Chapter 20
Role of Artificial Neural Network for Prediction of Gait Parameters and Patterns

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ABSTRACT

Walking is very important exercise. Walking is characterized by gait. Gait defines the bipedal and forward propulsion of center of gravity of the human body. This chapter describes the role of artificial neural network (ANN) for prediction of gait parameters and patterns for human locomotion. The artificial neural network is a mathematical model. It is computational system inspired by the structure, processing method, and learning ability of a biological brain. According to bio-mechanics perspective, the neural system is utilized to check the non-direct connections between datasets. Also, ANN model in gait application is more desired than bio-mechanics strategies or statistical methods. It produces models of gait patterns, predicts horizontal ground reactions forces (GRF), vertical GRF, recognizes examples of stand, and predicts incline speed and distance of walking.

INTRODUCTION

Ergonomics is the study of individuals at work. This field got its name in the mid-year of 1949 when a group of intrigued people gathered in Oxford, England to discuss human performance and its limits. Ergonomics comes from Greek word 'Ergo' and 'Nomics'. 'Ergo' implies work and 'Nomics' implies study. A few specialists define the objective of ergonomics and as designing machines to fit the human operator requirements. However, it is also necessary to fit operations to machine in the form of personnel channel selection and training. It is probably more accurate to describe this field as the study of human machine systems, with an emphasis on the human aspects. Ergonomists deals with the fact that people

come in different sizes and shapes, varying greatly in their strength, endurance and work capacity. A basic understanding of human anatomy, physiology and psychology can help ergonomists to find solutions that deal with these issues and help to prevent problems that can cause injury to workers. Scope of this problem, can be studied by considering some of the components system terms by the human body. Walking is very important exercise associated with human being. There are different types of walking i.e. Brisk walking, Treadmill waking, Interval walking, Water walking and Hill walking. Human want to walk for the purpose of the health benefits also. The human being has a stride length of 640.08 to 742mm, it take over 2000 steps to walk one mile. On an average a person covers 10,000 steps a day. Human foot movement is based on the gait cycle. Walking is characterized by Gait. Locomotion produced through the movement of human limbs. Gait defines the bipedal and forward propulsion of center of gravity (COG) of the human body. Natural gaits are of two types i.e. Walk and skip. The healthy person up to 6 years follows walking while under age of the 4 to 5 years called as skipping by children. The various stages of the gait cycle show in Figure1 are Heel contact, Flat foot, Mid-stance, Heel off and Toe off.

- **Heel Contact:** The starting of the stance phase is called the heel-strike because there is an impact between the heel and the ground.
- **Foot Flat:** After heel contact, the rest of the foot comes in contact with the ambulatory surface at foot flat. This generally occurs at about 8% of the gait cycle, just before toe off of the opposite leg. During the interval between heel strike and foot flat the GRF increase rapidly in magnitude.
- **Mid Stance:** The period of time between foot flat and heel off which occurs at about 30% of the gait cycle. At this point, the swing phase leg passes the stance phase leg.
- **Heel Off:** When the heel begins to lift from the walking surface. It occurs between 40-50% of the gait cycle.
- **Toe Off:** This occurs at about 60% of the gait cycle when the stance phase ends and swing phase begins. This phase is also commonly called the push off phase.
- **Mid Swing:** This is the opposite of mid-stance as the mid-swing on one leg corresponds to the mid-stance of the other. It is the time when the swinging leg passes the stance leg.

Figure 1. Various stages of the gait cycles (Marco, Augusto, Fabio, Giovanni, Carlo, Stefano, & Antonella, 2013)
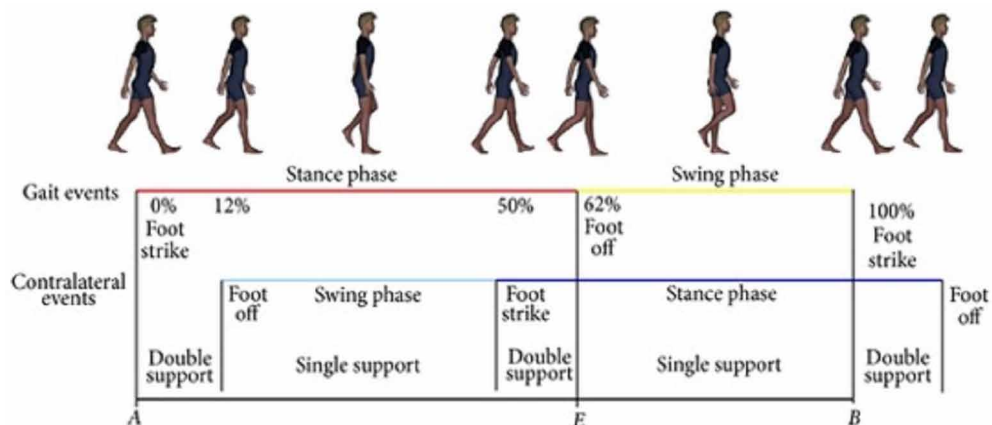
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