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Tackle and impact detection in elite Australian football using wearable microsensor technology

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Abstract
The effectiveness of a wearable microsensor device (MinimaxXTM S4, Catapult Innovations, Melbourne, VIC, Australia) to automatically detect tackles and impact events in elite Australian football (AF) was assessed during four matches. Video observation was used as the criterion measure. A total of 352 tackles were observed, with 78% correctly detected as tackles by the manufacturer’s software. Tackles against (i.e. tackled by an opponent) were more accurately detected than tackles made (90% vs 66%). Of the 77 tackles that were not detected at all, the majority (74%) were categorised as low-intensity. In contrast, a total of 1510 “tackle” events were detected, with only 18% of these verified as tackles. A further 57% were from contested ball situations involving player contact. The remaining 25% were in general play where no contact was evident; these were significantly lower in peak Player Load™ than those involving player contact (P < 0.01). The tackle detection algorithm, developed primarily for rugby, was not suitable for tackle detection in AF. The underlying sensor data may have the potential to detect a range of events within contact sports such as AF, yet to do so is a complex task and requires sophisticated sport and event-specific algorithms.

Keywords: accelerometer, contact sport, collision, event detection algorithm, player load

Introduction
Contact sports such as rugby league, rugby union and Australian football (AF) involve repeated physical collisions, many of which are the result of tackling. The frequency and nature of tackling in rugby league (Gabbett, 2008; Gabbett, Jenkins, & Abernethy, 2011a; Gabbett, King, & Jenkins, 2008) and rugby union (Hendricks, Karpul, Nicolls, & Lambert, 2012; Hendricks & Lambert, 2010) have been well documented, including links with muscle damage (McLellan, Lovell, & Gass, 2011; Takarada, 2003) and injury (Gabbett, Jenkins, & Abernethy, 2011b; Gabbett & Ryan, 2009; Gissane, Jennings, Kerr, & White, 2002). Skeletal muscle damage appears to be highly dependent on the number of heavy collisions in rugby league, with 46–91% of injuries shown to occur during tackle events (ball-carrier and tackler) (Gabbett, 2004). The tackle in rugby union is the most frequent contact event and is responsible for the highest number of injuries and greatest loss of playing time (Best, McIntosh, & Savage, 2005; Brooks, Fuller, Kemp, & Reddin, 2005). As a single event though, collisions and scrums pose a greater risk of injury than the tackle (Fuller, Brooks, Cancea, Hall, & Kemp, 2007). Positive correlations between the number of tackles and indirect markers of muscle damage (plasma creatine kinase and myoglobin) have also been observed (Takarada, 2003). AF has seen an increase in the number of tackle events per match since 2000, likely a result of rule changes, an increased emphasis on “possession” football and the perceived importance of tackling to performance outcomes (Gray & Jenkins, 2010). This increase in tackle events per match has been linked to the rising trends of collision, shoulder and soft-tissue injuries (Orchard, Seward, & Orchard, 2012).

The use of wearable microsensor technology is becoming increasingly popular in field team sports to monitor players and assess the physical work demands of training and competition (Aughey, 2011; Gabbett, 2013; Gastin, Fahrner, Meyer, Robinson, & Cook, 2013). Commercially available devices typically integrate a number of sensors into a single, small device that is worn on the upper trunk in a custom-made vest or stitched within the playing...