Fetal Head Circumference Prediction

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1 Introduction

With this project, I will build a model to identify and predict the circumference of the fetal head. I will use ultrasound images to serve this project.

2 Data Analysis

The dataset is HC18 grand challenge. The training set includes 1998 images 2D ultrasound images and truth marks. For U-Net, I divided 20% of the images and 20% of the truth marks to create the validation set. The test set consists of 335 images without truth marks. For VGG16, I split the dataset into three parts: 564 training images, 121 validation images, and 121 test images.

3 Model

For this project, I use two different models for two distinct tasks: U-Net and VGG16.

3.1 U-Net Model

The neural network is designed to segment the image quickly and accurately using the U-Net model. The architecture primarily focuses on positioning and zoning, grasping the image context and truth marks for precise segmentation.

3.2 VGG16 Model

VGG16 is chosen to calculate the head circumference. After receiving the segmented head region from the U-Net model, VGG16 predicts the fetal head circumference.

4 Results

With the U-Net model, after training for 20 epochs, the model has achieved stability, where training loss and validation loss no longer differ significantly.

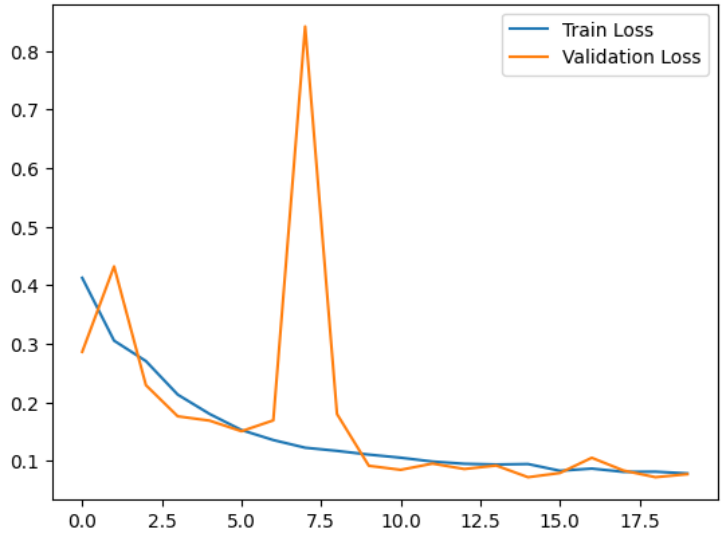

Figure 1: Train loss and validation loss for U-Net

For U-Net, I evaluate the model effectiveness using the Intersection over Union (IoU). After 20 epochs, the IoU on the test set is 89.46%.

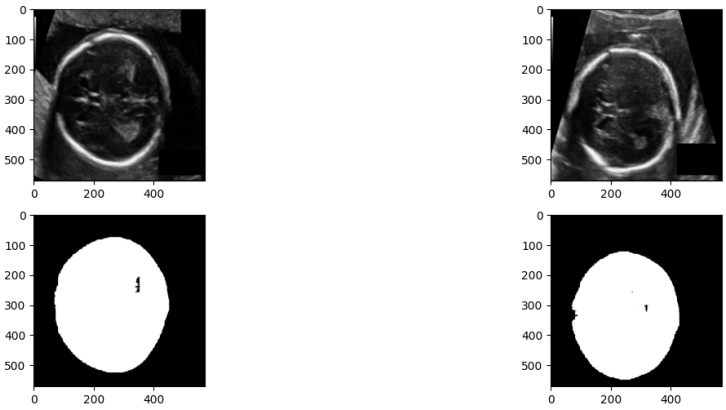

Figure 2: test U-Net

For the VGG16 model, after 16 epochs, I observed that by epoch 6 or 7, the

model had reached convergence, learning no new features.

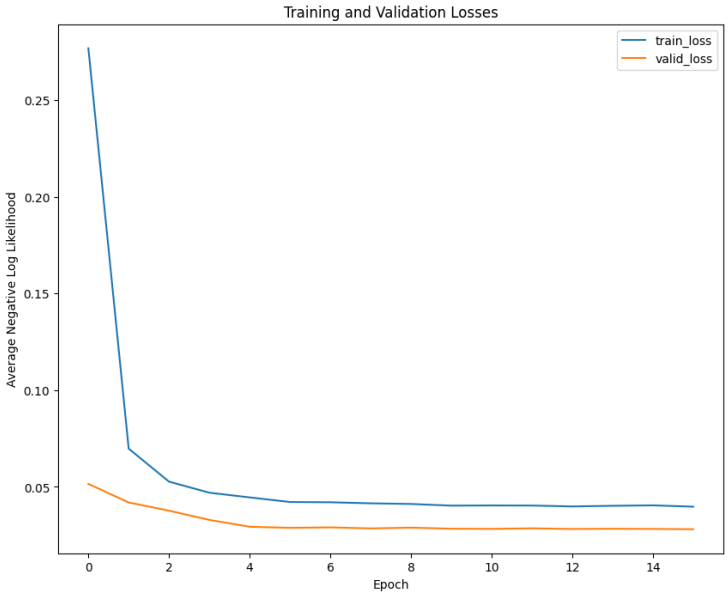

Figure 3: Train loss and validation loss for VGG16

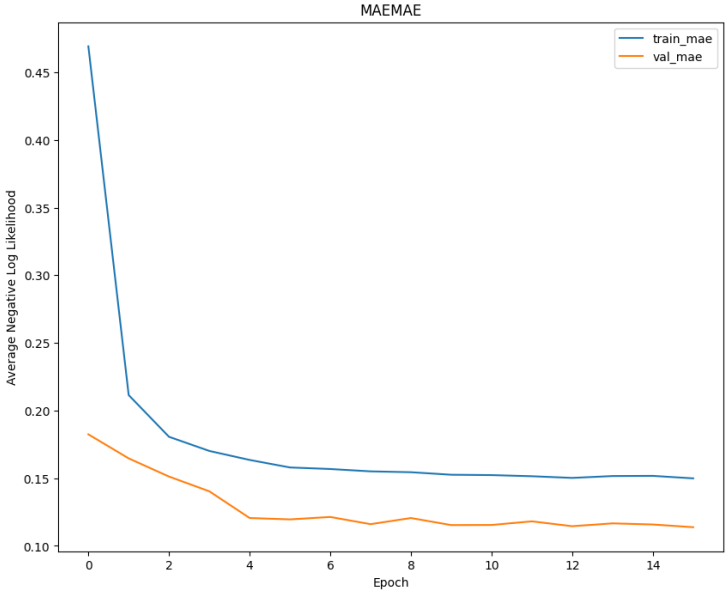

Figure 4: Train MAE and validation MAE for VGG16

The effectiveness of VGG16 is evaluated using Mean Absolute Error (MAE):

- Test set MAE loss = 0.1311
- Test set standard deviation of HC = 8.2222 mm
- Test set MAE loss of HC = 45.4101 mm