The Development and Testing of a Forensic Interpretation Framework for use on Anthropometric and Morphological Data Collected During Stance and Gait

A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy

By

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Certificate of Original Authorship

I, Dilan Seckiner declare that this thesis, is submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the Centre for Forensic Science/Mathematical and Physical Sciences at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

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Thesis by Compilation Declaration

The following publications will be included in the thesis titled 'The Development and Testing of a Forensic Interpretation Framework for use on Anthropometric and Morphological Data Collected During Stance and Gait' in the form of a thesis by compilation. PhD candidate Dilan Seckiner researched, wrote and edited the publications, while Dr Philip Maynard, Dr Xanthé Mallett, Prof Claude Roux and Prof Didier Meuwly all contributed their feedback, provided valuable guidance and their edits to the articles. Both of the following publications were accepted and published in Forensic Science International and will be included in chapter 1 of this thesis.

Forensic Image Analysis - CCTV Distortion and Artefacts (Accepted)

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Forensic Gait Analysis - Morphometric Assessment from Surveillance Footage (Accepted)

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Abstract

The ubiquitous nature of surveillance cameras allows continuous monitoring of an area where footage can be obtained for later use, if criminal or other activity of interest occurs, for investigative and evaluative purposes. In the process, gait is often important as facial analysis is not always possible due to obstruction of the face. Subsequently, a photo-comparative analysis of the footage and of a Person of Interest (POI) may be required. Such examination involves evaluation of the strength of evidence at both activity and source level, thus underlining its importance.

The aim of this PhD research is to assess and improve the scientific approaches applicable to forensic gait analysis through the investigation and development of an interpretation framework. The specific objectives include the development of an analytical model for morphometric body and gait analysis that shows distinctive features of gait in a forensic context, whilst determining features of the body during stance and gait (walk and run). The method includes a morphometric assessment of 25 anthropometric measurements (static and dynamic), 35 morphological features for stance and 51 morphological features for gait (male/female volunteers). Furthermore, the frequency, distinguishability and dependency of features within subpopulations were observed whilst viewing correlations of age/ethnicity/sex and examining the robustness of gait to different conditions (accessories, and environment) in forensic scenarios (speed and attire [hoodie] performing the best).

As a result, a standardised protocol was produced, and population databases established from which frequency statistics were attained. Moreover, features were observed as either common or distinct (most distinct observed as in-toeing of the feet and lateral placement of the hand) once compared to all age (85.39% predictive accuracy), ancestry (94.57% predictive accuracy) and sex (98.5% predictive accuracy) categories for correlation assessment. These components were then applied to assess the strength of evidence between the trace and the reference materials, resulting in a likelihood ratio score.

As a forensic tool, the forensic gait analysis method often lacks validation and its evaluation misses empirical substantiation. Nevertheless, the availability of trace material in numerous cases and the potential for development of the method suggests that research in this topic cannot be overlooked. The broader purpose of this study established a method of evaluating gait analysis

that offers valuable information to the criminal justice system whilst being scientifically robust and highlighting its limitations.