



## Runway Velocities and Force Plate Analysis of Olympic Caliber Horizontal Jumpers

Presented by

**Professor Emeritus Melvin R. Ramey**

2008 USA Olympic Track and Field Trials Super Clinic  
Eugene, OR

M. R. Ramey  
July 2008

### Background

Current testing taking place at the USOC Training center in Chula Vista, as part of the High Performance program, is capturing the ground reaction forces as well as quantifying the approach and take-off velocities. High speed digital videography is synchronized with the force records to produce new insights about the take-offs. We are coupling this information with the knowledge available in the coaching and scientific literature and applying it to individual athletes.

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### Goals

- Provide important quantitative and qualitative data to individual coaches and athletes that is generated during the support phases of their horizontal jumps
- Quantify the nature of the Ground Reaction Forces (GRF) for high performance athletes
- Quantify the velocity changes during the last two support phases of the long jump
- Quantify the velocity changes during the three support phases of the triple jump

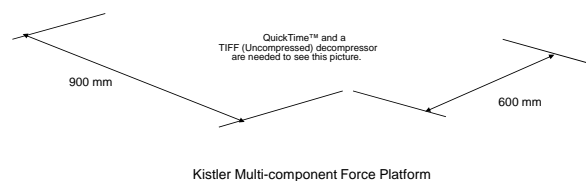
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### Goals (cont'd)

- Use high speed digital videography to study jump execution during the support phases
- Synchronize videography and GRF records to gain insights on takeoff mechanics
- Quantify various parameters that the scientific staff can use in their mathematical and computer based models of the horizontal jumps

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### Instrumented Runway



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### Instrumented Runway



Force Platform Installation

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*Instrumented Runway*



Force Platforms at LJ Takeoff      View of a Completed Setup

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*Instrumented Runway*



Data Being Collected

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*Program*

- Four sessions to date:  
 March 2006  
 April 2006  
 February 2007  
 July 2007
- Sixteen women(11 LJ, 5 TJ), five men(3 LJ, 2 TJ)
- Most jumps taken with a full approach
- Videos, force records and velocity measures were provided to the athletes as quickly as possible after the sessions

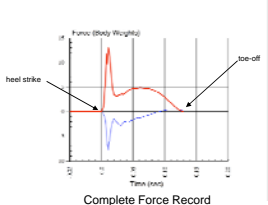
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*Long Jump*

The ground reaction forces are critically important in the development of the velocities. Typical force records are shown below



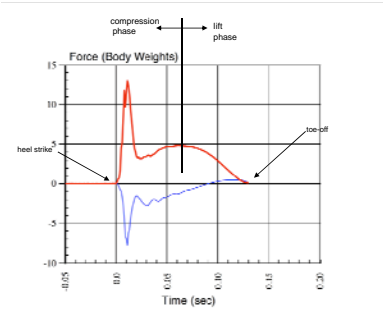
Athlete at toe-off



Complete Force Record

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*Long Jump*



Typical Force record

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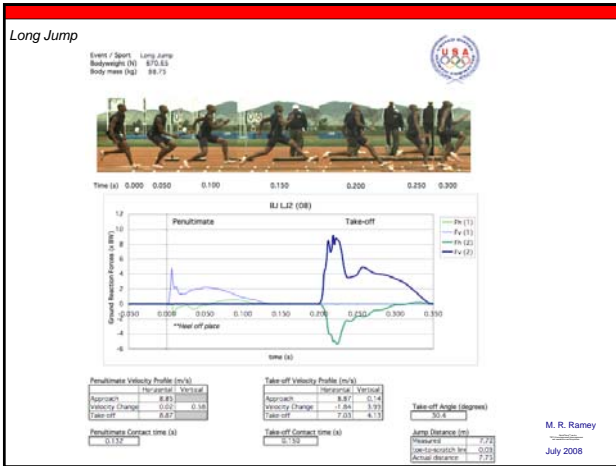
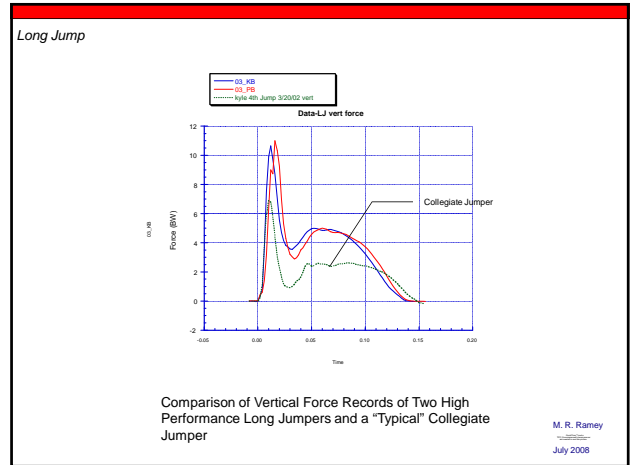
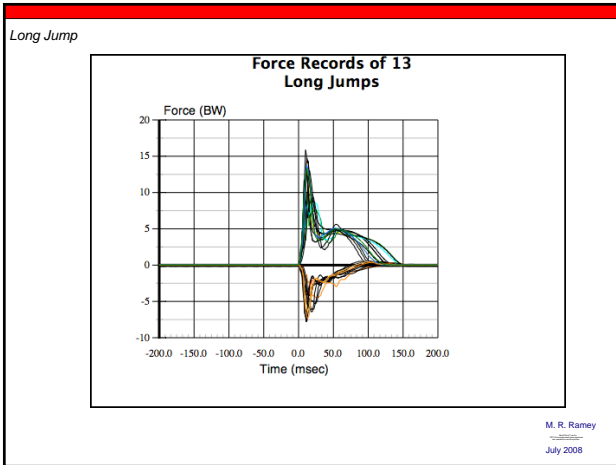
*Long Jump*

Observations:

- The horizontal force can produce a significant loss of horizontal velocity, therefore must be carefully managed
- The forces are primarily a result of a compression of the support leg complex
- "Compression" of the support leg must be sustained long enough to generate a sufficiently large vertical impulse--it appears that the support should last about 0.13-0.15 seconds

We will demonstrate these observations shortly.

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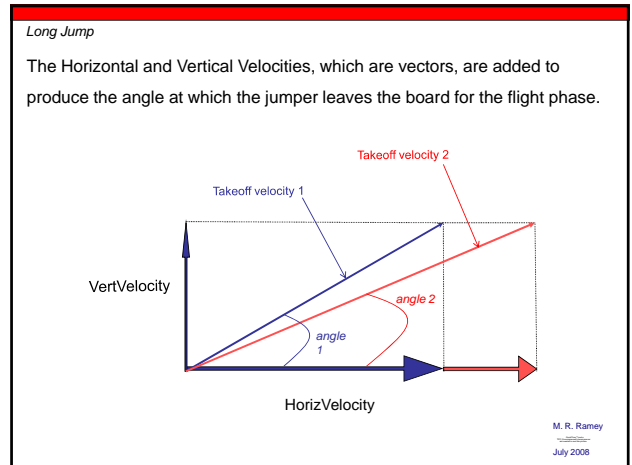


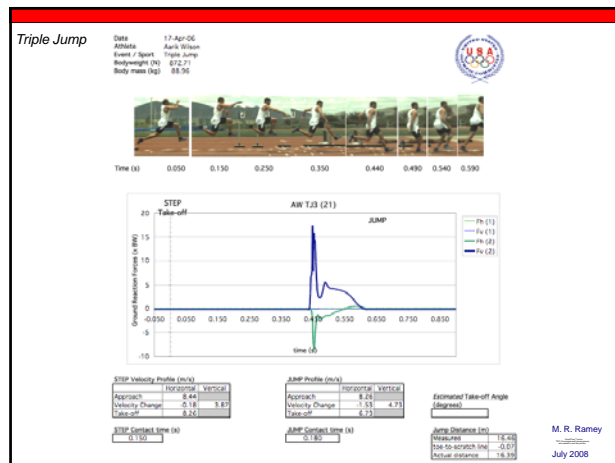
Long Jump

**A Comment About the Takeoff Angle:**

The takeoff angle should be thought of as a result of actions NOT the cause of actions. This is so because the takeoff angle is the result of the addition of the horizontal and vertical takeoff velocities in the special way in which vectors are added. The independently created horizontal and vertical velocities are the important cause actions. Let me illustrate.

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- Triple Jump**
- Notes:
- 1) The GRF is exceptionally large
  - 2) The shape of the GRF is similar to the long jump's but each phase has a different magnitude and duration
  - 3) Horizontal force losses are quite different in each phase
  - 4) The jumper used a jump-dominated technique
  - 5) A jumper must be able to sustain support leg compression in both legs especially in the last two phases
  - 6) The GRF record shown is one of the few available--more data like this are needed to enable us to move forward in enhancing performances and mitigate injuries
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- Concluding Remarks**
- The videos are provided to the athletes/coaches shortly after the sessions. Force records and subsequent calculations have also been provided.
  - Much of the information acquired in these efforts will be used to develop mathematical models of the jumps. The technical literature contains a variety of modeling approaches that are useful in developing "what if" scenarios. The models can help support training directions and provide a better understanding of how the multitude of variables interact.
  - New technologies and procedures will be brought into play as this program at the Training Center continues.
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