CHAPTER 7
TECHNOLOGY FOR GAIT ANALYSIS

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7.1 INTRODUCTION

The way an individual move is commonly referred to as their gait. Human gait classification represents a significant area of scientific exploration, employing diverse approaches to examine and analyse gait patterns during various locomotion activities like walking, running, and climbing (Gupta & Semwal, 2020). Walking on two feet, known as bipedal locomotion in humans, represents a fundamental trait that extensively engages both motor skills and adaptability. It stands as perhaps the most performed physical activity worldwide, capturing the attention of numerous scientists (Cereda, 2024).

The manner of walking, known as gait, is recognised as a prevalent characteristic among anthropoids. However, when viewed analytically, it holds significant potential as one of the intricate phenomena deserving thorough examination and scrutiny, as highlighted (Sethi et al., 2022). The gait integrates multiple interdependent sensory inputs and requires coordination of the motor outputs to achieve efficient, stable, and adaptive locomotion. The deterioration of human gait can severely affect people mobility, reduce a person level of activity, and affect their quality of life (Wang et al., 2024). An individual gait pattern can be

influenced by factors such as age, weight, health condition, gender, social context, and geographical circumstances.

The gait cycle is made up of various sub-events. The gait cycle consists of two primary stages, namely the stance phase and the swing phase. Each stage is further divided into three segments: the beginning, the middle, and the end. In the stance phase, both feet contact the ground, which is also referred to as the double support phase. Conversely, in the swing phase, also known as the single support phase, one limb remains grounded while the other is raised, initiating the subsequent motion (Gupta & Semwal 2020).

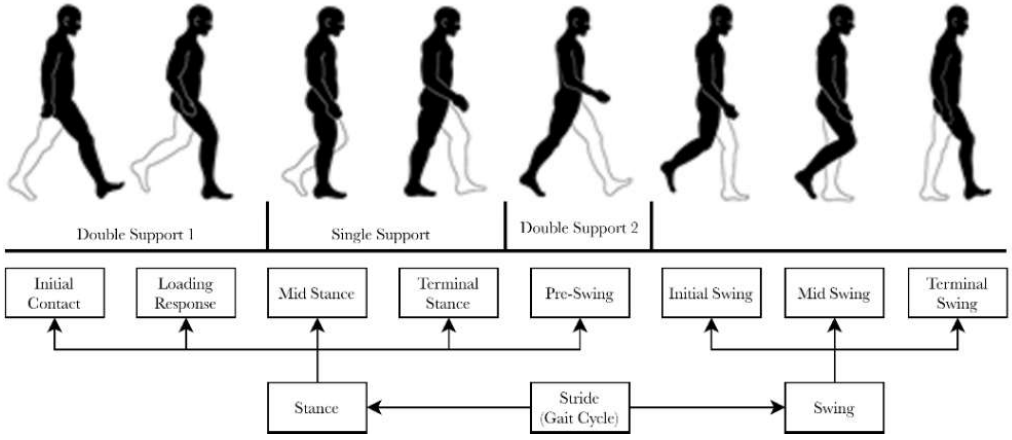

Figure 7.1 Functional divisions of the gait cycle (Source: Perry & Burnfield, 2024)

7.2 GAIT ANALYSIS

Gait analysis refers to a series of procedures used to observe, record, analyse, and interpret movement patterns associated with walking. Traditionally, its objectives include understanding movement control, enhancing performance, diagnosing movement disorders, and assessing the effectiveness of treatment and rehabilitation programmes. Clinical gait analysis, more specifically, involves recording and interpreting biomechanical data on gait to evaluate the impact of diseases and dysfunctions. The biomechanics data often require more sophisticated technology to measure.

In general, gait analysis will refer to these three main parameters: (1) Spatiotemporal parameters, (2) Kinematic parameters, and (3) Kinetic parameters. Spatiotemporal parameters refer to measurements that describe the spatial (distance-related) and temporal (time-related) characteristics of walking. Table 7.1 shows spatiotemporal parameters that are commonly used for gait analysis. Meanwhile, kinematic parameters refer to the study of motion without considering the forces causing it, such as joint angles, angular velocity and linear displacement. For kinetic parameters, clinicians or researchers often measure parameters such as ground reaction force, joint moments, joint power and centre of pressure. These parameters reveal the causes of abnormal movement, a comprehensive view of gait mechanics and enable precise diagnosis in clinical and research settings. Therefore, a holistic understanding of these parameters allows practitioners to accurately assess gait abnormalities, evaluate treatment effectiveness, and develop evidence-based rehabilitation strategies tailored to individual patient needs.

Table 7.1 Spatiotemporal parameter for gait analysis

Variable	Units	Definition
Velocity	metre/second	Distance is covered by the time to ambulate.
Cadence	steps/minute	Number of steps by the time to ambulate.
Stride Length	metre	Distance between heel points of two consecutive footfalls of the same foot.
Step Length	metre	Anteroposterior distance between the heel points of two consecutive footfalls of the opposite foot.
Step Width	metre	Mediolateral distance between the heel points of two consecutive footfalls of the opposite foot.
Stride Time	seconds	Duration to ambulate one stride length.
Step Time	seconds	Duration to ambulate one step length.
Double Support Time	seconds	Duration of when both limbs are in contact with the ground.