

# Abstract

The drop jump ratio is a metric used to measure fatigue by finding how quickly and forcefully a person can reverse their momentum after dropping off a raised platform. Most commonly used for competitive athletics, the drop jump ratio is useful for tracking performance over time. The current method for measuring the drop jump ratio requires a force plate to find when a participant touches and leaves the ground. Force plates are expensive devices, which therefore restrict the drop jump ratio metric to those that can afford the tools to measure it. The PlayerTrak project explores how wearable computing could be used to provide a larger population access to drop jump ratio data by examining the feasibility of using commercially available accelerometers to measure the metric. This research will show initial results comparing drop jump ratios measured with a worn accelerometer and a force plate in a biomechanics lab.

### Background

The PlayerTrak project focused on plyometric exercise known as the drop jump (DJ). This activity is performed by having a participant step off a raised platform and jump as soon they reach the ground. The time the participant is on the ground compared to the time they are in the air is then used to find the drop jump ratio (DJR). The drop jump was chosen over other plyometric exercises such as the counter movement jump (CMJ) or plyometric jump (PMJ) because unlike the CMJ or PMJ, the DJ is a dynamic exercise that can similarly be measured with a single piece of equipment.

# Data Analysis

**Accelerometer Algorithm** 

First and second landing points are found where accelerometer data peaks.

A moving average is applied to the dataset. This makes for a more accurate estimation of the takeoff point.

Takeoff point is found at moving average peak using the landing points as an interval to search over.

#### Force Plate Algorithm



#### PlayerTrak: Measuring the Drop Jump Ratio with Inertial Measurement Units Stephen Mitchell and Dr. Jason Forsyth James Madison University, Department of Engineering

First landing point is found based on when force reading becomes non-zero.

Takeoff is found based on when force reading returns to zero.

Second landing point is found based on when force reading becomes non-zero

### **Experimental Method**



Figure 1 (above) The physical process to perform a drop jump. The participant steps off a raised platform, hits the ground, and jumps as soon as possible.







Figure 3 (above) The graph generated from force plate readings as a drop jump is performed.

# Results

Accelerometer Data											
Trial	Initial	Takeoff	Landing	Time on	Time in	Total					
Number	Landing (ms)	Point (ms)	Point (ms)	Ground (ms)	Air (ms)	Time (ms)	DJN				
1	0	533	978	533	445	978	0.835				
2	0	511	942	511	431	942	0.843				
3	0	490	926	490	436	926	0.890				
4	0	423	902	423	479	902	1.132				
5	0	467	926	467	459	926	0.983				
Table 1 (above) Result of raw data from accelerometer processed by algorithm to find landing and takeoff											

points.

Force Plate Data											
Trial	Initial	Takeoff	Landing	Time on	Time in	Total					
Number	Landing (n	ns) Point (ms)	Point (ms)	Ground (ms)	Air (ms)	Time (ms	) DJN				
1	0	536	956	536	420	956	0.784				
2	0	525	960	525	435	960	0.829				
3	0	507	969	507	462	969	0.911				
4	0	544	977	544	433	977	0.796				
5	0	507	995	507	488	995	0.963				
Table 2 (above) Result of raw data from force plate processed by algorithm to find landing and takeoff points.											
Drop Jump Ratio Error											
		Trial 1	Trial 2	Trial 3	Trial	4 1	<b>Frial 5</b>				
DJR E	<b>Error</b> 0.05		0.01	-0.02	0.34 (		0.02				
<b>DJR % Error</b> 6. <sup>-</sup>		6.15%	1.76%	2.41%	29.71% 2		2.07%				
Table 3 (above) Error between algorithmically labeled datasets. Force plate data used as actual data.											



Based upon these initial results it is promising to believe that an accelerometer can be used as a proxy for a force plate for calculating the drop jump ratio. Approval for a human subject study has been received and will be carried out over the next few months. Additional analysis with multiple subjects will provide insight into how the DJR calculation may vary based upon each subject's body mechanics and how much calculation error can be expected between the force plate and the accelerometer across the general population.



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#### Conclusions

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