

# Report Summary

## Motivation:

The fetal biometry landmark detection challenge was chosen due to its critical importance in prenatal healthcare. Ultrasound-based measurements, such as biparietal diameter (BPD) and occipitofrontal diameter (OFD), play a vital role in estimating gestational age, assessing fetal growth, and detecting central nervous system (CNS) anomalies. Developing accurate algorithms for automated landmark detection can assist clinicians in diagnosing fetal abnormalities early, potentially improving patient outcomes and reducing healthcare costs.

## Abstract:

In this study, two approaches were explored for fetal biometry landmark detection: landmark detection-based and segmentation-based methods. For the landmark detection-based approach, deep learning models were trained to predict BPD and OFD landmark points directly from fetal axial images. In the segmentation-based approach, a segmentation model was trained to identify the cranium region, followed by a computer vision algorithm to locate the BPD and OFD points. Experimental results demonstrated the effectiveness of both approaches in accurately detecting fetal biometry landmarks, providing valuable insights for prenatal healthcare.

## Introduction:

The goal of this study is to develop algorithms capable of accurately identifying BPD and OFD landmark points in fetal axial images. These landmarks are crucial for estimating gestational age, assessing fetal growth, and detecting CNS anomalies. Two main approaches were investigated: landmark detection-based and segmentation-based methods. The landmark detection-based approach directly predicts landmark points from images, while the segmentation-based approach first segments the cranium region before detecting landmarks. The choice of models and methodologies was based on their suitability for the task and potential impact on clinical practice.

## Data PreProcessing/Analysis:

The dataset consists of fetal axial images annotated with BPD and OFD landmark points. Preprocessing steps included resizing images to a standardized resolution, normalization, and data augmentation to enhance model generalization. Data augmentation techniques such as rotation, shifting, and flipping were applied to increase the diversity of the training dataset. Ground truth annotations were verified for accuracy and consistency to ensure reliable model training.

## Model Architecture:

For the landmark detection-based approach, convolutional neural network (CNN) architectures were employed to directly predict landmark coordinates from images. Various CNN architectures were explored, including standard architectures such as ResNet and custom-designed architectures optimized for landmark detection tasks. For the segmentation-based approach, U-Net architecture was utilized for cranium segmentation, followed by custom algorithms for landmark localization within the segmented regions.

### **Experimental Setting:**

The experimental setup involved partitioning the dataset into training, validation, and test sets. Training was performed using stochastic gradient descent (SGD) optimizer with appropriate learning rates and momentum. Mean squared error (MSE) loss function was used for both landmark detection and segmentation tasks. Hyperparameters were fine-tuned using validation data to optimize model performance.

### **Hypotheses Tried:**

Several hypotheses were tested to improve the performance of the models. These included exploring different CNN architectures, adjusting model hyperparameters, incorporating regularization techniques such as dropout and weight decay, and experimenting with different data augmentation strategies. Transfer learning from pre-trained models and ensemble learning techniques were also investigated to leverage existing knowledge and improve model robustness.

### **Results:**

Experimental results demonstrated the effectiveness of the proposed approaches in accurately detecting fetal biometry landmarks. Both landmark detection-based and segmentation-based methods achieved promising results, with accurate localization of BPD and OFD points. Performance metrics such as mean absolute error (MAE) and intersection over union (IoU) were used to evaluate model performance on the test dataset. Comparative analysis of different models and methodologies provided valuable insights into their strengths and limitations.

### **Key Findings:**

The key findings from this study highlight the importance of accurate landmark detection in prenatal healthcare. The landmark detection-based approach offers a direct and efficient way to predict biometry points from images, while the segmentation-based approach provides additional context by segmenting the cranium region before landmark localization. Experimentation with various models, architectures, and techniques revealed the significance of model selection, data preprocessing, and hyperparameter tuning in achieving optimal performance. Overall, the study contributes to advancing automated fetal biometry analysis, potentially improving prenatal diagnosis and patient care.