

## Introduction to Deep Learning Progress Report

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# Exploration of Deep Learning regression capabilities for Diastolic and Systolic Blood Pressure Estimation (DBP and SBP) through ECG (electrocardiogram) and PPG (photoplethysmogram)

### Model Implemented:

- Dataset:
  - Training Samples: 465480
  - Test Samples: 57600
  - Optimizer: Adam
  - Lr = 1e-5
  - Batch\_size: 256
  - Sample\_frequency: 125Hz (same for ppg and ecg signals)
  - Time Duration: 10 seconds per signal
- The intrinsic parameters (number of nodes, number and size of kernels, number, and size of the pooling layers) are not given at hand in the paper for intermediate models used in the construction of the final model.
- It was found a discrepancy in the proposed loss function that results in canceling the learning of the DBP. Instead of following their loss function, it was decided to go with the standard mean squared error loss.
- Loss Function:
  - $$Loss = \frac{1}{n} \sum_i^n \left[ (SBP_{pi} - SBP_{ti})^2 + corrcoeff * (DBP_{pi} - DBP_{ti})^2 \right]$$
  - $$corrcoeff = \frac{(SBP_{pi} - SBP_{ti})^2}{(DBP_{pi} - DBP_{ti})^2}$$
  - As we can see, this correlation coefficient did not do what it was supposed to do. It cancels the contribution of the diastolic counterpart, allowing the network to learn only the systolic blood pressure part.
- Evaluation Metrics – Regression Problem:
  - Mean Squared Error
  - Mean Absolute Error
- Architecture Images (source [1]):

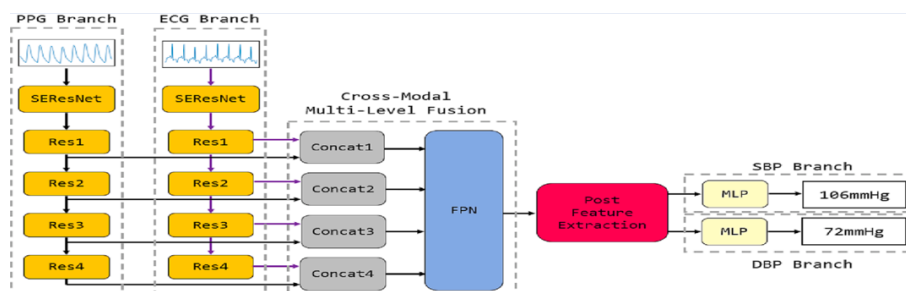


Figure 1 Structure of the implemented model

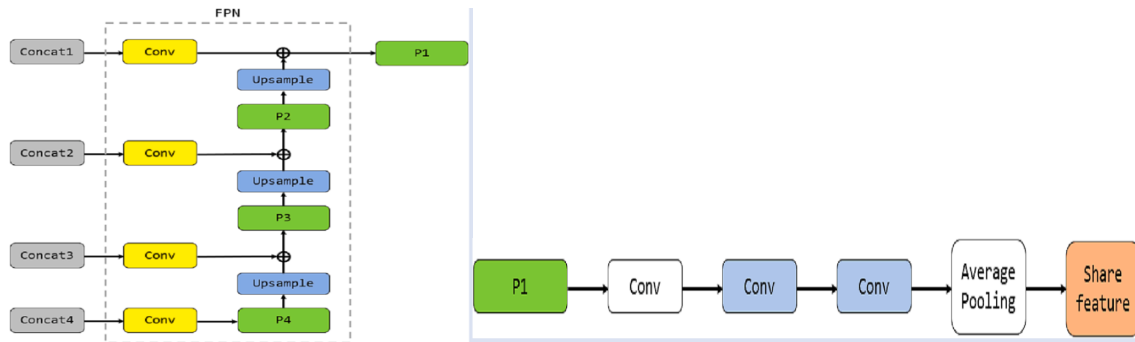
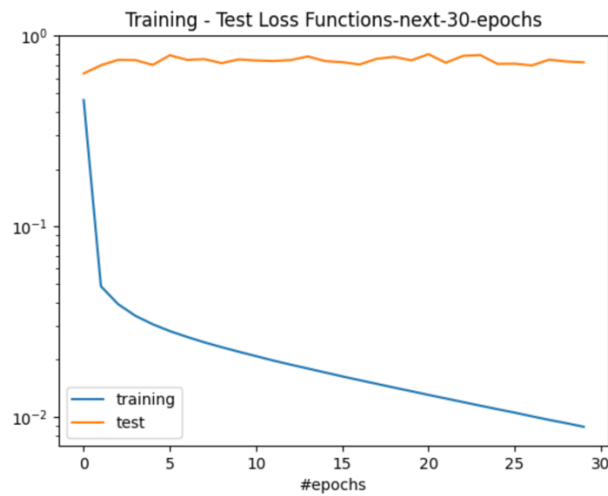


Figure 2 Left (feature pyramid network -fpn- structure) and at Right (the postprocessing of the fpn layer)

## Results:



1. SBP MSE for the first batch test: 0.4607
2. DBP MSE for the first batch test: 60.1746
3. SBP MAE for the first batch test: 0.5609
4. DBP MAE for the first batch test: 7.7291

## Expected Results:

- ☐ The model is training on the new loss function, and we expect the same behavior from SBP in the DBP, since now the cancelling effect of "correlation coefficient" given by the authors is correct.

## Input Example Signals:

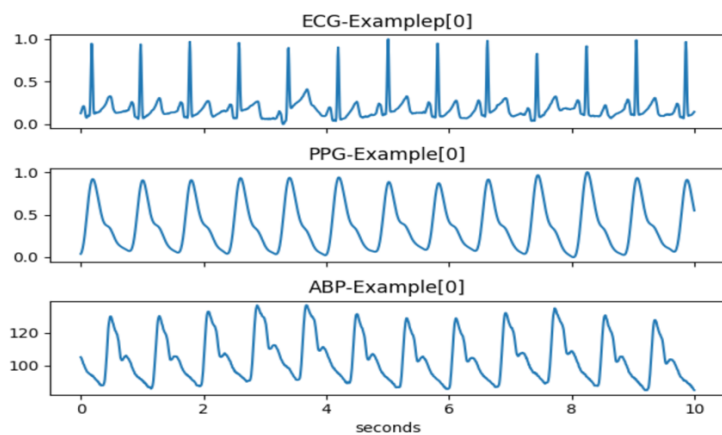


Figure 3 We are using only the ECG and the PPG signals for the scope of this work.

## References:

- [1] Long, W., & Wang, X. (2023). BPNet: A multi-modal fusion neural network for blood pressure estimation using ECG and PPG. In *Biomedical Signal Processing and Control* (Vol. 86, p. 105287). Elsevier BV. <https://doi.org/10.1016/j.bspc.2023.105287>