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High Performance Computing for Intelligent Medical Systems

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Chapter 4

Deep learning for cuffless blood pressure monitoring

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There is a great motivation to use easy-access bio-signals to alleviate the difficulties and shortcomings of present invasive and cuff-based blood pressure monitoring techniques. Many studies propose methods mainly using photoplethysmogram and electrocardiogram signals. Most of these methods are based on hand-crafted features. Although they take advantage of our previous knowledge, it is highly desirable to propose models that are less dependent on feature engineering.

To this aim, in this chapter, we develop several architectures based on deep neural networks. Through discussing their advantages and drawbacks, we try to develop more appropriate models to meet the demands of the British Hypertension Society and the Association for the Advancement of Medical Instrumentation standards. The building blocks of our models are convolutional neural networks and long short-term memories. We evaluate our models on 200 subjects.

4.1 Introduction

Cardiovascular problems are responsible for the death of almost 50% of all people who die because of non-communicable diseases. Therefore, since blood pressure (BP) is among the most vital physiological indicators that reflect the cardiovascular situation, its continuous measurement is very crucial. It can be a true indicator of many health issues, such as hypertension, heart attack, asthma, and kidney failure [1].

Several methods are available for BP monitoring. The most prevalent techniques are intra-arterial catheter insertion, auscultation, oscillometry, and volume clamping.

The intra-arterial catheter insertion approach requires the insertion of a catheter in a vessel. The method makes accurate and continuous BP reading possible. It was first practiced by Hales *et al* by inserting tubes into some animal vessels in 1733.

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In this chapter, we develop several architectures based on deep neural networks (DNN). Through discussing their advantages and drawbacks, we try to develop more appropriate models to meet the demands of the British Hypertension Society and the Association for the Advancement of Medical Instrumentation standards. The building blocks of our models are convolutional neural networks (CNN) and long short-term memories (LSTM). We evaluate our models on 200 subjects.

The following models for BP estimation are discussed here:

1. LSTM Model
2. PCA-LSTM Model
3. CNN Model
4. CNN-LSTM Model

To access the processed data used here, refer to the following "Google Drive" links:

https://drive.google.com/file/d/18vgqywmqlArXRX5M7l_WJSd5WH8dM1xe/view?usp=sharing

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