

# Utilization of Biomechanics in Human Performance



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International Symposium on Sports Medicine – Israel 2004

# Biomechanics of the 21<sup>st</sup> Century



# The Spectrum of Athletic Performances

- Explosive events

- Throwing
- Sprinting
- Jumping



- Endurance events

- Long distance run
- Swimming
- Cycling



- Accuracy events

- Golf
- Archery
- Tennis



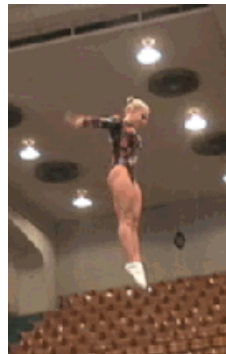
- Team sports

- Soccer
- Basketball
- Hockey



- Esthetic events

- Figure skating
- Gymnastics
- Diving



- Multi events

- Decathlon
- Pentathlon



# Camera Views



# The world record in triple jump of 18.29m by J. Edwards, UK





# Biomechanical Analysis of Discus Throwing at Olympic Games



# **Methods**

**The track & field project involved collecting video records of the preliminaries and final performances of various events for the immediate development of digital movies to be uploaded on the internet.**

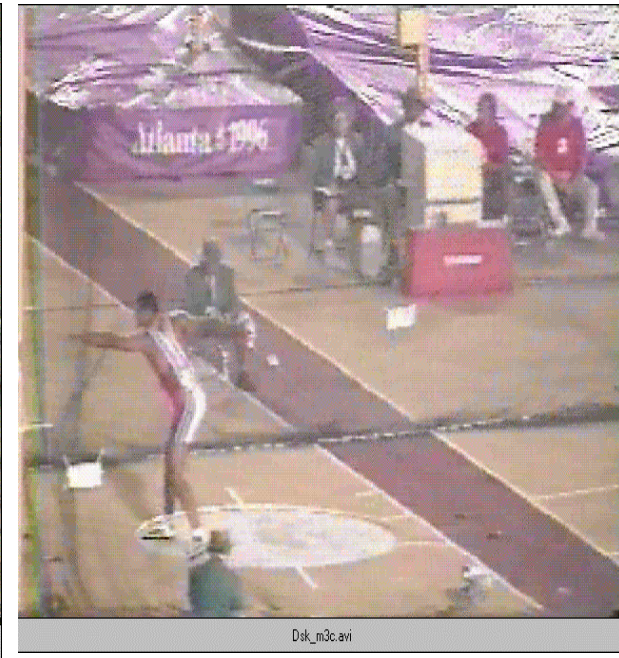


**There Were 18 Throwers During the Qualifying Round and the Best 8 Athletes Competed for the Gold Medal in the Final Round.**



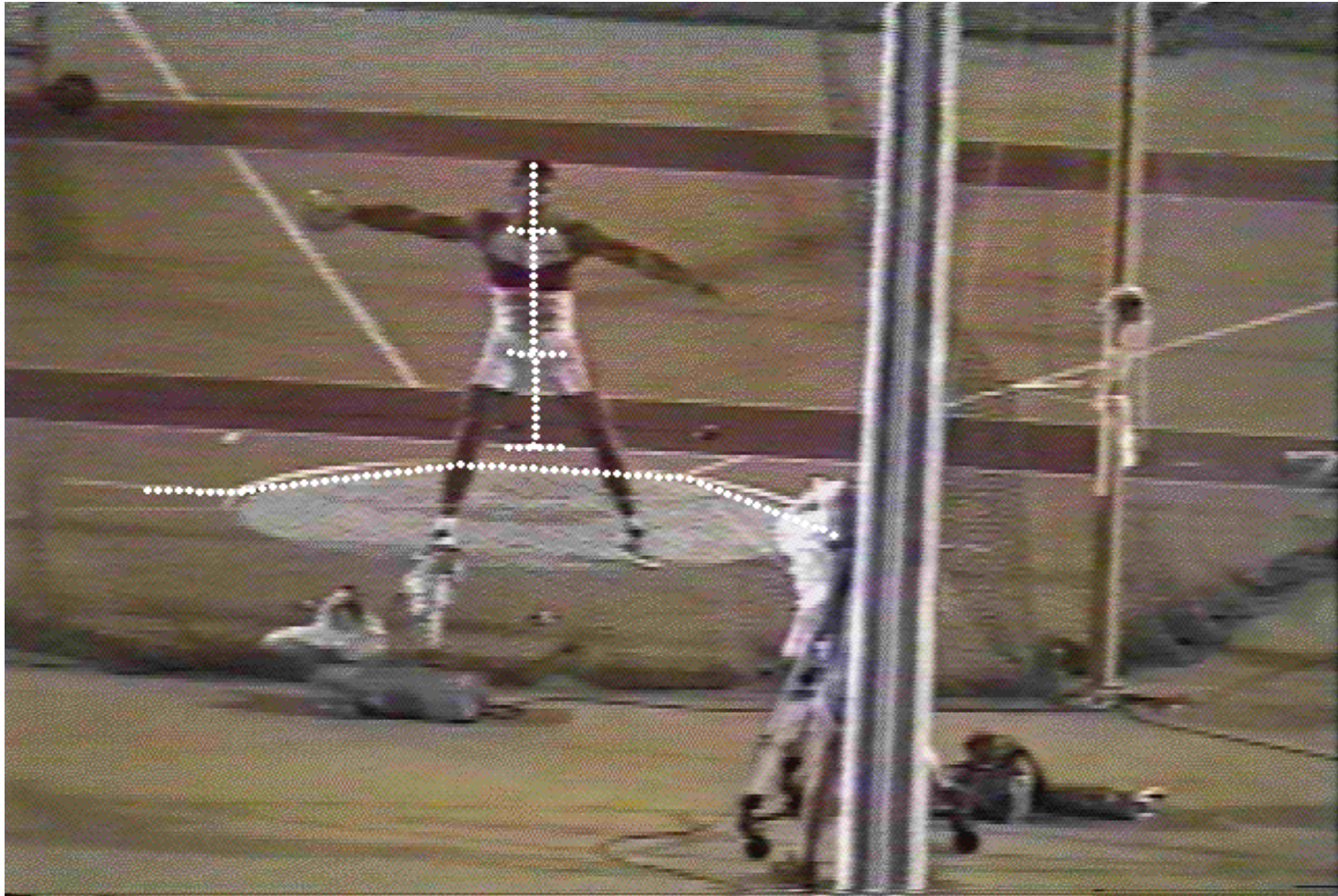


# Video Cameras Were Placed in Several Locations to Maximize the Data Obtained for the Event





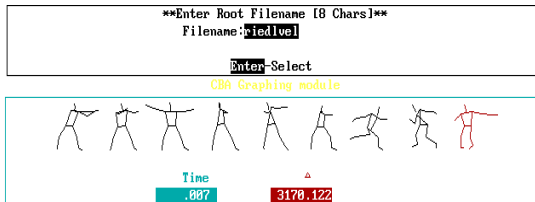
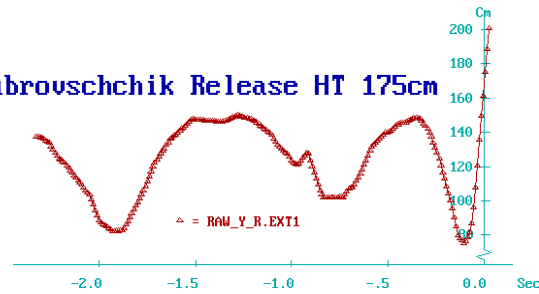
# 3-D DLT Composite Control Cube



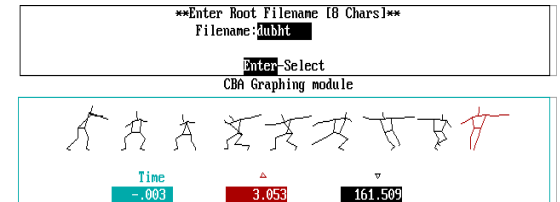
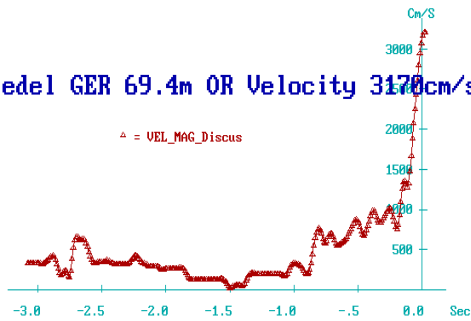
# Results



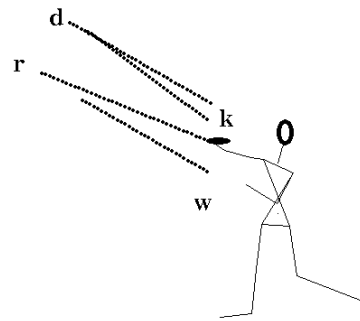
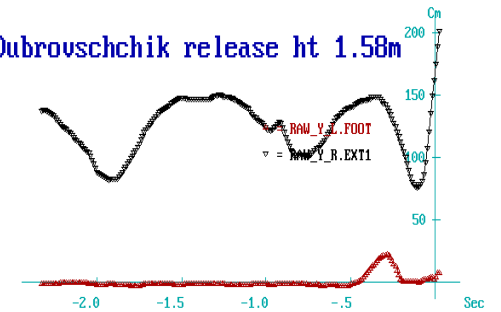
Dubrovichik Release HT 175cm



Riedel GER 69.4m OR Velocity 3170 cm/sec



Dubrovichik release ht 1.58m



DISCUS THROW KINEMATICS

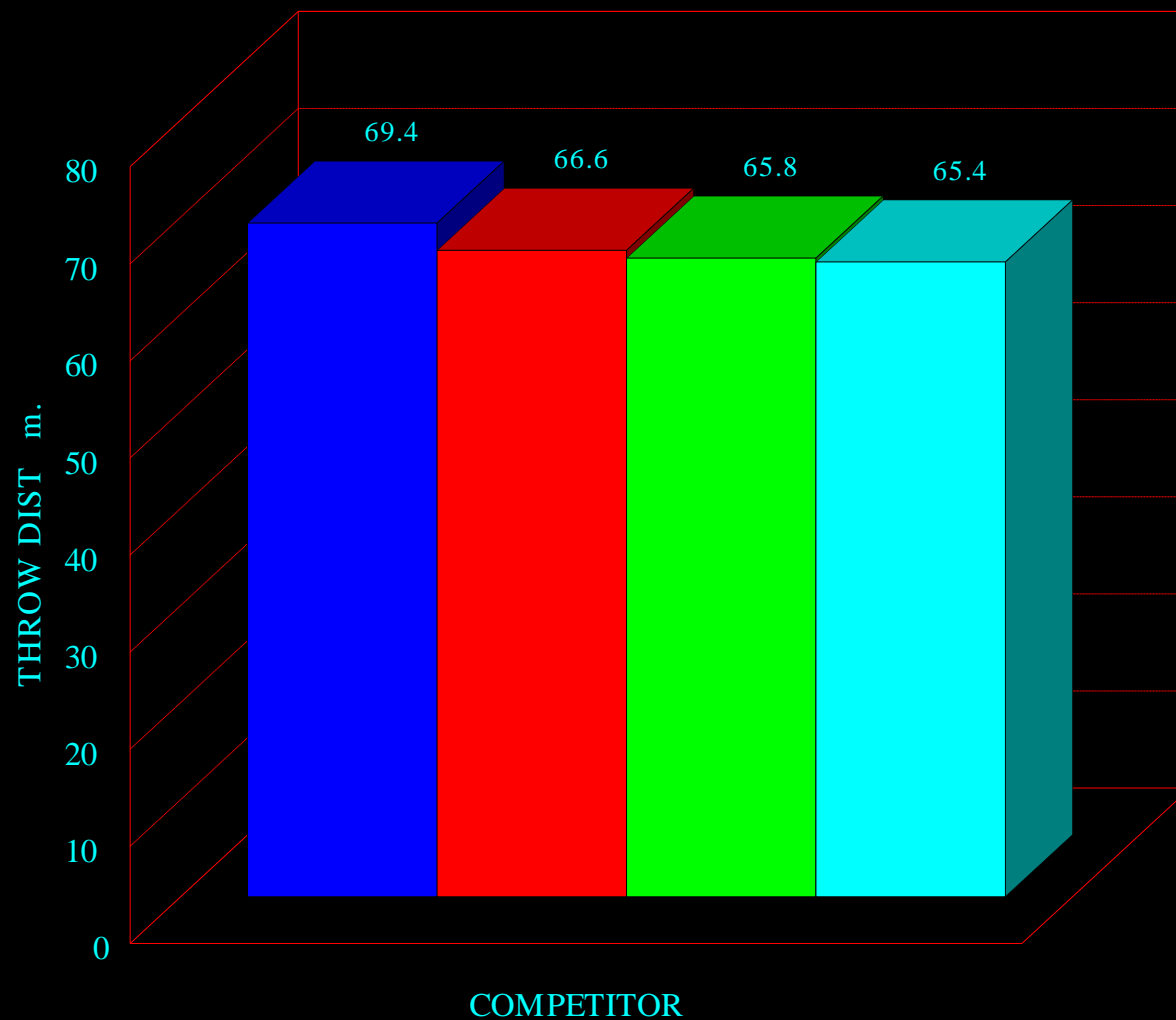




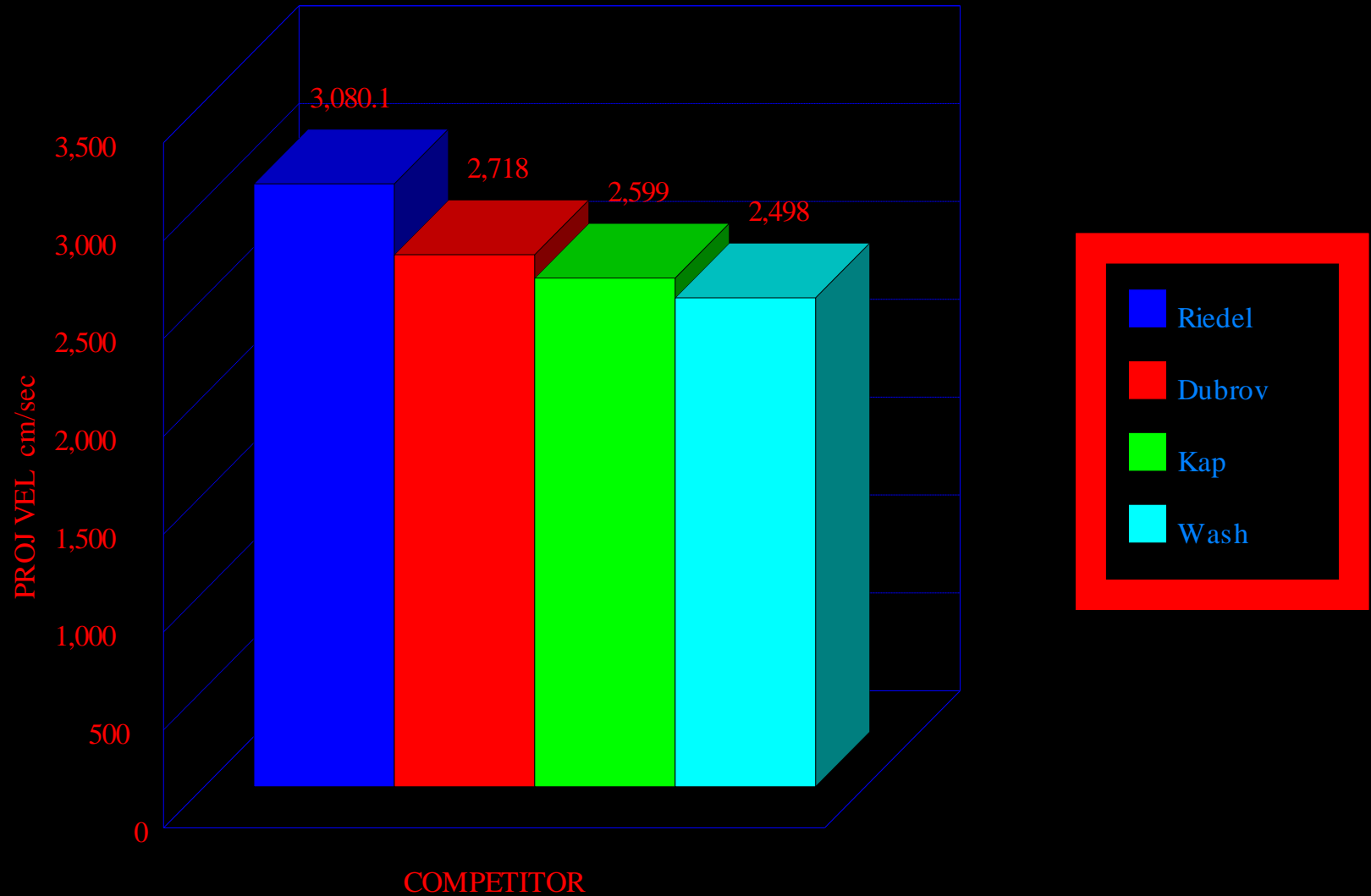
# Washington Throwing Kinematics

Attempt	Distance m.	Velocity $\text{cm}\cdot\text{sec}^{-1}$	Projection Angle rad (deg)	Release HT cm	Move Time sec
Best Throw	65.4	2541 $V_r$ 2134 $V_x$	.52 (29.9)	120	1.2
Worst Throw	61.3	2441 $V_r$ 1222 $V_x$	1.05 (59.9)	140	1.4
% Change	-6.3%	-4.0% $V_r$ -43.0% $V_x$	+100%	+17%	+12%

# DISCUS THROW DISTANCE m.

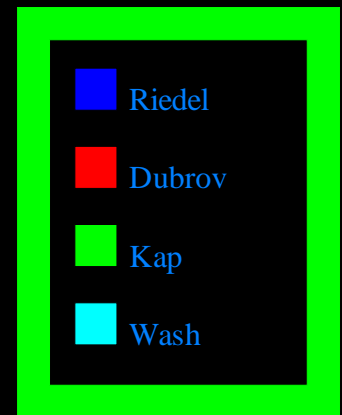
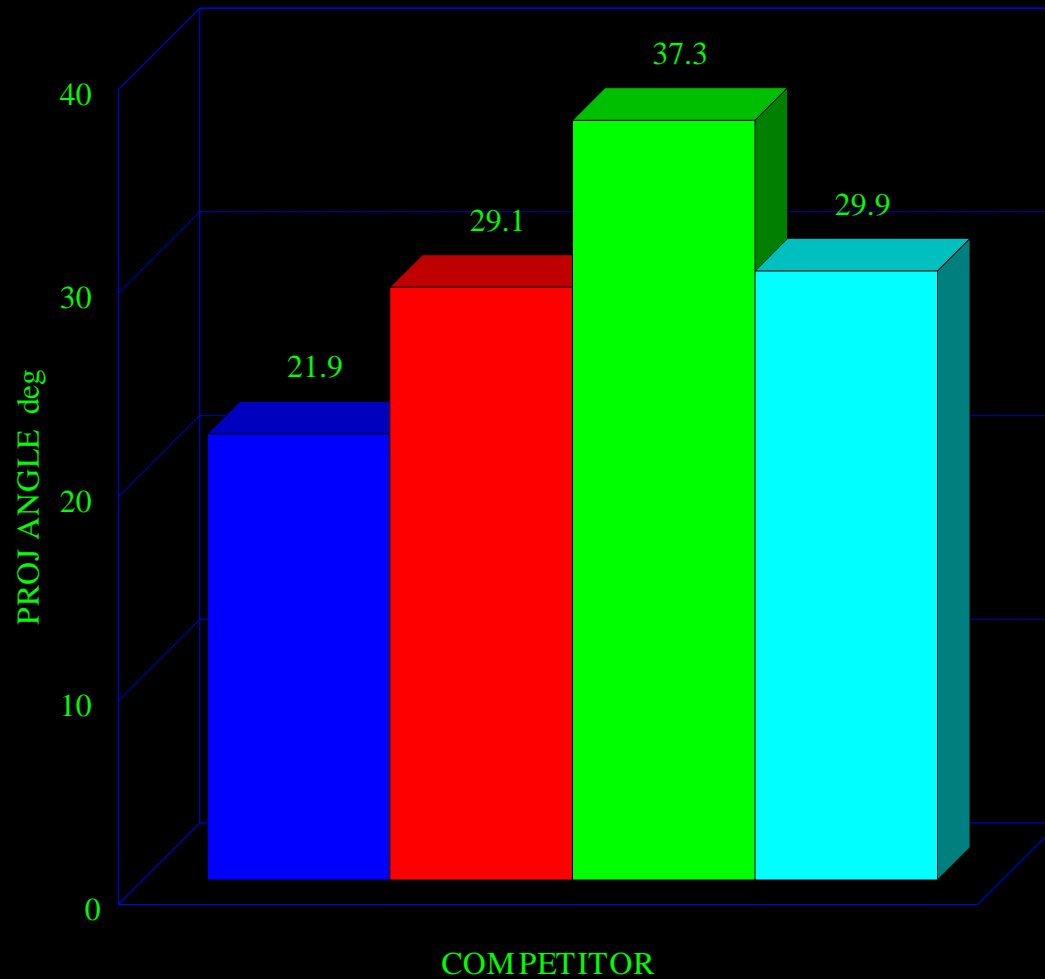


# DISCUS PROJECTION VELOCITY cm/sec

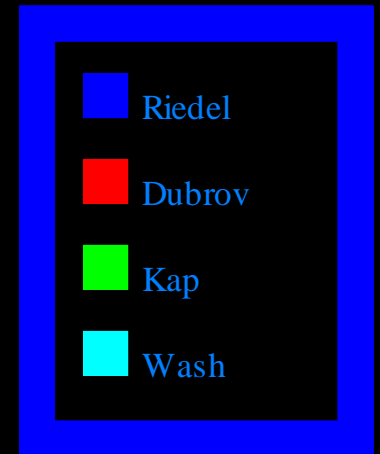
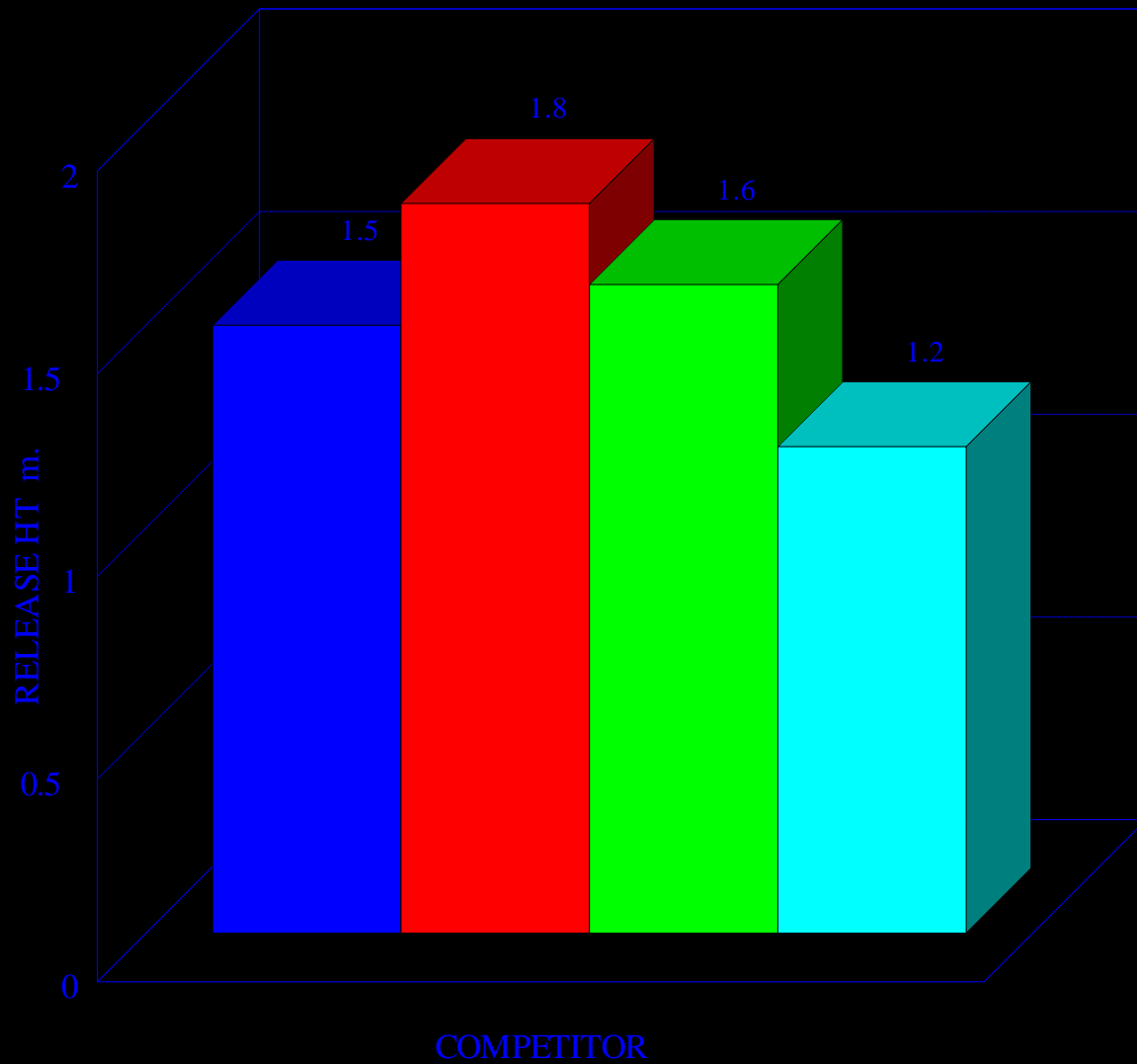




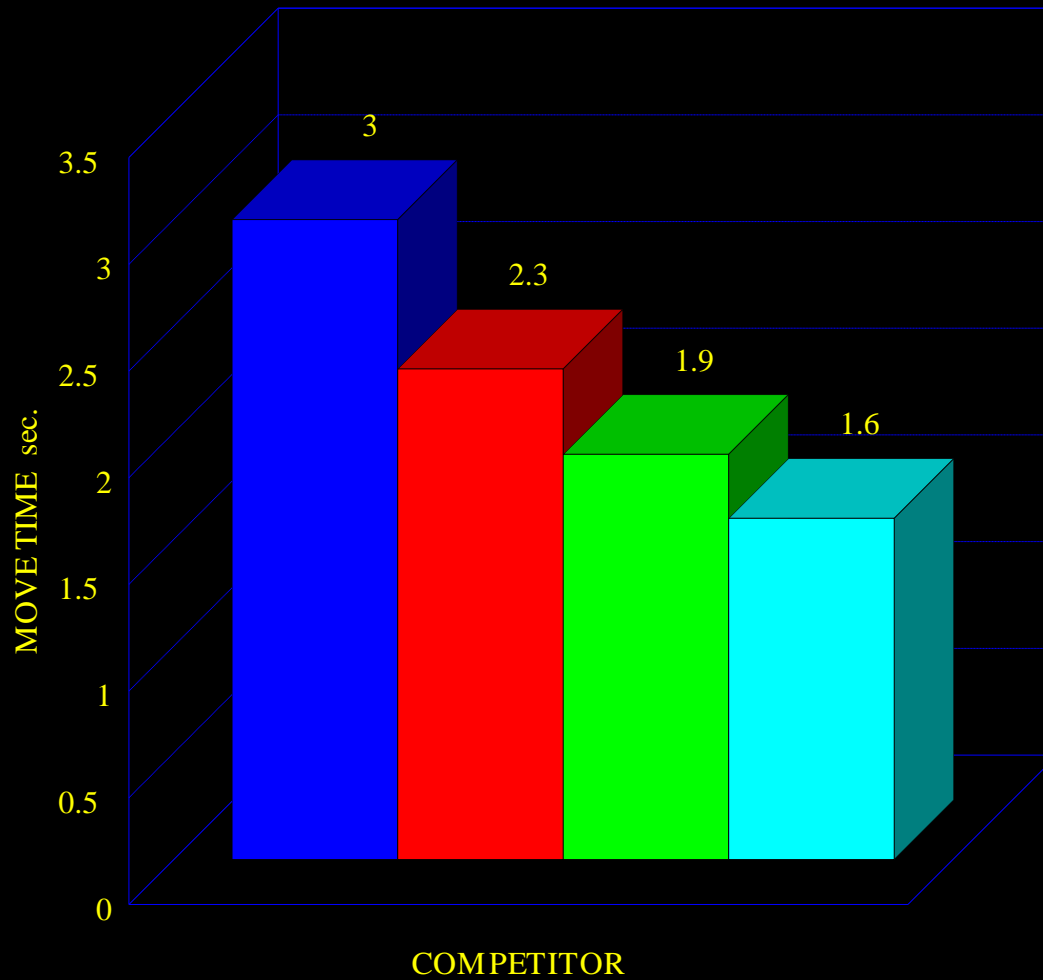
## DISCUS RELEASE ANGLE deg



# DISCUS RELEASE HEIGHT m.



## DISCUS MOVEMENT TIME sec.



Riedel  
Dubrov  
Kap  
Wash



# Throwing Kinematics for Top Four Discus Performers at 1996 Atlanta Olympics

<b>Riedel (Ger)</b>	<b>69.4</b>	<b>3080.1</b>	<b>21.9</b>	<b>1.5</b>	<b>3.0</b>
<b>Dubrovshchik (Blr)</b>	<b>66.6</b>	<b>2718.5</b>	<b>29.1</b>	<b>1.8</b>	<b>2.3</b>
<b>Kaptyukh (Blr)</b>	<b>65.8</b>	<b>2599.0</b>	<b>37.3</b>	<b>1.6</b>	<b>1.9</b>
<b>Washington (USA)</b>	<b>65.4</b>	<b>2498.0</b>	<b>29.9</b>	<b>1.2</b>	<b>1.6</b>

Poor Throw

Best Throw

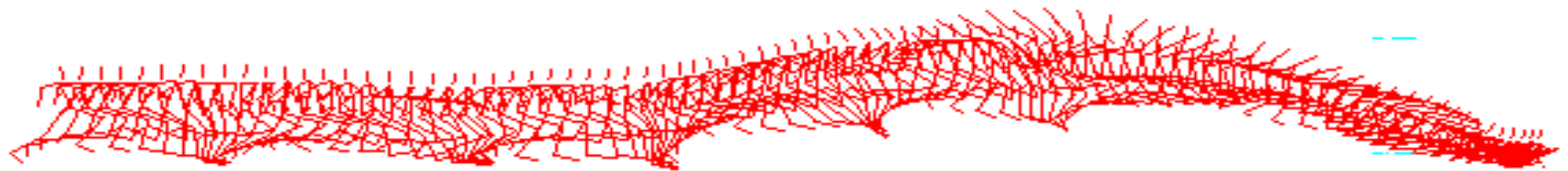
Washington

# DISCUS THROW KINEMATICS

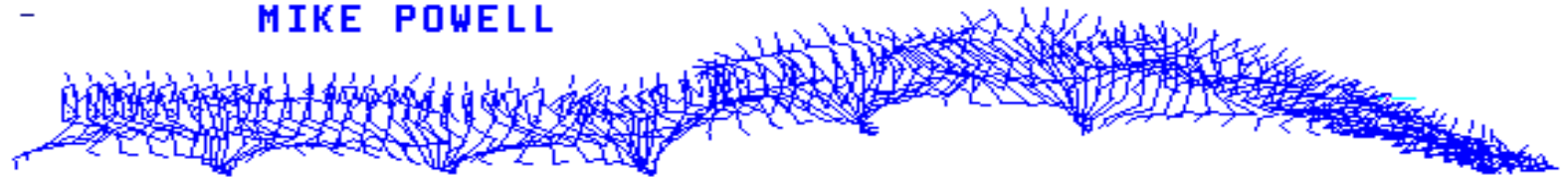


# THE CASE OF THE LONG JUMP:

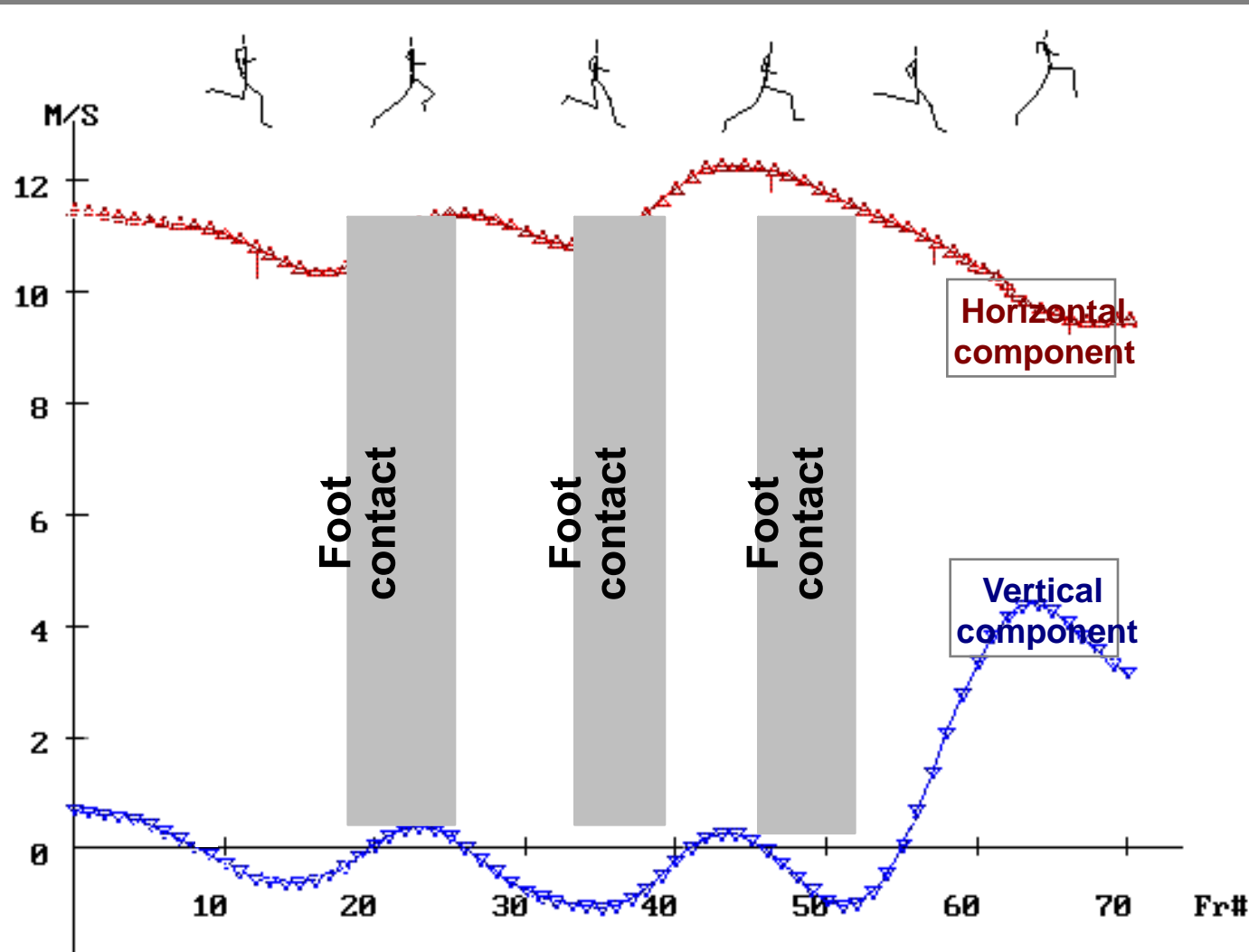
CARL LEWIS



MIKE POWELL



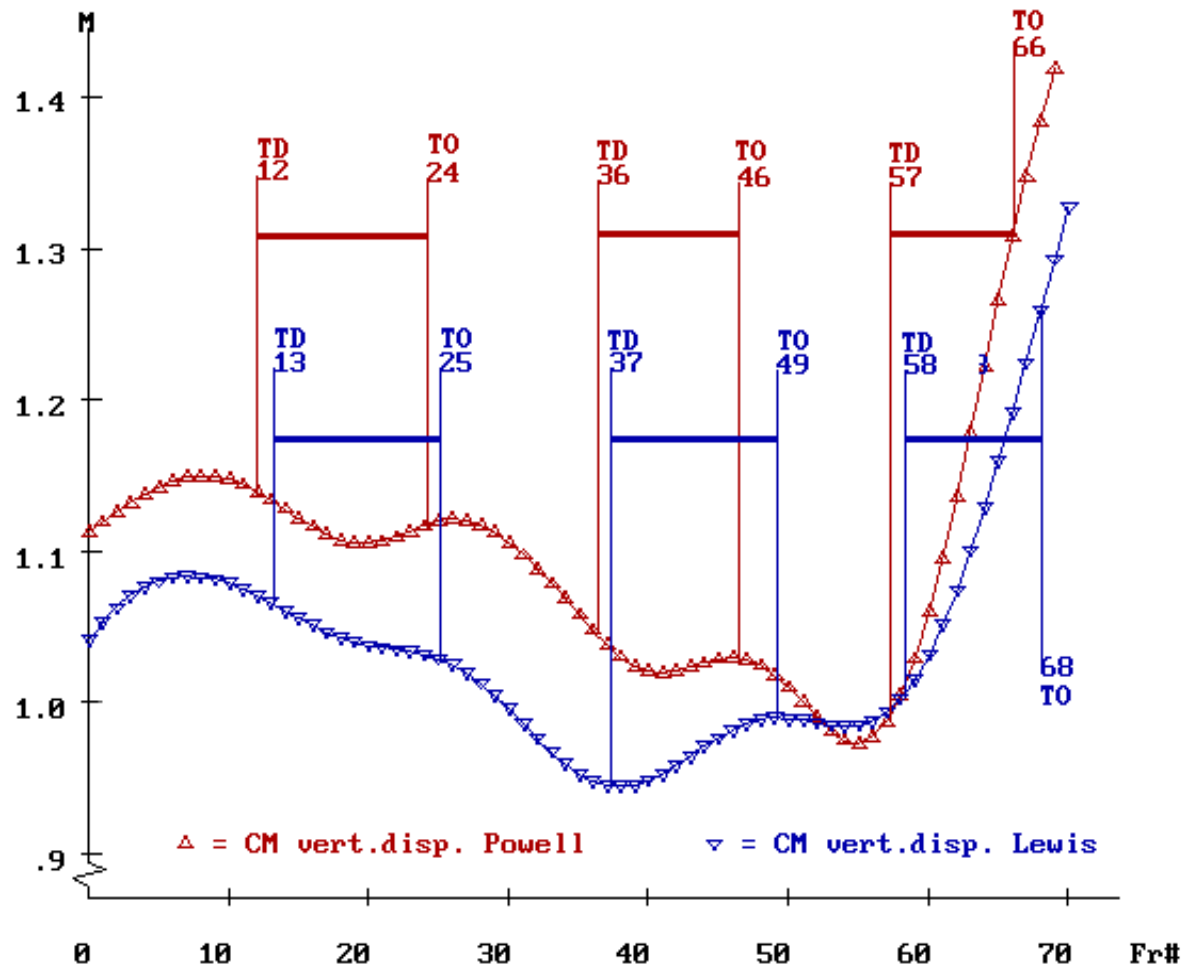
# Velocity of the Center of Mass



Mike Powell 8.95m - World Record

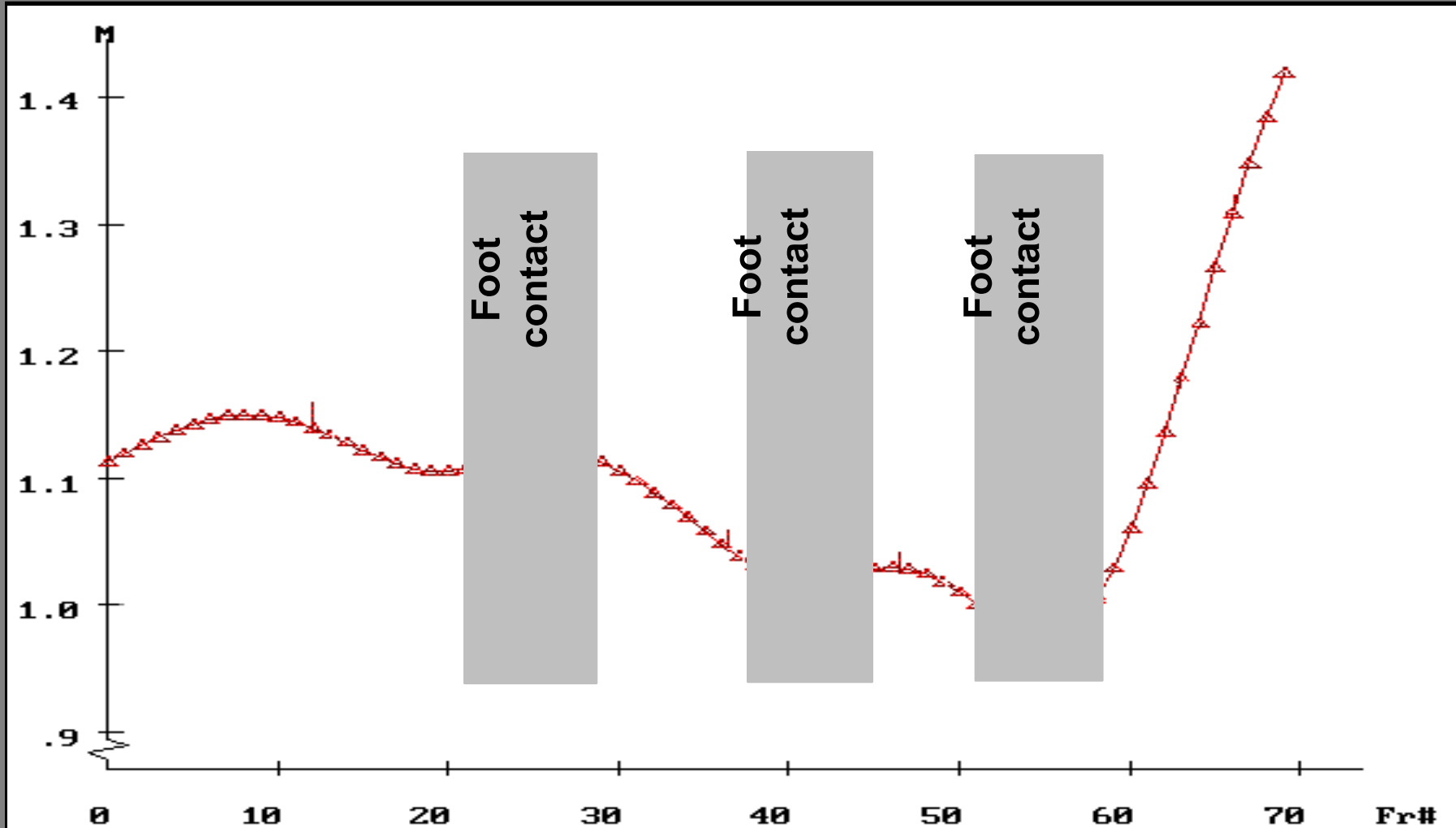


# Change of the Height of CM





# Height of the Center of Mass



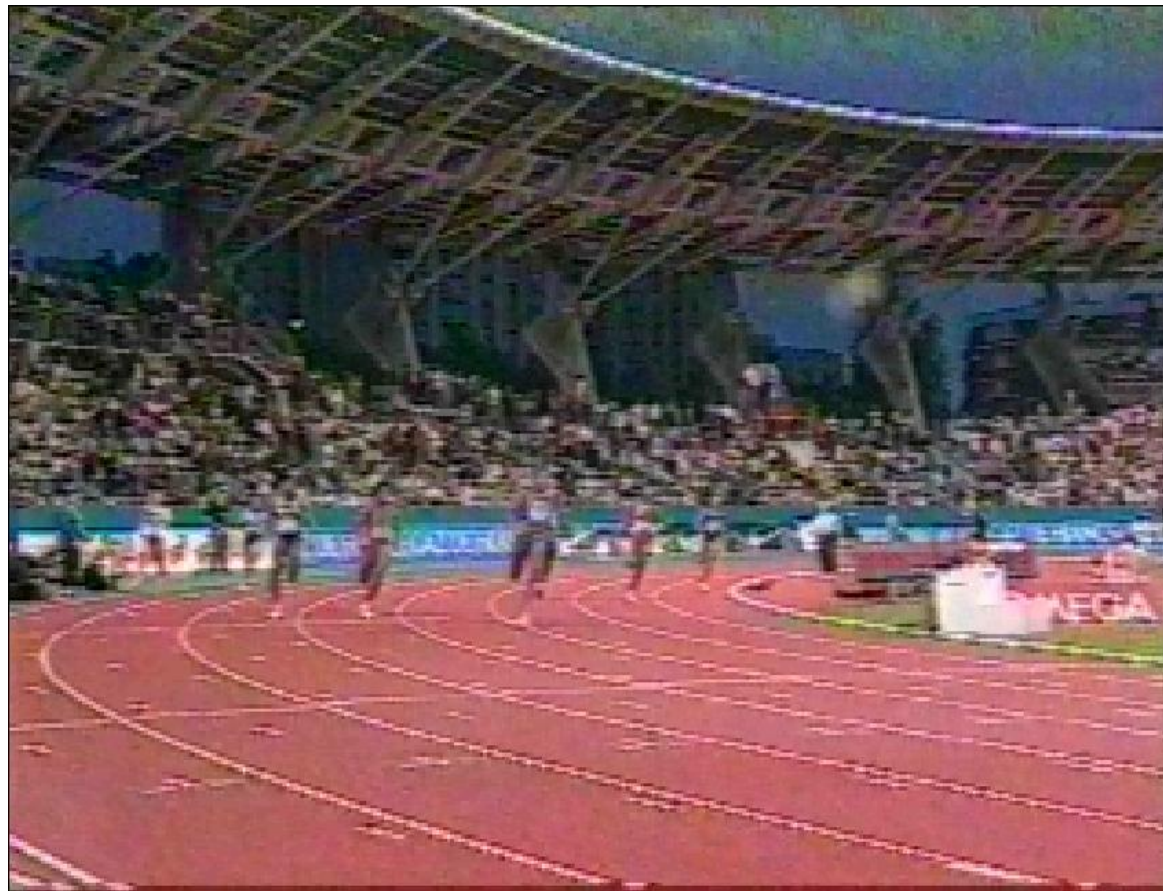
Mike Powell 8.95m - World Record

# Comparative Kinematic Characteristics

Parameters of the Long Jump	M.Powell	C.Lewis
General Information		
Official Distance [m]	8.95	8.91
Effective Distance [m]	8.98	8.91
Favorable Wind Velocity [m/s]	0.3	2.9
The Approach		
Average Speed: 11-6m to the Board [m/s]	10.79	11.23
Average Speed: 6-1m to the Board [m/s]	10.94	11.26
The Length of the Third-Last Stride [m]	2.4	2.23
The Length of the Second-Last Stride [m]	2.47	2.7
The Length of the Last Stride [m]	2.28	1.88
The Take-Off		
CM Horizontal Velocity [m/s]	9.27	9.11
CM Vertical Velocity [m/s]	4.21	3.37
Angle of Projection [deg]	24.1	20.3
Angle of body Lean at Touch-Down [deg]	71.8	77
Angle of body Lean at Take-Off [deg]	73.9	67.5



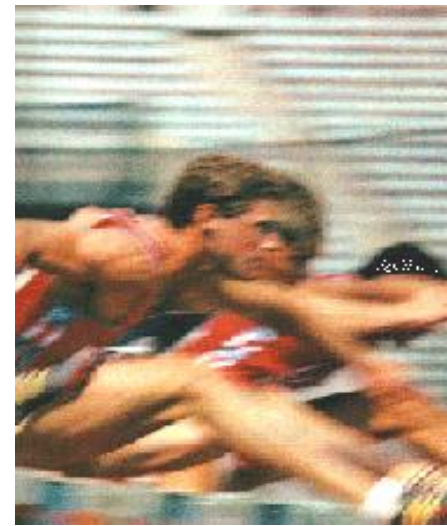
Hammer1.avi







Hurdle1.avi







[Video](#)

# THANK YOU

