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Chapter I

Overview of Movement Analysis and Gait Features

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ABSTRACT

This chapter provides an overview of the commonly used motion analysis approaches and techniques and the key features that are extracted from movement patterns for characterizing gait. The ultimate goal of gait analysis should be to provide reliable, objective data on which to base clinical decisions (Kaufman, 1998). Thousands of gait features/parameters have been used over the years. Selection of the correct gait features forms an important part of the research process, and often the success of the research outcomes depends heavily on selecting the most appropriate gait features. Analysis tools based on both statistical and machine-learning techniques use various types of gait features, ranging from the basic and directly measurable parameters to parameters that have undergone significant data processing and treatments. In this chapter, we attempt to introduce the commonly used methods to extract these features for use with the various statistical and computational intelligence analysis tools.

INTRODUCTION

Walking is one of the most common and most important forms of human movement. Gait analysis entails measurement, analysis and assessment of the biomechanical features that are associated with the walking task. Significant technical and intellectual progress has been made in the area of gait analysis over the past few decades, especially because of advances in computing speed which in turn has aided the development of more advanced movement-recording systems that require less data processing time. Improved computing speed has also made feasible and inspired increasingly complex and innovative gait data analysis techniques.

As a consequence of the vastly improved gait analysis techniques over recent decades, there has been an exponential increase in the number of applications of gait analysis, some examples of which include: assessment of treatment outcomes (e.g., following anterior cruciate ligament reconstruction, Knoll et al., 2004, and hip joint surgery, Kyriazis & Rigas, 2002), evaluation of the orthotic and prosthetic alignment on the lower limbs (Johnson et al., 2004) and falls risk assessment (Maki, 1994). Gait analysis is used in disability/injury management programs, for initial assessment of gait function, monitoring of progress (e.g., post-surgery), and discharge testing (e.g., prior to leaving hospital or returning to work). It can also be used to screen healthy individuals and is used in a preventative medicine/health screening context (e.g., falls risk assessment). In general, gait analysis is considered an acceptable tool for kinesiologic analysis of movement disorders, including for evaluating gait and posture disturbances.

In recent times there has been a surge in health care costs around the world associated with gait-related issues. One major problem in this regard, has been identified as falls in the aging population (Fildes, 1994). In Australia, falls have a larger injury-

Figure 1. Direct medical costs of all injuries in Australia (adapted from SRDC, 1999)