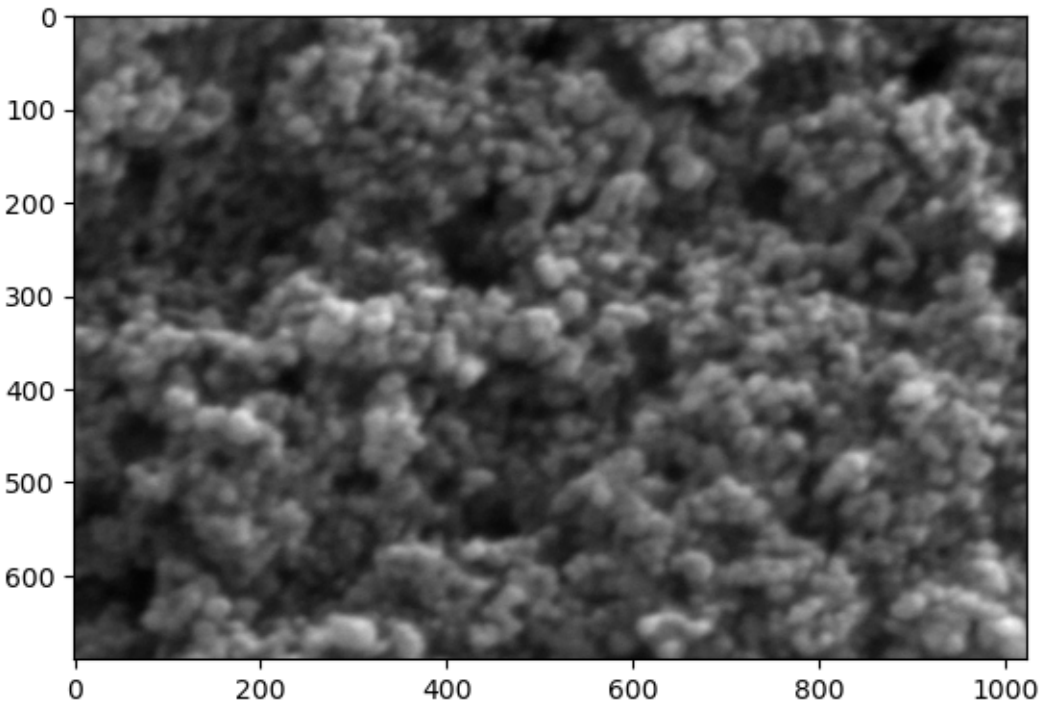
3D representation of a microscopic images

September 4, 2023

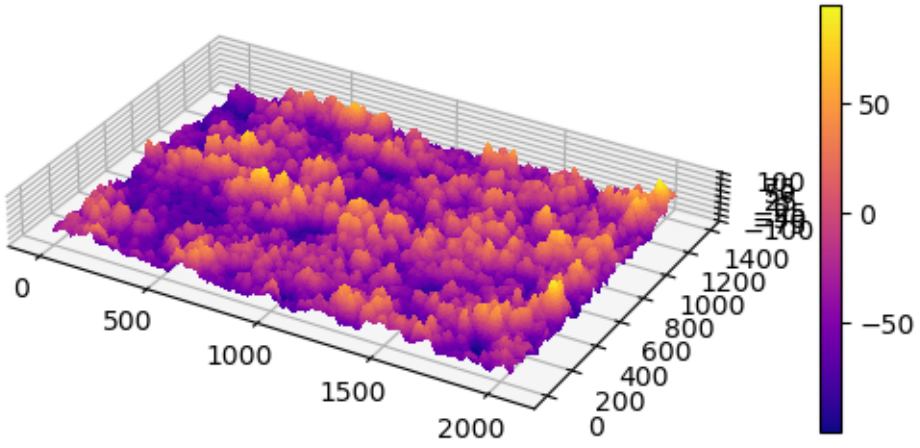
[1]:
```
import numpy as np
import matplotlib.pyplot as plt
from PIL import Image
import scipy.ndimage as ndi
import plotly.graph_objects as go
import pandas as pd
```

[2]:
```
# Load the grayscale microscopic image using Pillow
image_path = "img/test.tif"
image = Image.open(image_path).convert('L')

# Convert the image to a NumPy array
image_array = np.array(image)[:690]
plt.imshow(image_array, cmap='gray')
```

[2]:
```
<matplotlib.image.AxesImage at 0x2210544ed70>
```



[3]:
```
# Normalize image intensity to the range [-1, 1]
normalized_image = 2.0 * (image_array - np.min(image_array)) / np.
 ↪ptp(image_array) - 1

# Define the depth difference assumption (e.g., 200 nm)
depth_difference_nm = 100
normalized_image = normalized_image * depth_difference_nm

# Find Scale of x, y axis
# Determine the scale of the x and y axes
pixel_length_ratio = 100 / 50  # Length per pixel
x_scale = np.arange(image_array.shape[1]) * pixel_length_ratio
y_scale = np.arange(image_array.shape[0]) * pixel_length_ratio

x_mesh, y_mesh = np.meshgrid(x_scale, y_scale)

# Create a 3D plot
fig, ax = plt.subplots(subplot_kw={"projection": "3d"})

# Create the 3D depth surface plot with a chosen colormap
colormap = plt.get_cmap('plasma')  # Choose your preferred colormap
surface = ax.plot_surface(x_mesh, y_mesh, normalized_image, cmap=colormap,␣
 ↪rstride=1, cstride=1, linewidth=0, antialiased=False)

# Add a colorbar to the plot
colorbar = fig.colorbar(surface, shrink=0.6, aspect=20, pad=0.12)

# Set the aspect ratio of the 3D plot
ax.set_box_aspect((np.ptp(x_mesh), np.ptp(y_mesh), np.ptp(normalized_image)))

# Display the 3D plot
plt.show()
```

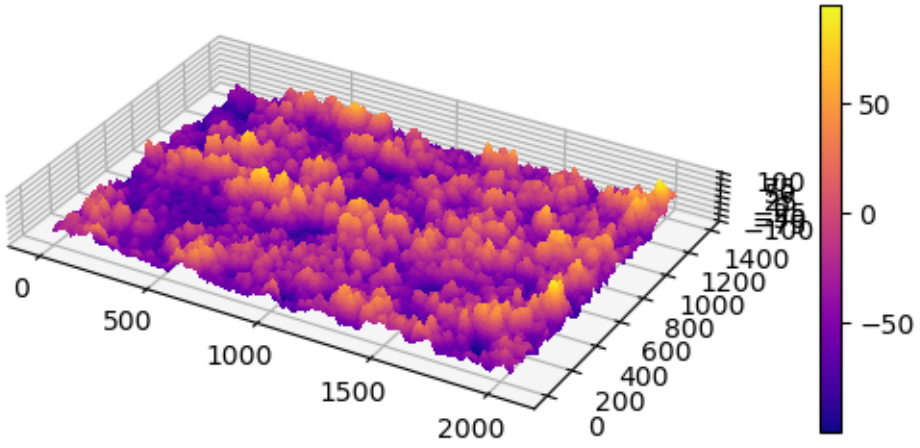


I Created Custom function to these operations

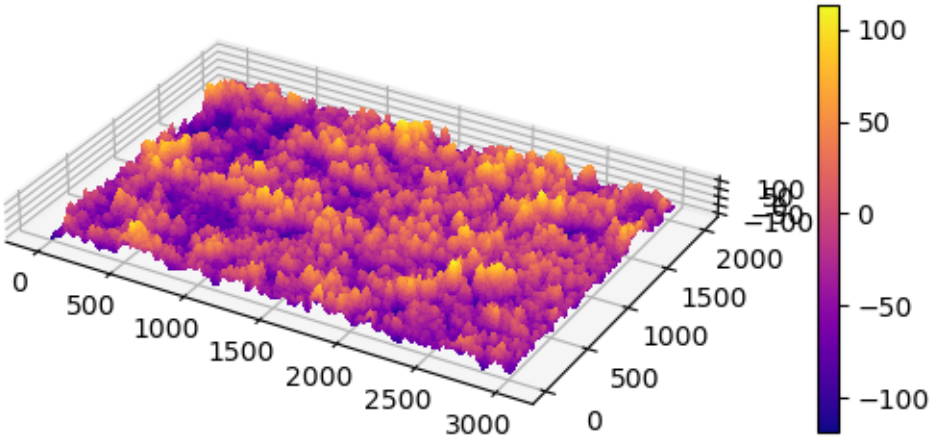
[4]:
```
import numpy as np
import matplotlib.pyplot as plt
from PIL import Image

def plot_3d_microscopic_image(image_path, depth_difference_nm,␣
↪pixel_length_ratio):
    """
    Plot a 3D representation of a microscopic image.

    Parameters:
    - image_path (str): The path to the image file.
    - depth_difference_nm (int): The depth difference in nano meters.
    - pixel_length_ratio (float): Scaling factor for x and y axes (how much␣
↪length in nano meters equal to one pixel).

    Example usage:
        image_path = "img/test.tif"
        depth_difference_nm =100
        pixel_length_ratio = 100 / 50
        plot_3d_microscopic_image(image_path, depth_difference_nm,␣
↪pixel_length_ratio)
    """
```

```
    # Load the grayscale microscopic image
    grayscale_image = Image.open(image_path).convert('L')

    # Convert the image to a NumPy array
    image_array = np.array(grayscale_image)
    image_array = image_array[:690]  # Crop the image if needed

    # Normalize the image to the range [-1, 1]
    normalized_image = 2.0 * (image_array - np.min(image_array)) / np.
↪ptp(image_array) - 1

    # Calculate the depth information based on the provided depth difference
    normalized_image = normalized_image * depth_difference_nm

    # Determine the scale of the x and y axes
    x_scale = np.arange(image_array.shape[1]) * pixel_length_ratio
    y_scale = np.arange(image_array.shape[0]) * pixel_length_ratio

    x_mesh, y_mesh = np.meshgrid(x_scale, y_scale)

    # Create a 3D plot
    fig, ax = plt.subplots(subplot_kw={"projection": "3d"})

    # Create the 3D depth surface plot with a chosen colormap
    colormap = plt.get_cmap('plasma')  # Choose your preferred colormap
    surface = ax.plot_surface(x_mesh, y_mesh, normalized_image, cmap=colormap,␣
↪rstride=1, cstride=1, linewidth=0, antialiased=False)

    # Add a colorbar to the plot
    colorbar = fig.colorbar(surface, shrink=0.6, aspect=20, pad=0.12)

    # Set the aspect ratio of the 3D plot
    ax.set_box_aspect((np.ptp(x_mesh), np.ptp(y_mesh), np.
↪ptp(normalized_image)))

    # Display the 3D plot
    plt.show()
```

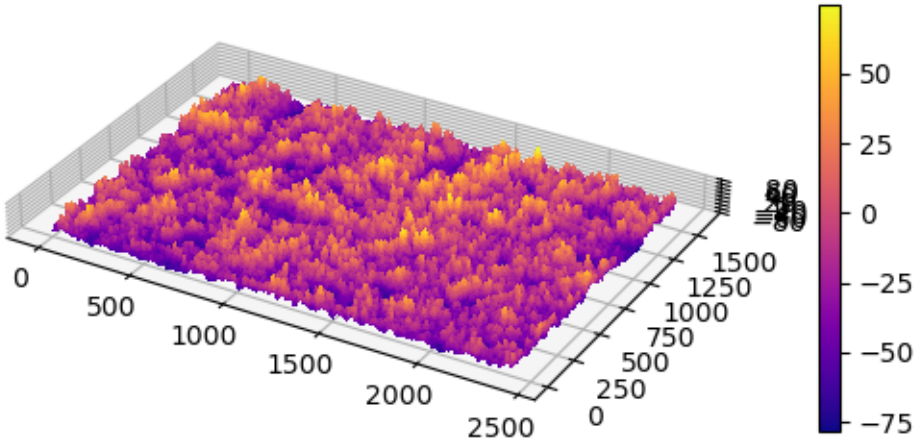
[5]:
```
plot_3d_microscopic_image("img/img01.tif", 100, 100/50)
```



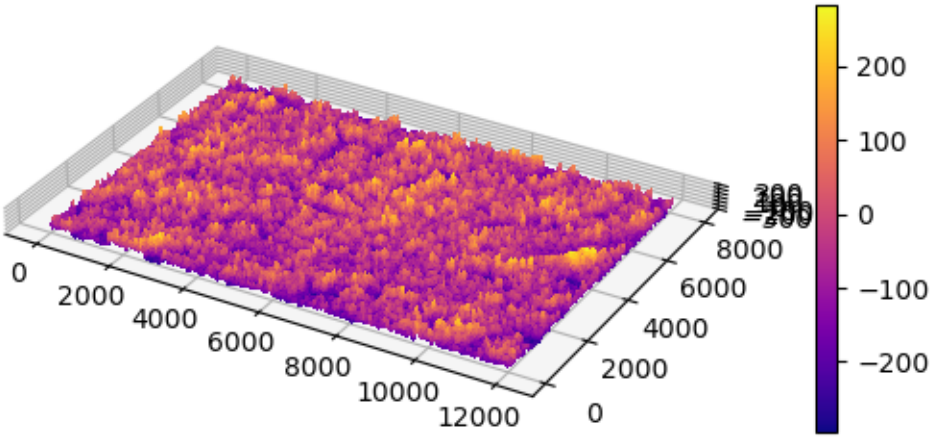
[6]:
```
plot_3d_microscopic_image("img/img02.tif", 120, 100/34)
```



[7]:
```
plot_3d_microscopic_image("img/img03.tif", 80, 200/85)
```



[8]:
```
plot_3d_microscopic_image("img/img04.tif", 300, 1000/85 )
```


0
2000
4000
6000
8000
10000
12000
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2000
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100
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−100
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[ ]: