Quantification of Oyster Seeds using Deep Learning.

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Introduction

Figure 1. Oyster sizes in ascending order of range(0-2mm, 2-4mm, >4mm)

- In order to efficiently count oyster seeds of various sizes within a Petri dish, we use a Machine Learning model based on Stardist2D, which excels at nuclei/cell detection. This is a project made in collaboration with Louisiana Sea Grant Research Lab.
- Oyster seeds are filtered into size groups 0-2mm, 2-4mm, and >4mm as shown above.

Objectives

- Our goal is to give Louisiana Sea Grant researchers a tool that can quickly and accurately count the number of oyster seeds in a given image.
- The machine learning model is based on Stardist. Given this technology, we hope to reduce the amount of time spent on hand counting oysters for growth and distribution.
- Stardist has U-net as the backbone and considers object probabilities and radial distances.
- Below Figure (2) shows the object probabilities and radial distance of an input image.

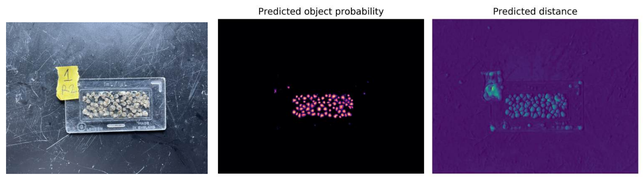

Figure 2. Training model based on Stardist- Object probabilities and radial distances of Oyster Image

Distance and Probability Loss over 500 Epochs

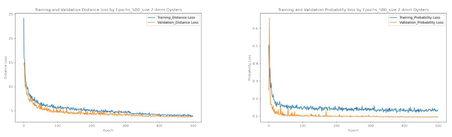

Figure 3. Distance and Probability Loss over 500 Epochs

- The distance loss and probability loss training and validation metrics illustrate the learning process and the model's capacity to fine-tune its internal parameters for improved data fitting.
- The metrics provided reflect the performance of the model over 500 epochs. Analysis of these metrics reveals inherent fluctuations in both training and validation scores, which is

Metrics of F1 score, Precision, Accuracy and Recall over Epochs

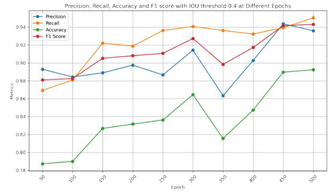

Figure 4. Illustration of the metrics-F1 score, Precision, Accuracy, and Recall on Epochs 50 to 500

- The graph depicts the variations in f1 score, accuracy, recall, and precision for varying epochs during the training of U-Net CNN architecture and StarDist.
- The dataset was split into 80 percent training and 20 percent testing and model was evaluated using an Intersection over Union (IoU) threshold equal to 0.4.
- Testing the epochs of this model, a noticeable jump in accuracy occurs at both 300 and 450 epochs, indicating the importance of prolonged training iterations in order to enhance the model's accuracy further.

GUI Prediction

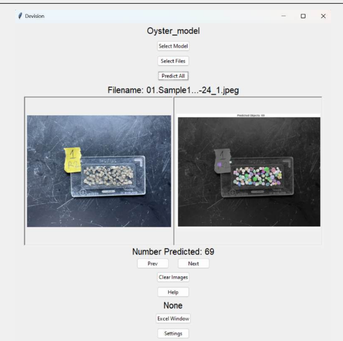

Figure 5. GUI Prediction of Oysters 2-4 mm

- The GUI provides an efficient platform for individuals and businesses seeking to use this models predictions.
- This interface enables users to upload multiple images they wish to count, select from multiple available models, if applicable, and features a detailed annotated visualization that highlights the model's oyster seed predictions while displaying the total number predicted.
- In Figure(5) shows the predicted image by GUI based on the selected best model.

Prediction

Figure 6. Predictions Oysters: Count-70(left), Count-71(right)

- After the model has been trained, it is tested on data that was not included in the training set.
- The best model gave 91 percent accuracy when predicting images with darker backgrounds.

Future work

- For future work, we would like to study oysters of sizes 0-2mm and 4mm and continue our research in developing a robust machine-learning model.
- Additionally, we aim to develop a GUI based on the best model to count oysters of different sizes.
- We also would like to train our models on images of oysters taken on lighter backgrounds, as when the model predicted on those types of images, accuracy would drop.

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References

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