

# Measurement of Gait and Running Mechanics in Elite Distance Runners: Utilization of Accelerometer Technology

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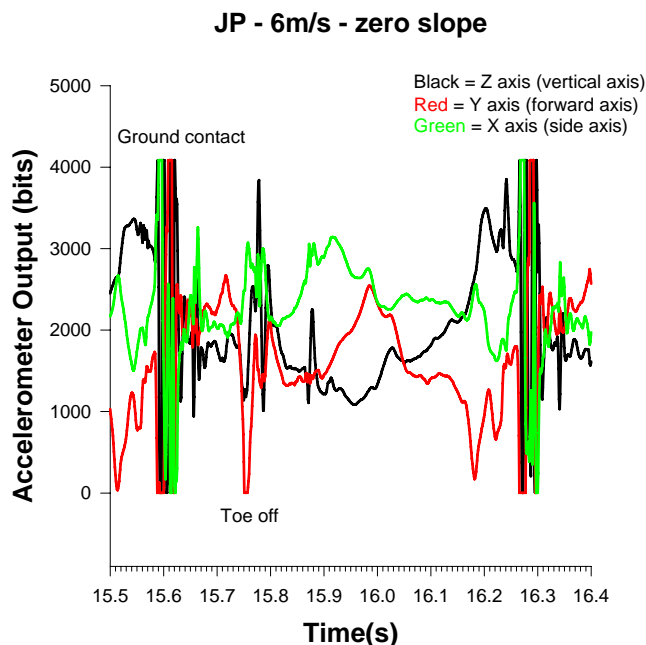
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## Introduction / Purpose

At the 2008 NPEP Conference, I presented information on a new application for accelerometer technology, designed to accurately measure variables related gait and running mechanics. This 2009 talk will focus on the results of studies and measurements we have completed over the last year.

## Methodology

Accelerometers are relatively new devices which allows for very precise measurements of motion. Recently, accelerometer technology has advanced significantly, making these devices small, light, and portable enough to be placed upon the top of a shoe to measure force due to motion. These accelerometers have no wires and can either store data in internal memory or transmit data wirelessly to a computer, allowing for measurements to be taken on a track in a real competitive or workout situation. The sampling rates of these devices can exceed 1000 Hz, allowing for sensitivity to measure ground contact time while running accurately to the nearest thousandth of a second. As an example, note the output data (graph below) from an accelerometer placed on top of a runner's foot. After extensive testing on a large pool of runners, we have determined the various "signatures" athletes exhibit, and we can determine the exact time point of initial ground contact and toe-off.



Additionally the same data from the accelerometer can be used to calculate swing time (i.e. flight time), stride frequency, and (if distance covered is known) stride length.

## **Protocols**

### Characterization

The first step in this project has been to characterize variables related to running mechanics (i.e. ground contact time, swing time, stride length, and stride frequency) in various groups of distance runners. Data will be presented at the NPEP conference comparing the variation in individual athlete responses, men versus women, elite versus collegiate athletes, and middle distance versus long distance athletes

### Intervention

The next step in the project has been utilizing various interventions to see if variables related to running mechanics can change, either with a short term or long term intervention. Data will be presented comparing: responses when athletes are “fit” versus “unfit”, before and after a fatiguing workout, before and after altitude training, and before and after wearing calf compression sleeves (in an attempt to change the stiffness of the calf / leg).

### Relation to running economy

We have been able to simultaneously measure running economy with running mechanics measures. Data will be presented on how different patterns of running mechanics affect running economy, with a discussion of how altering mechanics may be both positive and negative in terms of metabolic cost.

## **Critical Zone Application**

A partial list of potential application of project results to the critical zone for endurance events:

1) Identification of ground contact times in our best distance runners.

- Can success in the critical zone be explained by shorter ground contact times?
- Do certain elites have significantly longer ground contact times than their peers, thus making possible mechanical interventions more likely to improve performance in the critical zone?

2) Changes in ground contact times in elites as the runner fatigues over the course of a race.

- Does a change in ground contact time with fatigue as the critical zone is approached affect finishing speed / performance inside the critical zone?
- Do changes in stride length, stride frequency, and aerial time also affect performance in the critical zone?

- Are some athletes better able to reduce ground contact time within the critical zone? What characteristics do they have that enable them to do so?
- If ground contact times get longer over the course of a race in our top distance runners, coaches/athletes can be informed and can look to modify training to overcome this change.

### 3) Changes in ground contact time after altitude training.

- Does ground contact time explain why many athletes feel neuromuscularly slower immediately after an altitude training camp?
- Can we identify the time course of ground contact time changes after an altitude camp, better helping elite athletes time altitude camps prior to key races?