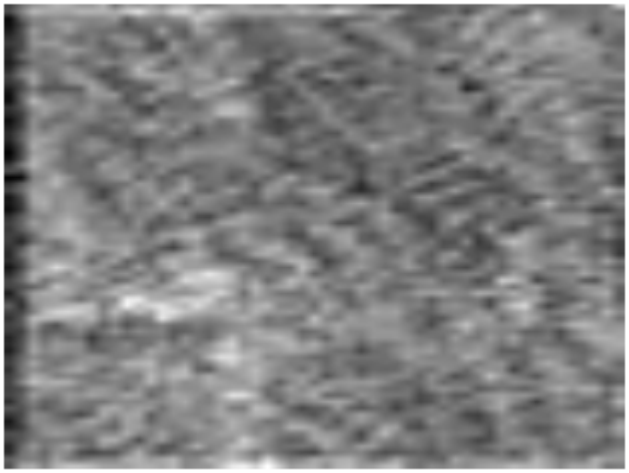
Predicted Contact

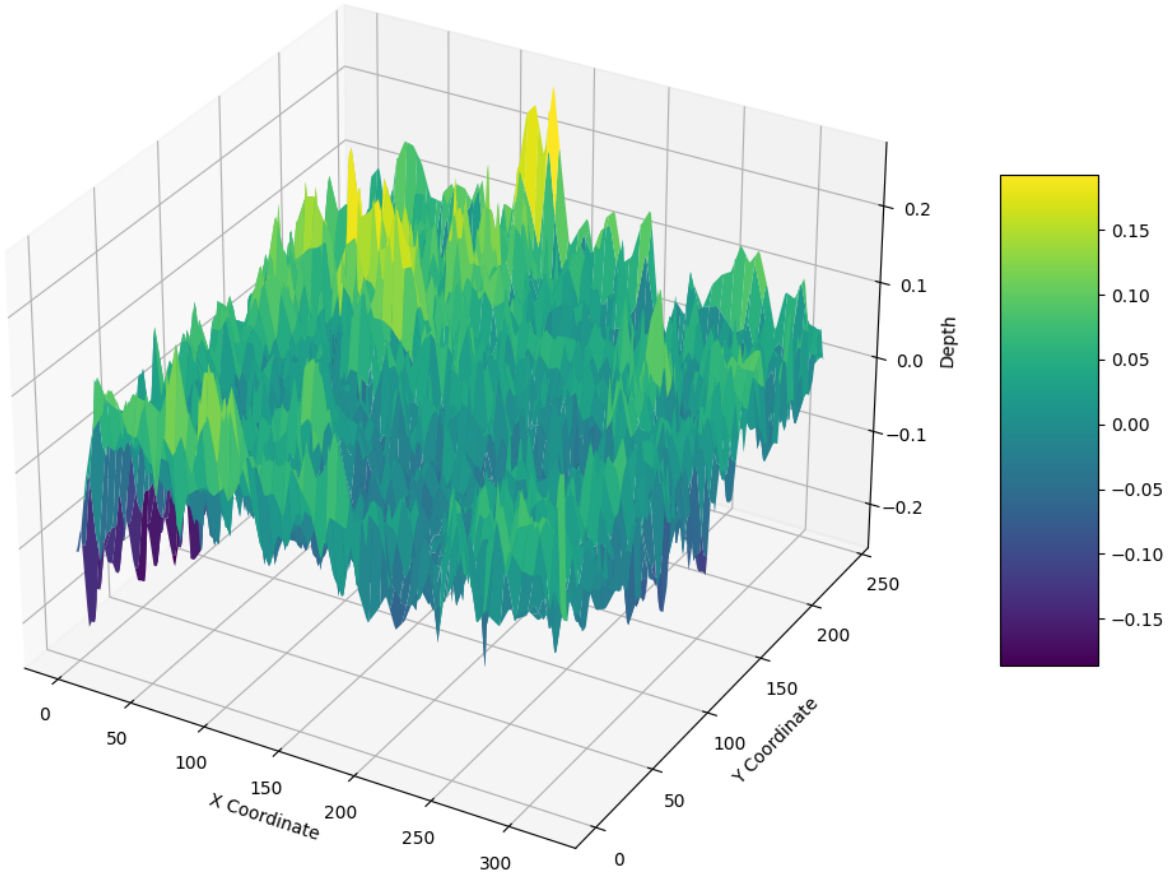


Predicted Depth

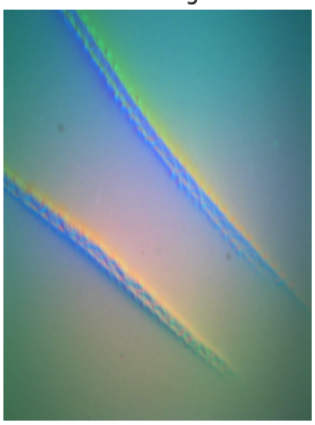


Predicted Depth

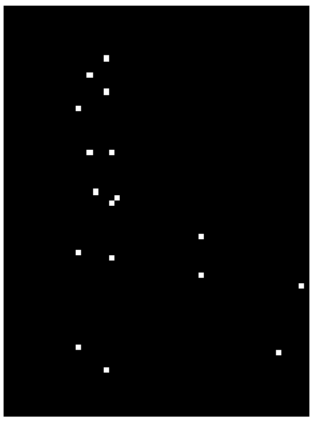




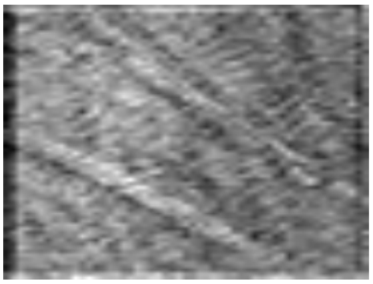
Tactile Image 77

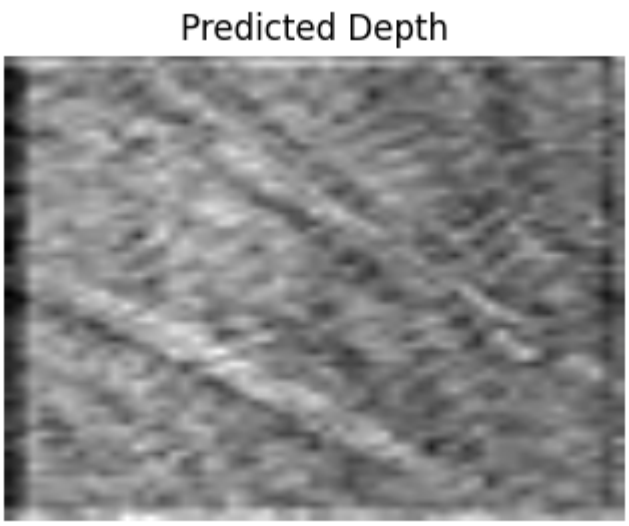


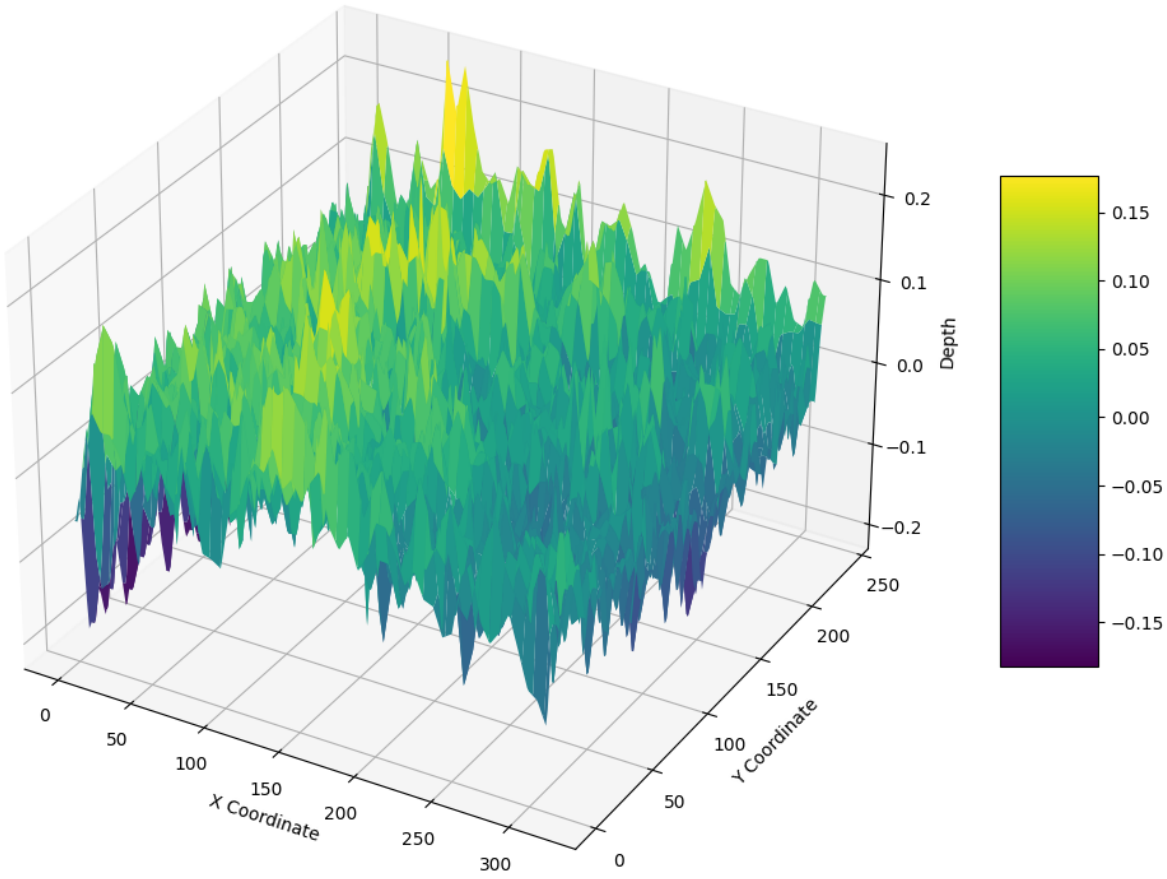
Predicted Contact



Predicted Depth



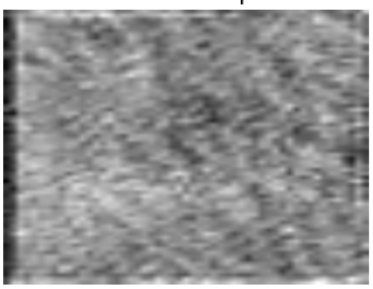

Predicted Depth


0.2
0.1
0.0
−0.1
−0.2
Depth
0
50
100
150
200
250
300
X Coordinate
0
50
100
150
200
250
Y Coordinate
0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15

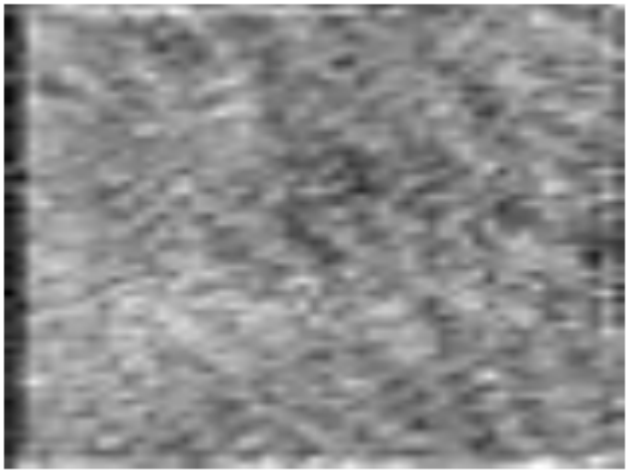
Tactile Image 78

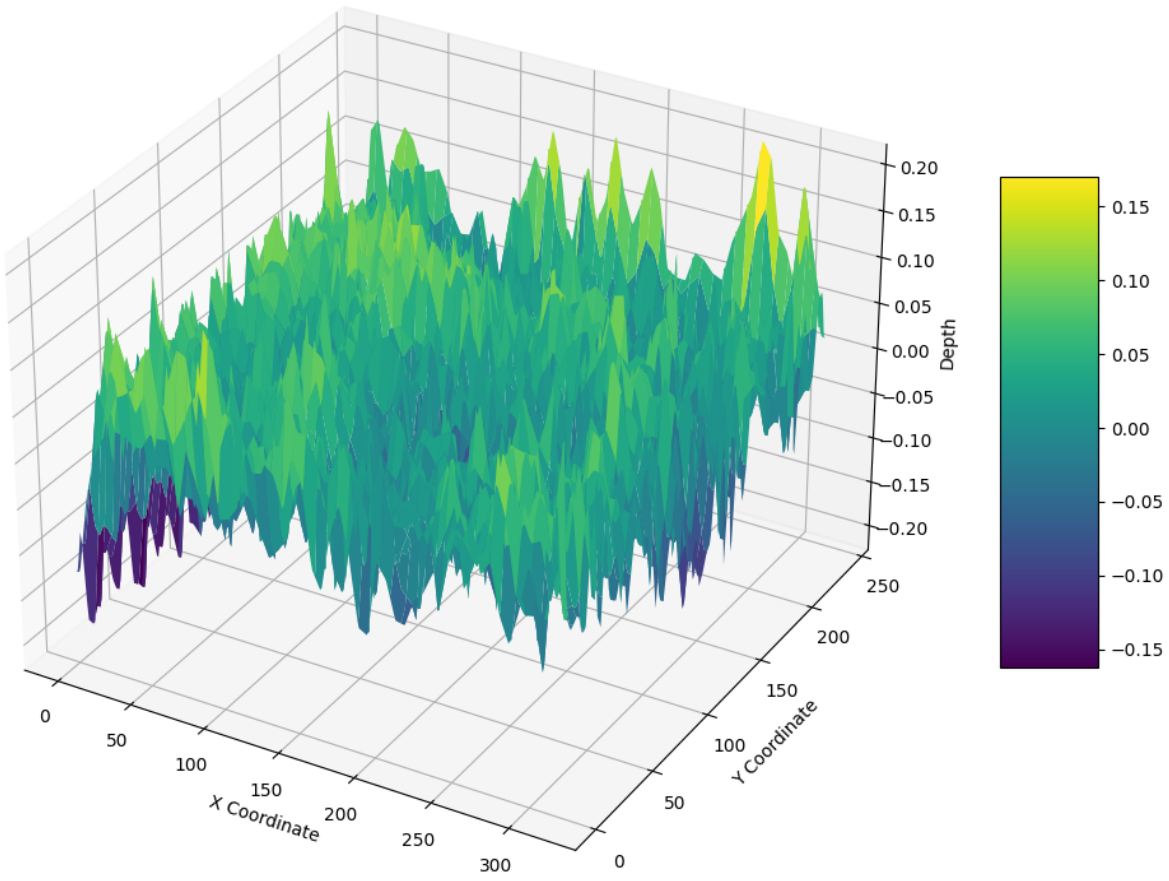
Predicted Contact

Predicted Depth

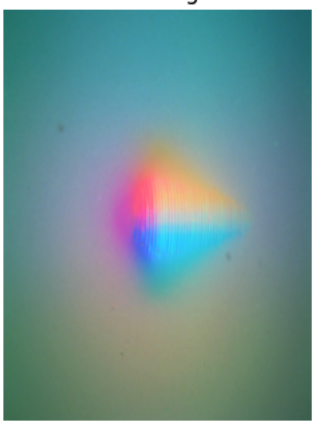


Predicted Depth

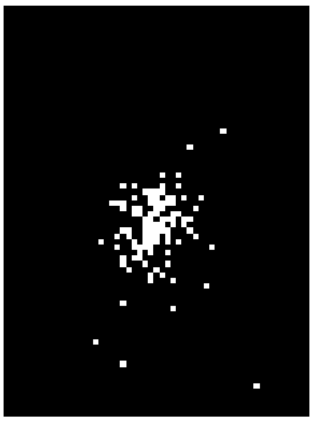




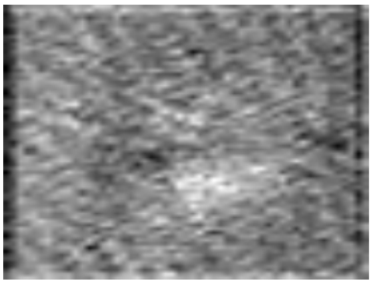
Tactile Image 79

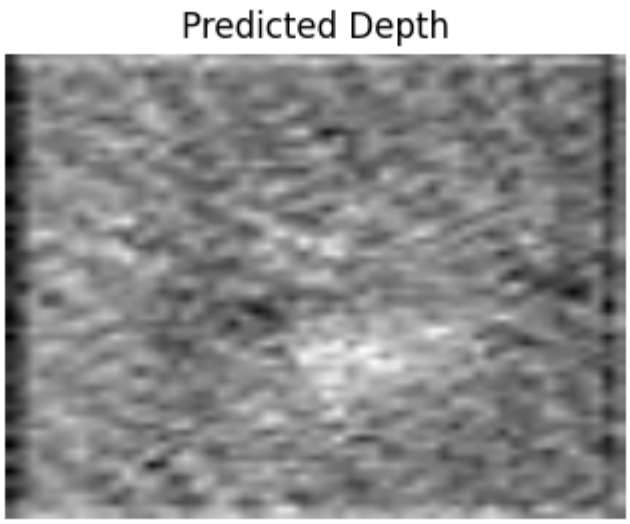


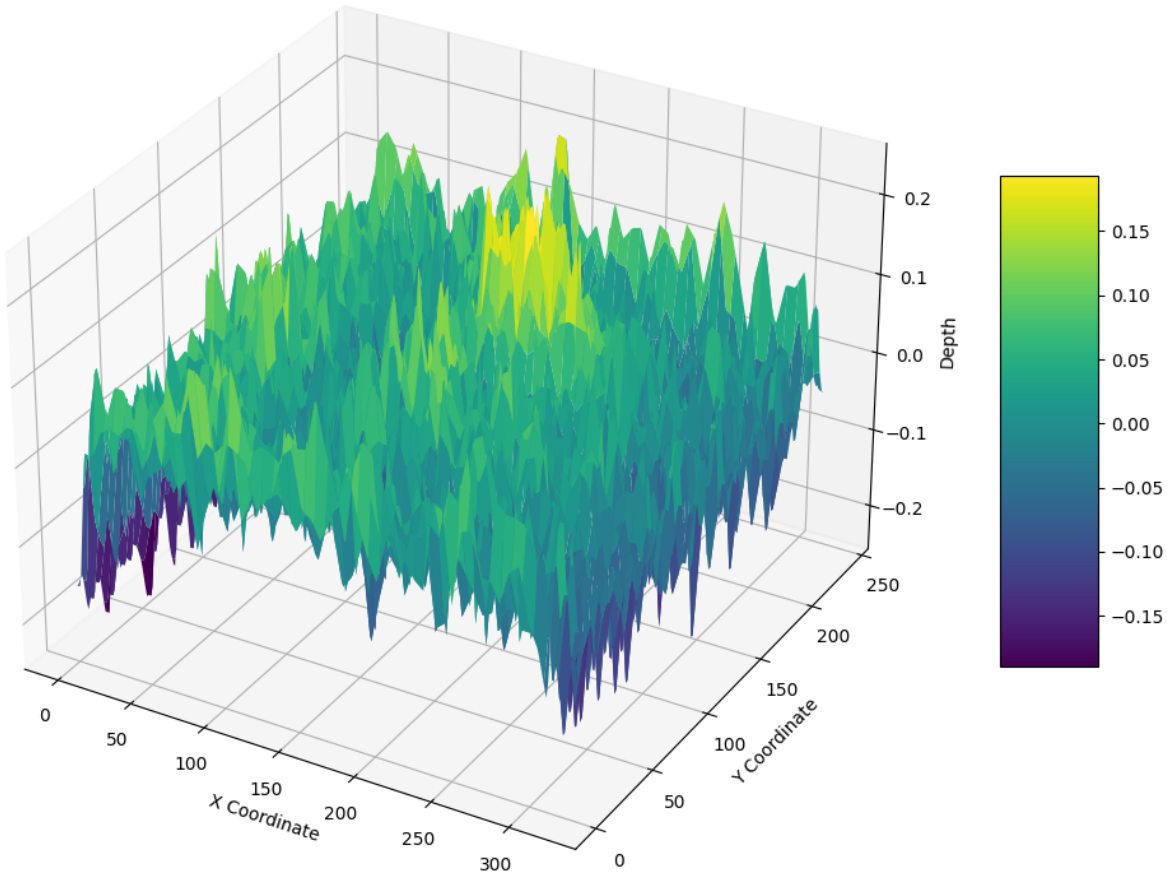
Predicted Contact



Predicted Depth







Grading Criteria:

Every group is required to present(in 10 mins) their project in a video pesentation. Grading will be based on the performance on unseen data. Therefore, your choice of data augmentations, network design, loss function etc., will be crucial aspects to focus on. You should also upload a LaTeX report about the experiments you had in this template. Please read about the leaderboard on piazza.

Refrences:

[1] Depth Map Prediction from a Single Image using a Multi-Scale Deep Network

[2] MidasTouch: Monte-Carlo inference over distributions across sliding touch

[3] depth-eigen