

# **The Design, Construction and Assessment of a Sprint Kayaking Balance Training Aid**

By

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A Doctoral Thesis

Submitted in partial fulfilment of the requirement for the award of  
Doctor of Philosophy of Loughborough University

November 2013

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## Abstract

The main purpose of this study was to develop and assess an on-land training aid for learning balance in sprint kayaking. The literature has shown the importance of biomechanical analysis and how training aids can provide a beneficial part in the learning process of new skills. An on-water experimental analysis was conducted on experienced paddlers to establish the kinematic characteristics and the centre of rotation position of the kayak-paddler system. From this analysis it was found that the kayak rolling motion is dependent on the paddler's ability and the centre of rotation of the kayak paddler system relative to the seat of the kayak was found to be between 10 cm – 13 cm above the seat. Findings from this analysis were interpreted into technical requirements and integrated into the design of the training aid. Once built the training aid prototype was evaluated by a series of testing and modification to enhance its ability to replicate the on-water kayak. The evaluation data showed that the stationary sprint kayak on-water medial-lateral rolling motion is affected by weight variations and further evaluation demonstrated that the training aid has the ability to replicate the motion for different weights. An experimental assessment on a group of beginners was carried out and the results showed that the training aid was able to facilitate the learning of balance in sprint kayaking. The experimental subjects who used the balance training aid had the same total number of sessions as the control subjects who learned to balance in the actual sprint kayak (experimental,  $9 \pm 1$  sessions; control,  $9 \pm 1$  sessions). However, the experimental subjects only spent half of the total number of sessions learning on-water ( $4 \pm 1$  sessions) and the other half on the training aid ( $5 \pm 1$  sessions).

*Key words: sprint kayak, training aid, balance, equipment design.*



### Conference Presentations

Dasril, B., King, M.A. and Yeadon, M.R. 2011. "Centre of rotation for sprint kayak medial-lateral (rolling) balancing motion". *Proceeding of the 26th Biomechanics Interest Group of the British Association of Sport and Exercise Sciences: 2011*, pp 24.

Dasril, B., King, M.A. and Yeadon, M.R. 2011. "Kinematics of stationary sprint kayak medial-lateral balance control". *Proceeding of the 27th Biomechanics Interest Group of the British Association of Sport and Exercise Sciences: 2012*, pp 25.

### Workshop Presentations

Dasril, B., King, M.A. and Yeadon, M.R. 2011. "Balance control in sprint kayaking and development of sprint kayak balance training aid". *Workshop Leader Proceeding of the 2012 Canoe England Coaching Conference, 24<sup>th</sup> and 25<sup>th</sup> November*; pp 2.

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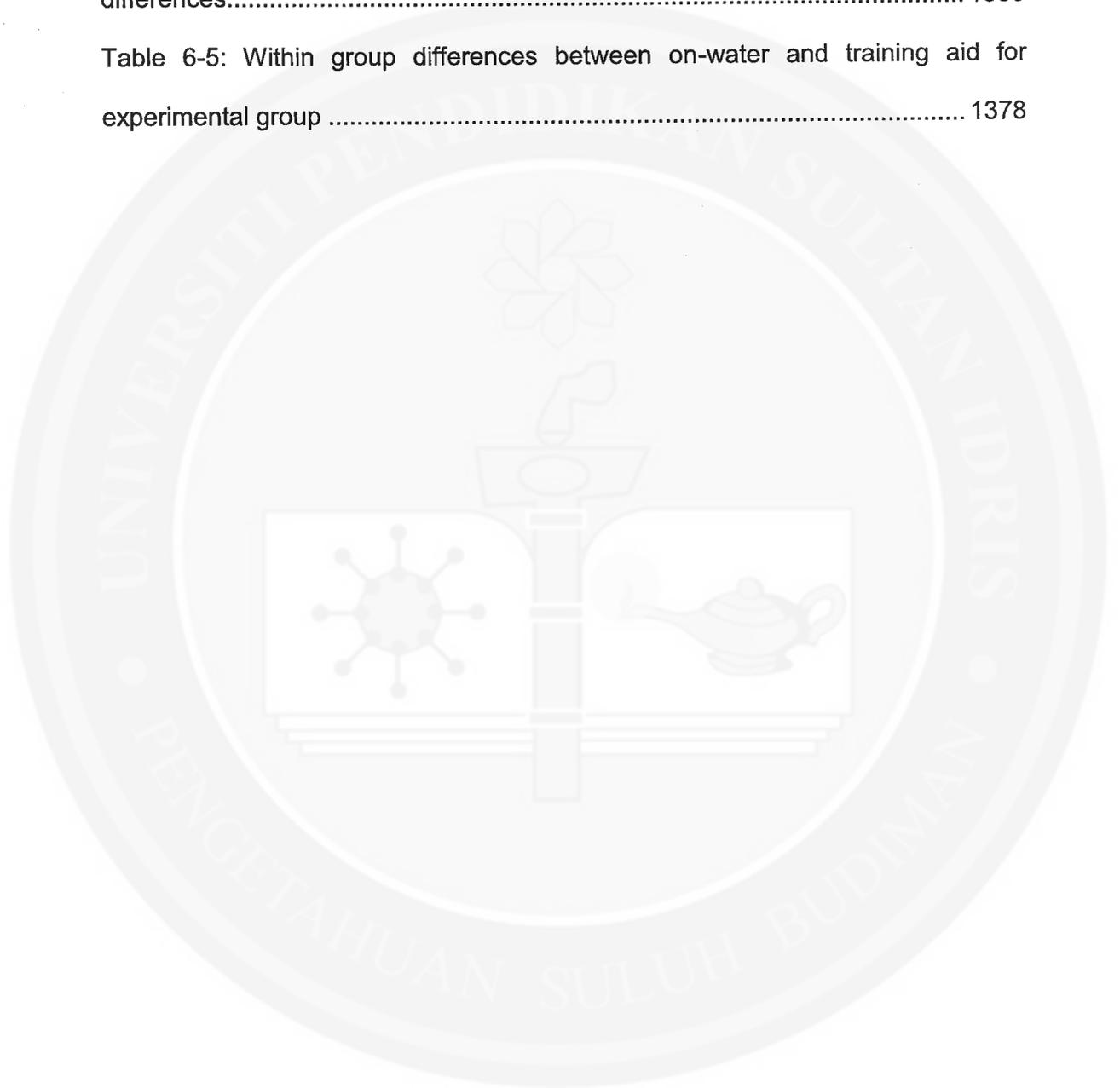
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# Chapter 1

## Introduction

### 1.1 Chapter overview

This chapter presents an overview of balance in sprint kayaking. Also included in this chapter are the statement of purpose and specific research questions. To provide an overview of the structure of this thesis, the organisation of chapters is described.

### 1.2 Background of study

Sprint kayak primary design considerations are acceleration and maximum speed (Szanto & Henderson, 2004). For these reasons sprint kayaks are built relatively long, narrow and lightweight. A long and narrow cross-section of the kayak results in instability but provides greater speed while a short and wide kayak tends to be more stable and slower. The speed and acceleration of the kayak moving over water is a function of the force of the paddling, and the effect of the drag/friction created against the hull of the kayak as it passes through the water. The greater the drag, the more power is required to move the kayak at the same speed. However the International Canoe Federation has established and enforced rules for kayak design to create an equal opportunity and to ensure that the athletes determine the outcome of competition, not the design of the kayak (Szanto & Henderson, 2004).





evaluate a balance training aid that can simulate the real medial-lateral angular (rolling) movement of the kayak.

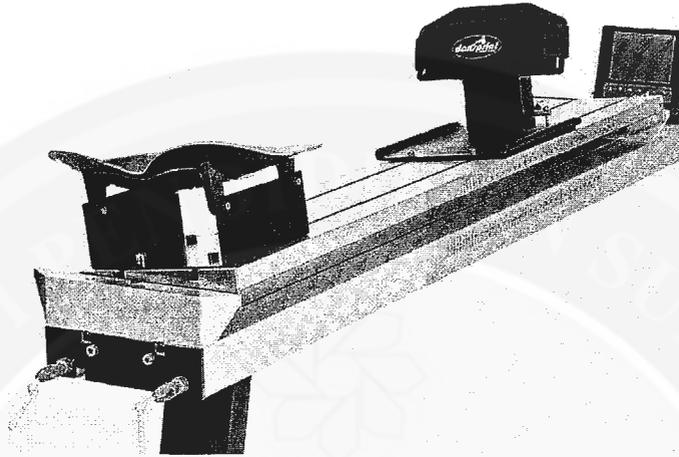


Figure 1-1: Dansprint Balance (adapted from [www.dansprint.com](http://www.dansprint.com)).

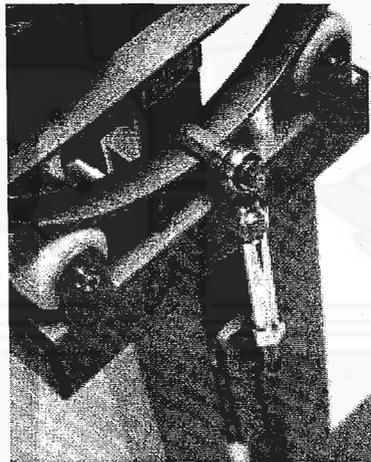


Figure 1-2: Dynamic Balance (adapted from [www.landkayak.co.uk](http://www.landkayak.co.uk)).

### 1.3 Statement of purpose

The purpose of this study is to develop and assess an on-land balance training aid for sprint kayaking.

#### 1.4 Research question

**Question 1:-** *What are the characteristics of on-water kayak-paddler motion and where is the centre of rotation of the kayak-paddler system relative to the seat of the kayak?*

In order to design a suitable and reliable sprint kayak balance training aid, the fundamental kinematic characteristic of the kayak and the paddler motion during on-water balancing need to be established. It has been determined that the medial-lateral rolling motion has the greatest effects on the kayak balance and stability (Baker, 2012; Michael et al., 2009). Two dimensional motion analysis is the most appropriate method used to determine the on-water kayak-paddler motion characteristic and the optimal centre of rotation height relative to the seat of the kayak.

**Question 2:-** *Is the on-water kayak rolling motion affected by weight variations?*

The sprint kayak balance training aid should be able to accommodate a wide range of paddler's size and weight. Therefore, further analysis on the kayak medial-lateral rolling motion with additional weight variations is conducted to validate the effects.

**Question 3:-** *Can the sprint kayak balance training aid prototype replicate the medial-lateral rolling motion of the stationary sprint kayak?*

A training aid should simplify the movement task by permitting individual degree of freedom and should successfully fulfil all identified requirements (Yeadon et al., 2012). Moreover, it should replicate the motion of the task in its real environment.

Therefore, in-depth evaluation of the prototype sprint kayak balance training aid should provide more information on its reliability.

**Question 4:-** *Does the sprint kayak balance training aid facilitate the learning of balance for a beginner paddler?*

An experimental assessment enables the researcher to determine the functionality of the prototype sprint kayak balance training aid. A balance training programme is administered to complete beginners using the training aid and compared with on-water training using the same programme.

## 1.5 Chapter organisation

Chapter 2: Literature review

This chapter will discuss details of relevant reviewed literature. It also contains several topics which are considered important in the development process of sprint kayak balance training aids. The chapter also provide information specifically related to this study.

Chapter 3: On-water analysis of stationary sprint kayak.

The purpose of this chapter is to establish scientific information on stationary sprint kayak on-water motions during balancing. The information gained will be integrated into the design of the balance training aid.

Chapter 4: Sprint kayak balance training aid design and construction.

This chapter discusses in detail the design procedure undertaken during the development of the sprint kayak balance training aid. An experimental evaluation