Biomechanical Analysis of the Shot-Put Event at the 2004 Athens Olympic Games

By

Gideon Ariel, Ann Penny, John Probe, Rudolf Buijs, Erik Simonsen Alfred Finch , and Larry Judge

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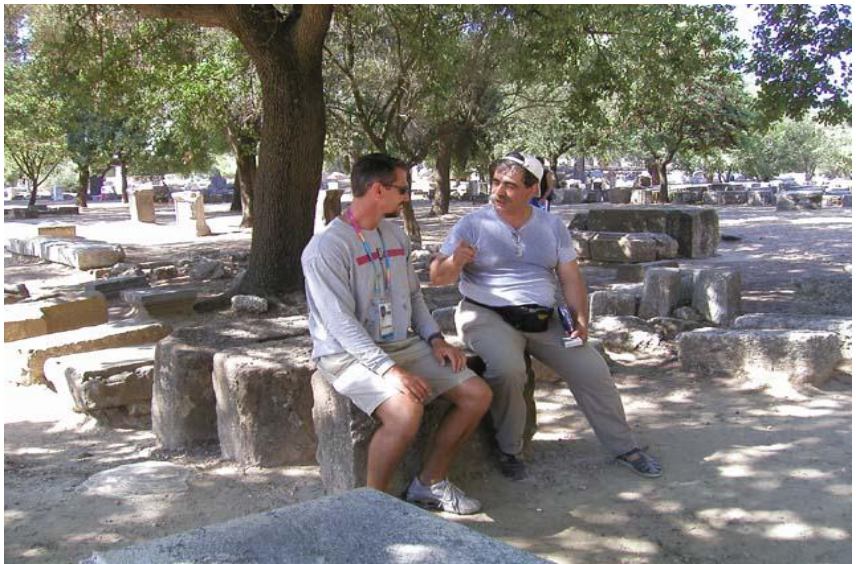
Introduction

The Shot Put competition at the 2004 Athens Olympiad was held in the Ancient Olympia stadium. This was the site of the ancient Games of the Olympiad, 2,800 years ago. Despite skepticism from the rest of the world, the organizers of the Athens games did so many things right and nothing exemplified this more than holding the shot put competition at Olympia. In a games already steeped in history, the organizers thoughtfully connected the ancient and modern Olympics in a serene setting that was so unusual that it will probably be remembered as one of the highlights of these games whenever they are recalled.



Purpose of the Study

The purpose of this study was to analyze the best shot put performances in the Athens 2004 Olympic Games. Multiple high speed digital video cameras were placed in specific locations on the field at proper angles in order to capture the performance of the athletes in the preliminaries and finals. Two stationary cameras were placed at 45 degrees to each other. In addition 3 more cameras used by the NBC broadcasting were used to assist the other 2 cameras. Temporal and kinematics variables were calculated from the videos records and were analyzed yielding three-dimensional biomechanical results. Kinematics parameters for the best 3 final performers were presented in this study.

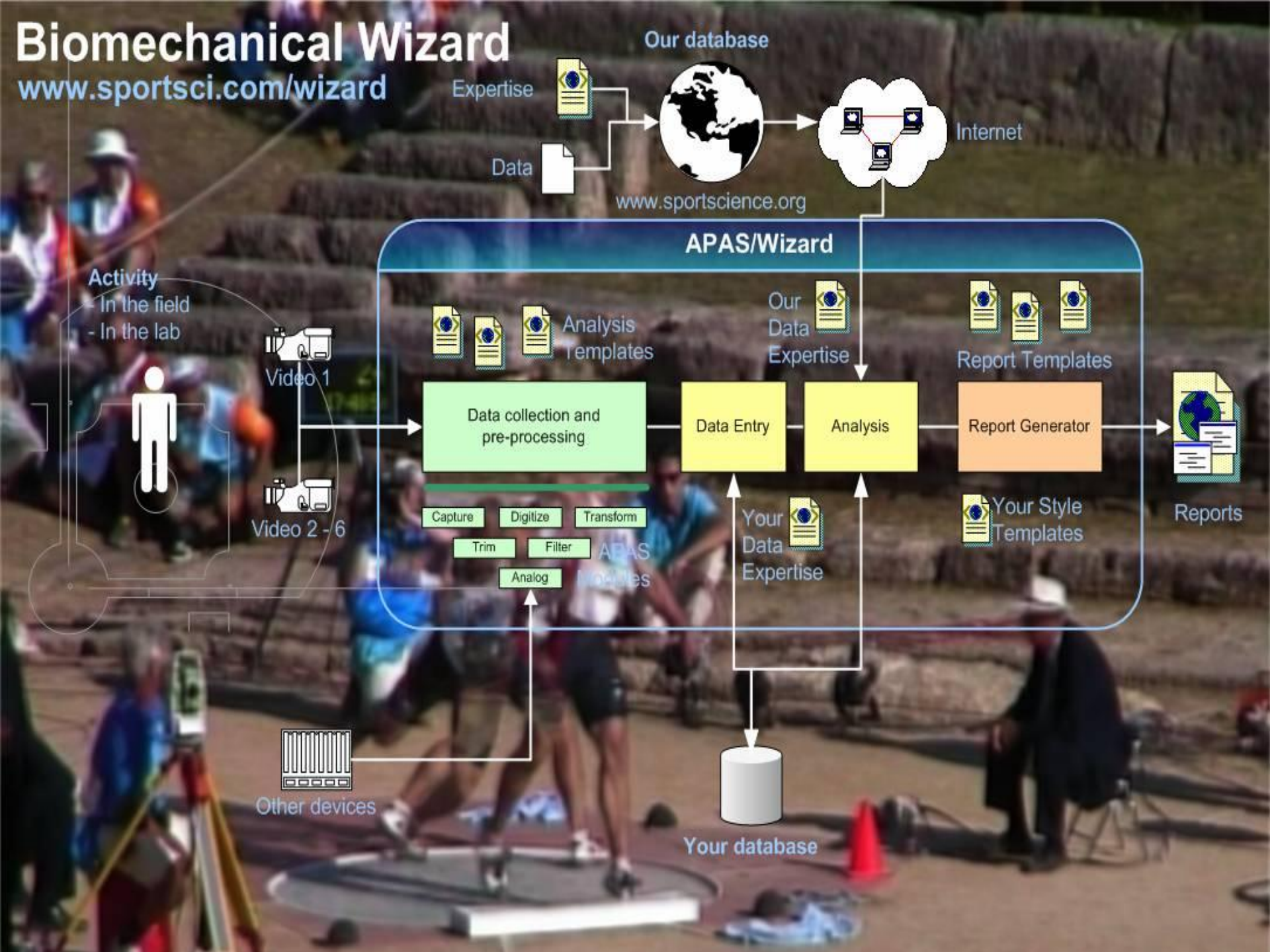
Belonog

Nelson

Olson

Methods

- Multiple high speed digital cameras (60 fps) were used to collect videos of the shot put performers in the 2004 Olympic Games. All throws at the preliminaries and final performances were recorded. Videos collected were transferred automatically to two notebook computers via IEEE1394 interface PCMCIA cards, and synchronized to produce trimmed files representing the complete throws. The trimmed videos from each performer were transmitted through the Internet to a server in order to distribute the data to multiple locations for analysis. All the video digital cameras recorded at 60 fields per second.
- Dimensions of known factors and various other measured objects in the field of view were used for the calibration points. Since it was impossible to place a pre-measured calibration frame in the field for security reasons, known measurements on the field as well as utilizing the athletes' body dimensions were used.


Biomechanical Wizard
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Activity
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Reports
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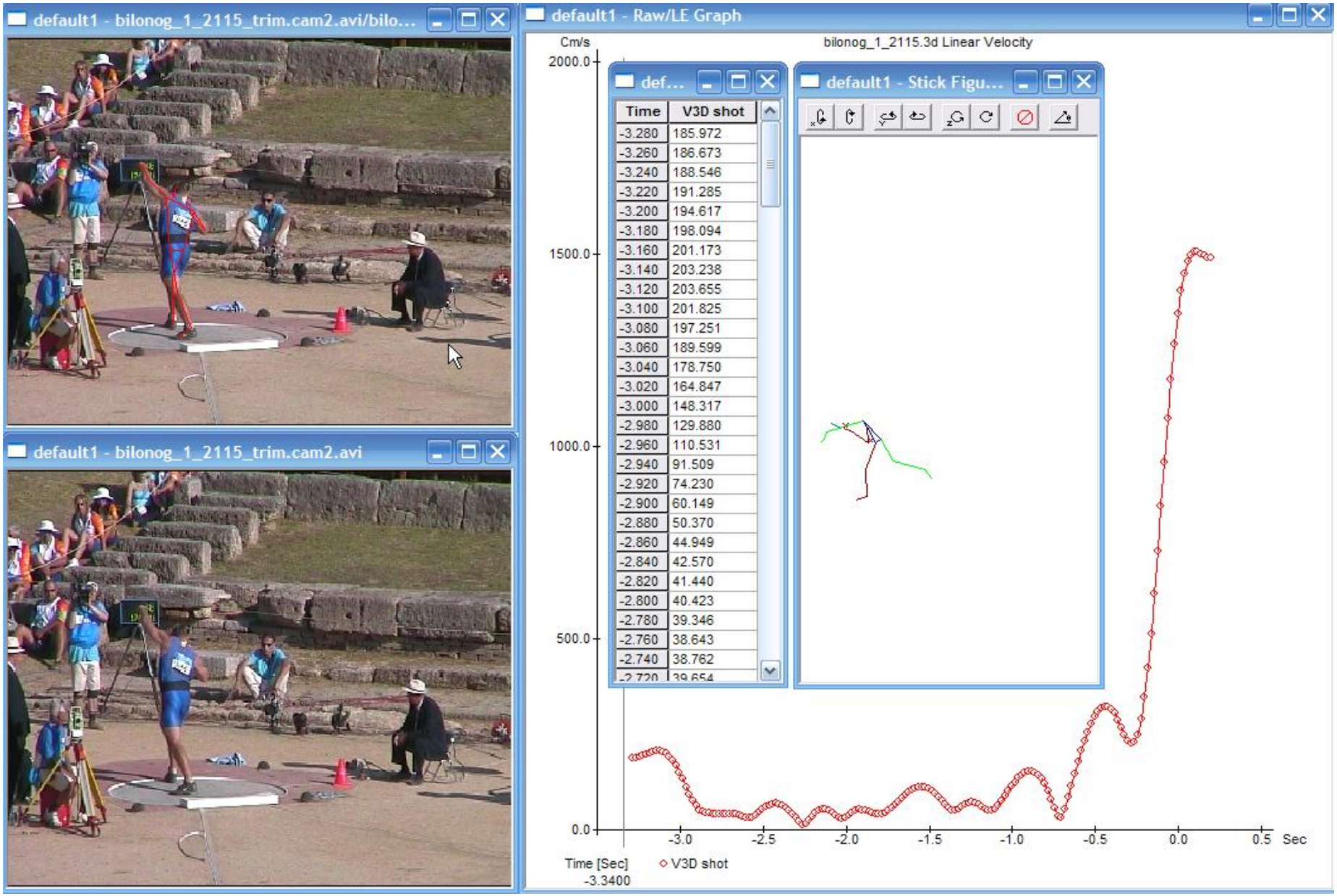
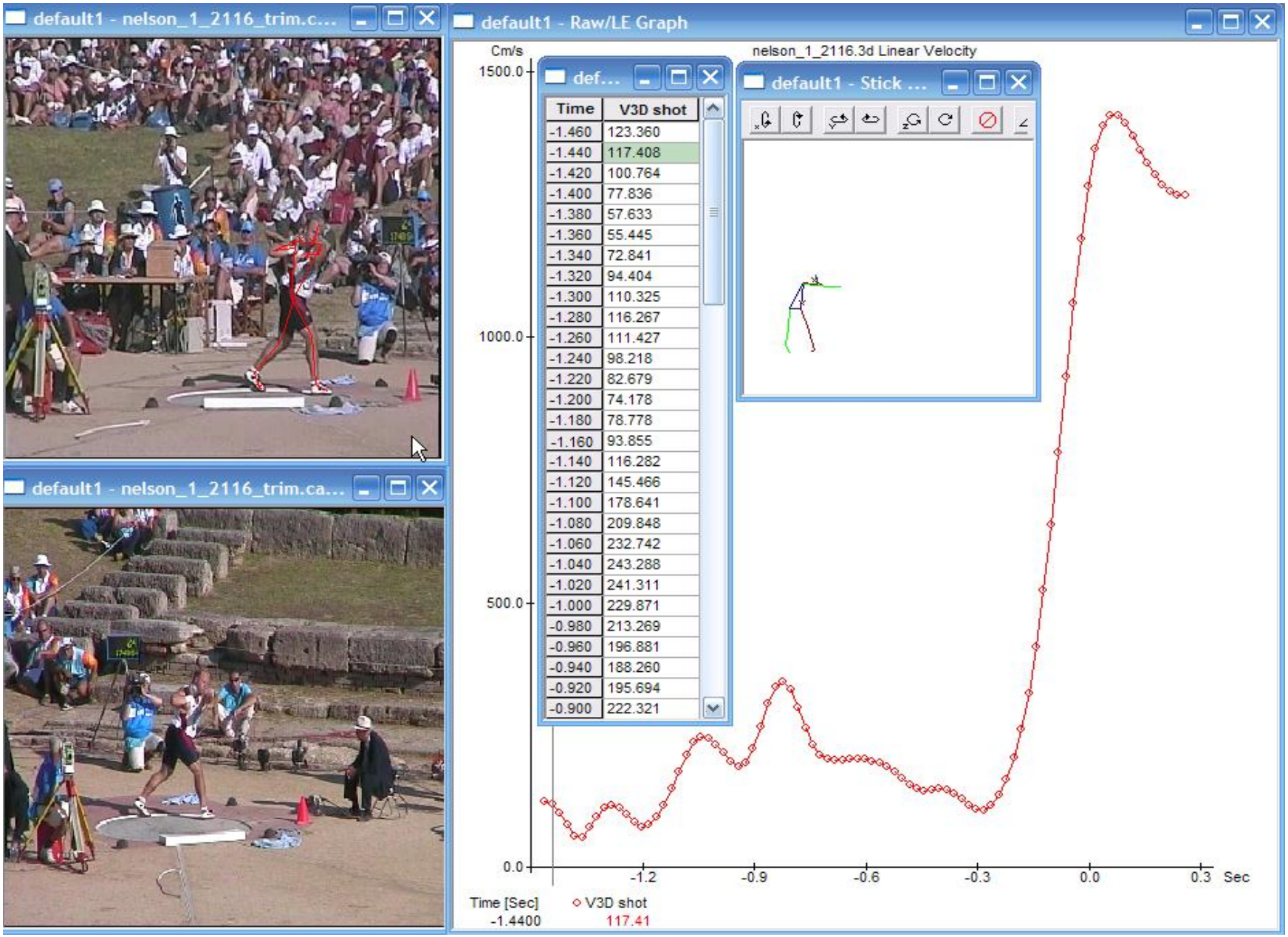
Filter
Analog
APAS Modules
Your Data Expertise
Your Style Templates
Other devices
Your database

Belonog Shot-put Velocity Curve

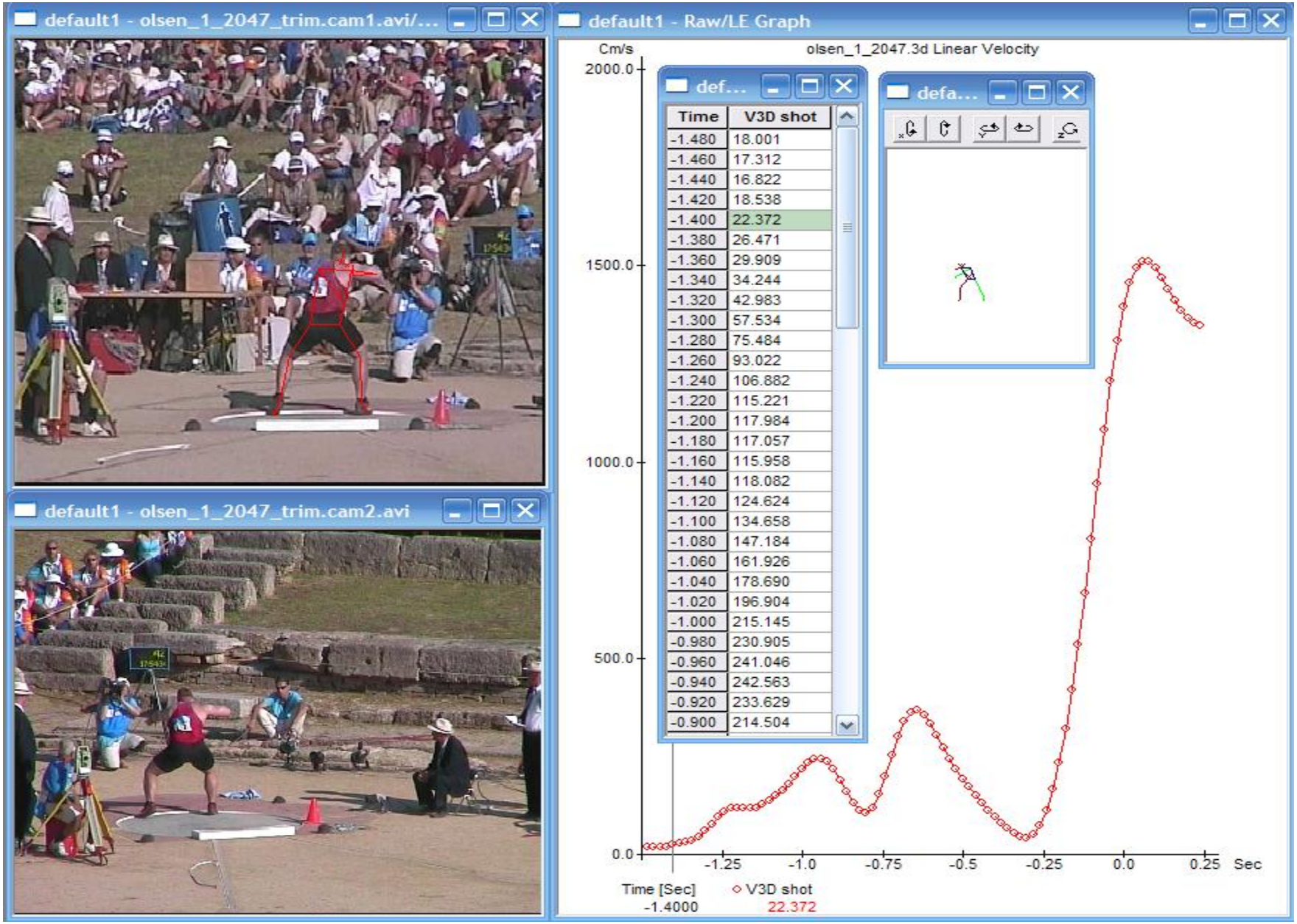


Nelson Shot-Put Velocity Curve

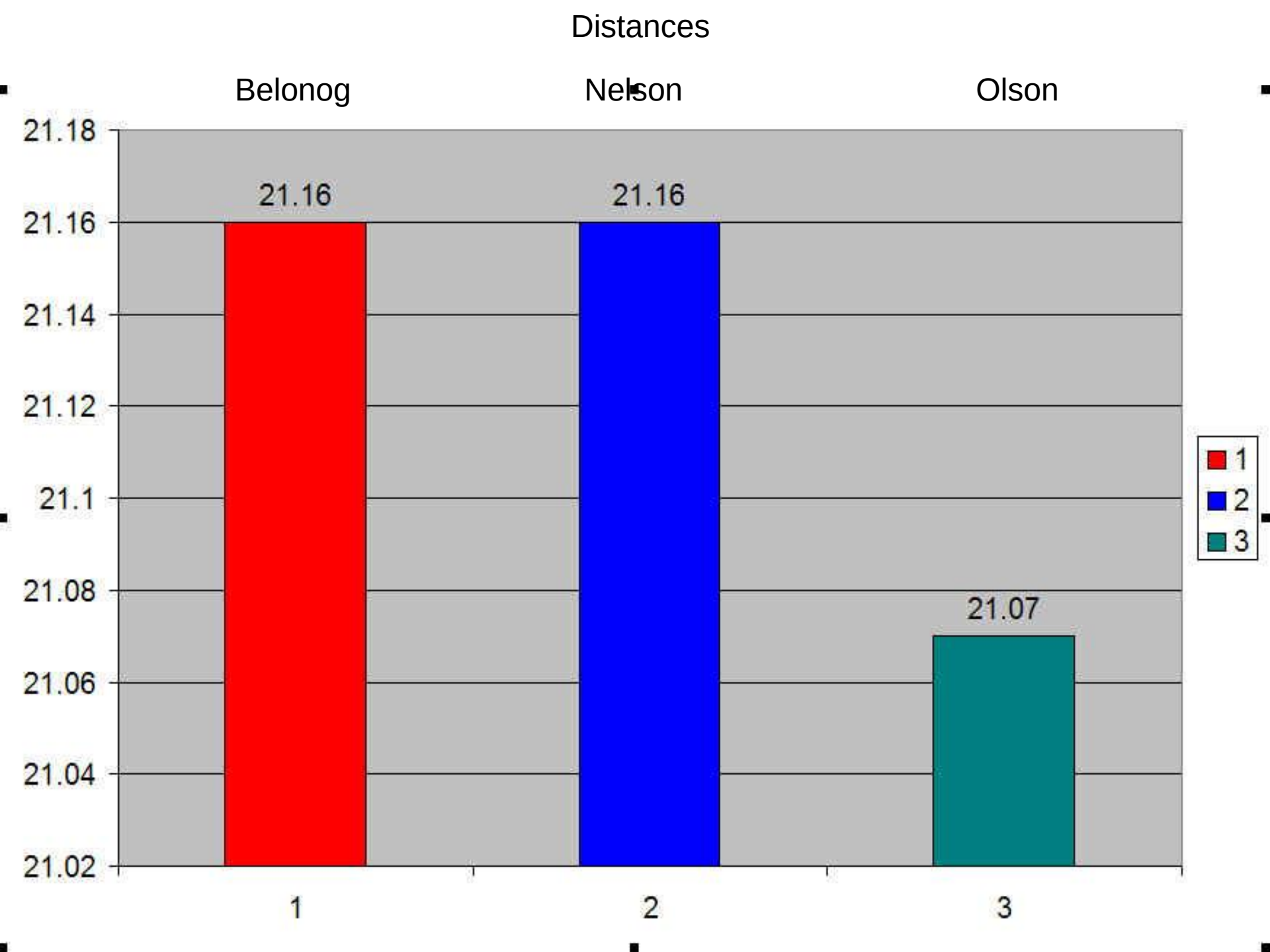


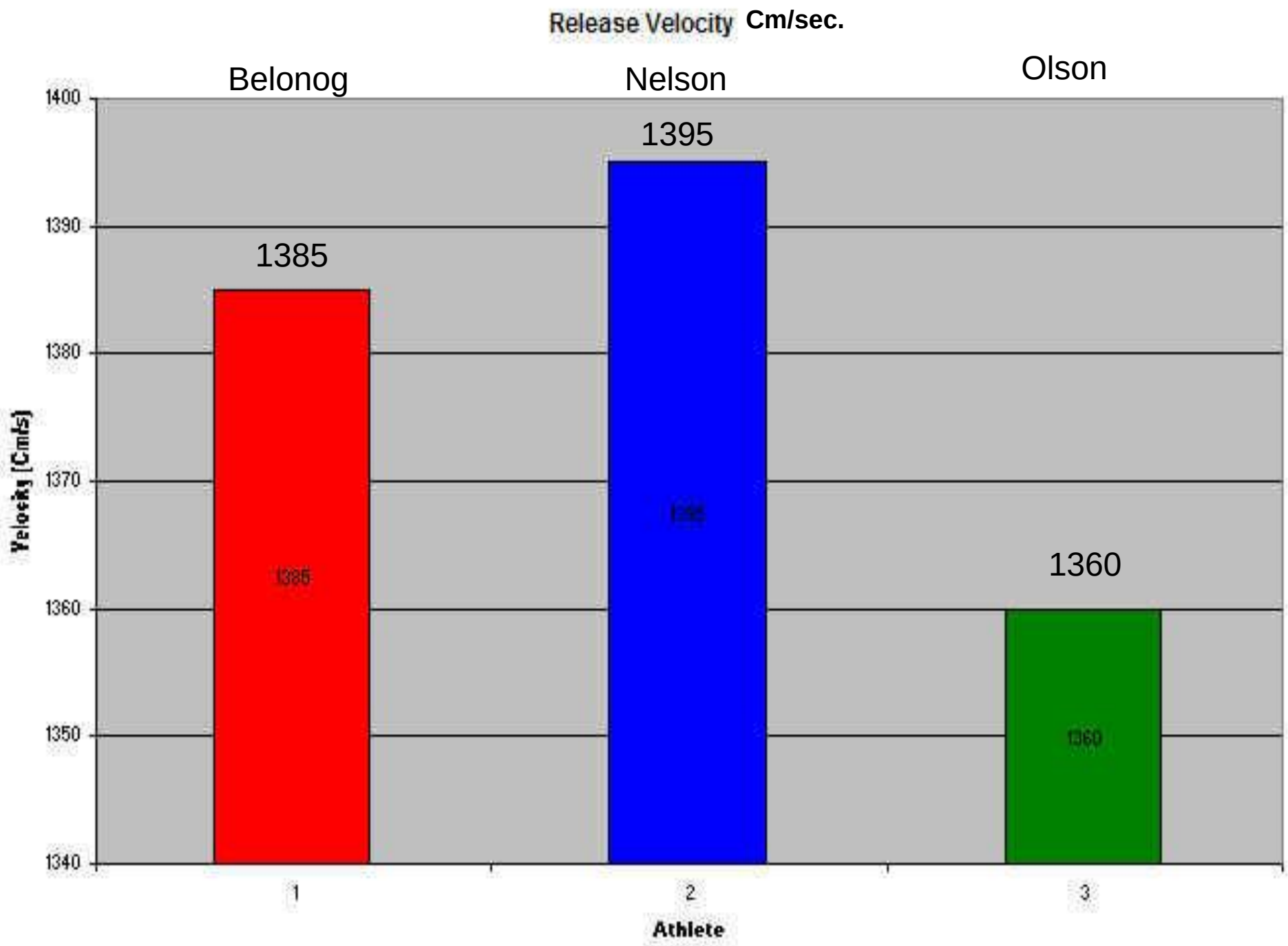
Time	V3D shot
-1.460	123.360
-1.440	117.408
-1.420	100.764
-1.400	77.836
-1.380	57.633
-1.360	55.445
-1.340	72.841
-1.320	94.404
-1.300	110.325
-1.280	116.267
-1.260	111.427
-1.240	98.218
-1.220	82.679
-1.200	74.178
-1.180	78.778
-1.160	93.855
-1.140	116.282
-1.120	145.466
-1.100	178.641
-1.080	209.848
-1.060	232.742
-1.040	243.288
-1.020	241.311
-1.000	229.871
-0.980	213.269
-0.960	196.881
-0.940	188.260
-0.920	195.694
-0.900	222.321

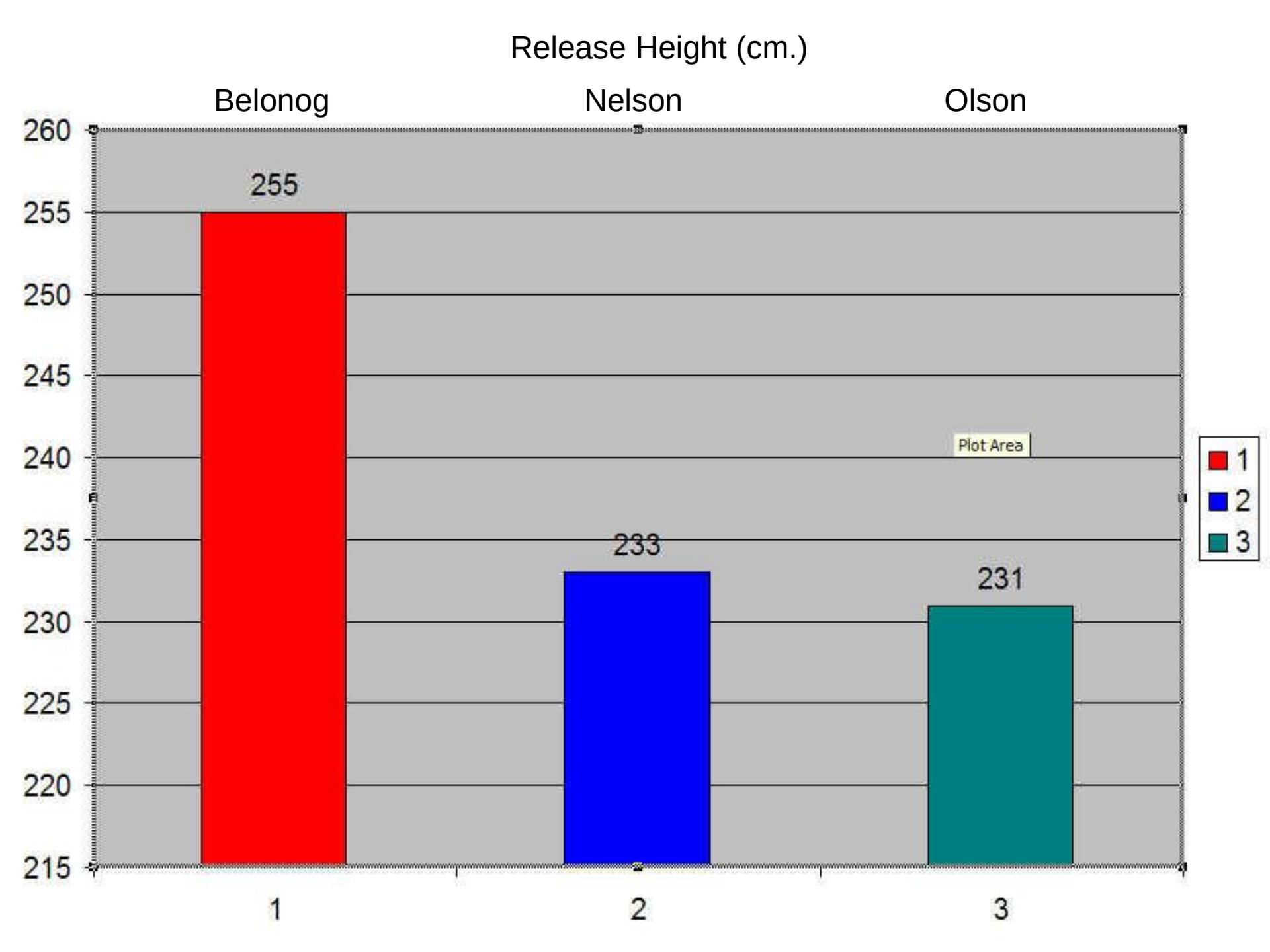
Olson Shot-Put Velocity Curve

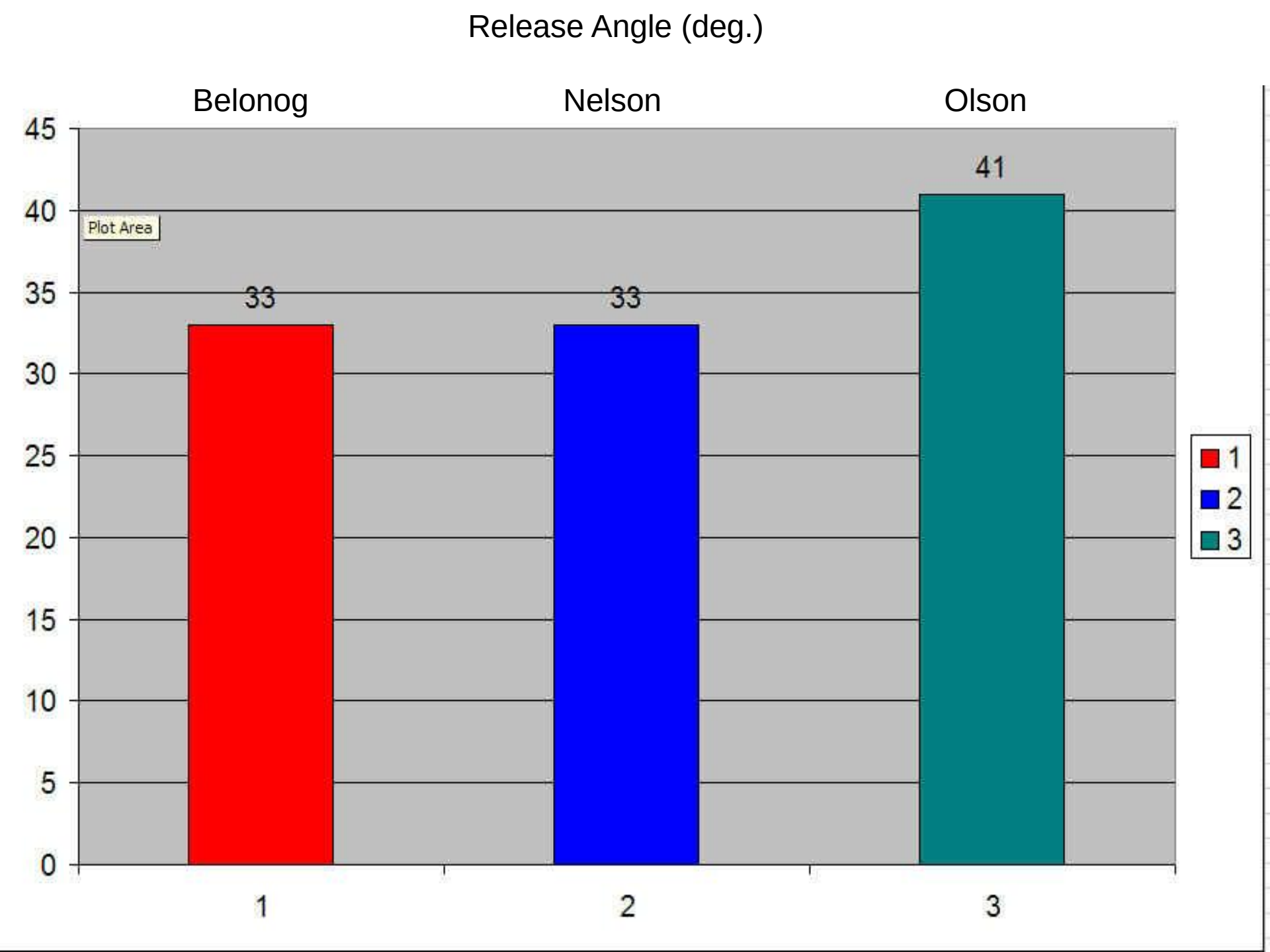


Time	V3D shot
-1.480	18.001
-1.460	17.312
-1.440	16.822
-1.420	18.538
-1.400	22.372
-1.380	26.471
-1.360	29.909
-1.340	34.244
-1.320	42.983
-1.300	57.534
-1.280	75.484
-1.260	93.022
-1.240	106.882
-1.220	115.221
-1.200	117.984
-1.180	117.057
-1.160	115.958
-1.140	118.082
-1.120	124.624
-1.100	134.658
-1.080	147.184
-1.060	161.926
-1.040	178.690
-1.020	196.904
-1.000	215.145
-0.980	230.905
-0.960	241.046
-0.940	242.563
-0.920	233.629
-0.900	214.504


Distances
Belonog
Nelson
Olson
21.18
21.16
21.14
21.12
21.1
21.08
21.06
21.04
21.02
21.16
21.16
21.07
1
2
3
1
2
3


Release Velocity Cm/sec.
Belonog
Nelson
Olson
1400
1390
1380
1370
1360
1350
1340
1385
1395
1360
1385
1360
Velocity [Cm/s]
1
2
3
Athlete


Release Height (cm.)
Belonog
Nelson
Olson
260
255
250
245
240
235
230
225
220
215
255
233
231
Plot Area
1
2
3
1
2
3

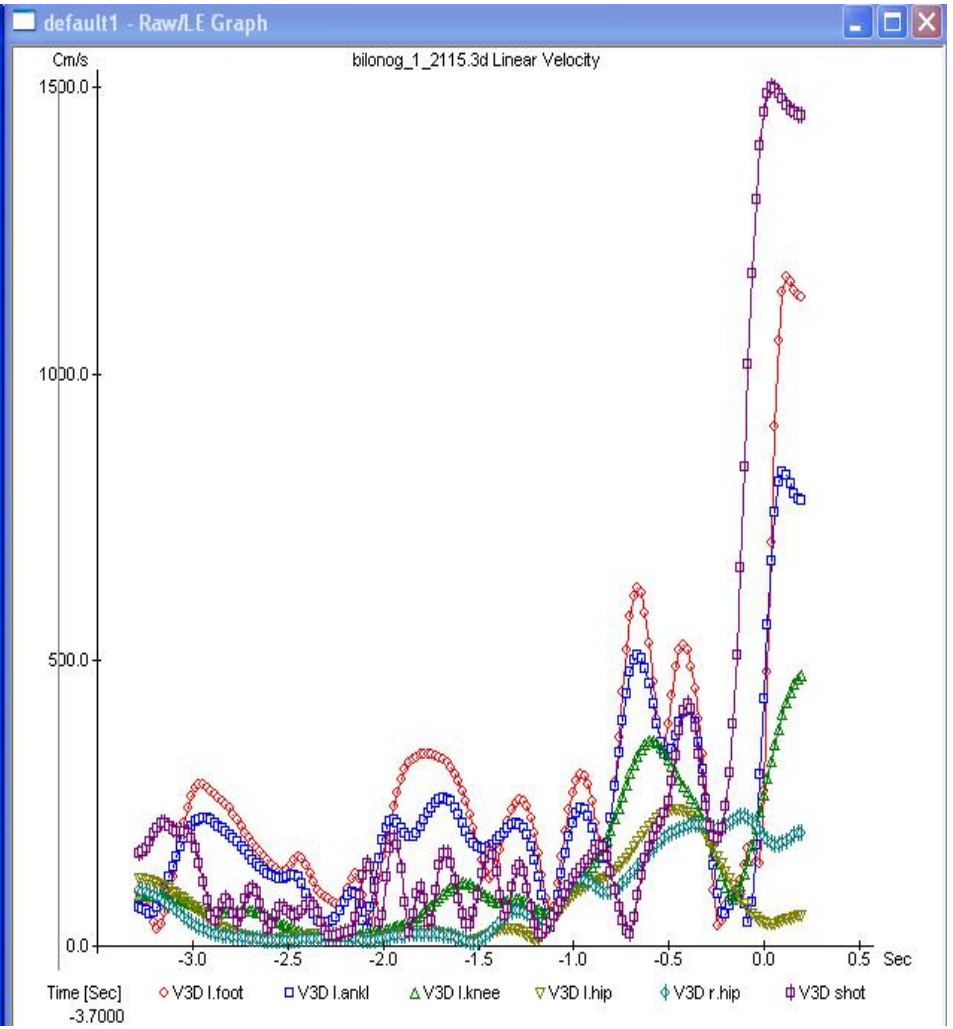

Release Angle (deg.)
Belonog
Nelson
Olson
45
40
35
30
25
20
15
10
5
0
Plot Area
33
33
41
1
2
3
1
2
3

Selected Kinematic Performance Parameters of the Top Three Throwers

Performer	Place	Distance m	Release Height m	Shot Velocity $m*s^{-1}$	Release Angle Rad (deg)
Yuriy Belonog	Gold (1)	21.16	2.55	13.85	.58 (33)
Adam Nelson	Silver (2)	21.16	2.33	13.95	.58 (33)
Joachim Olsen	Bronze (3)	21.07	2.31	13.60	.72 (41)

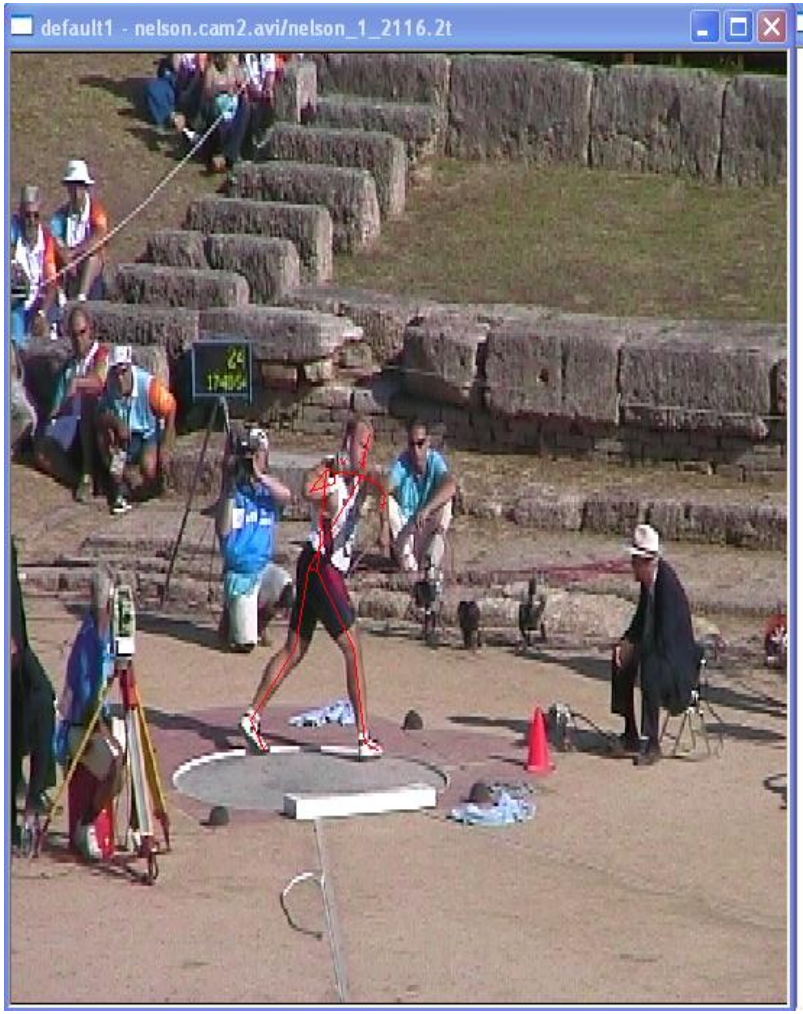
Belonog

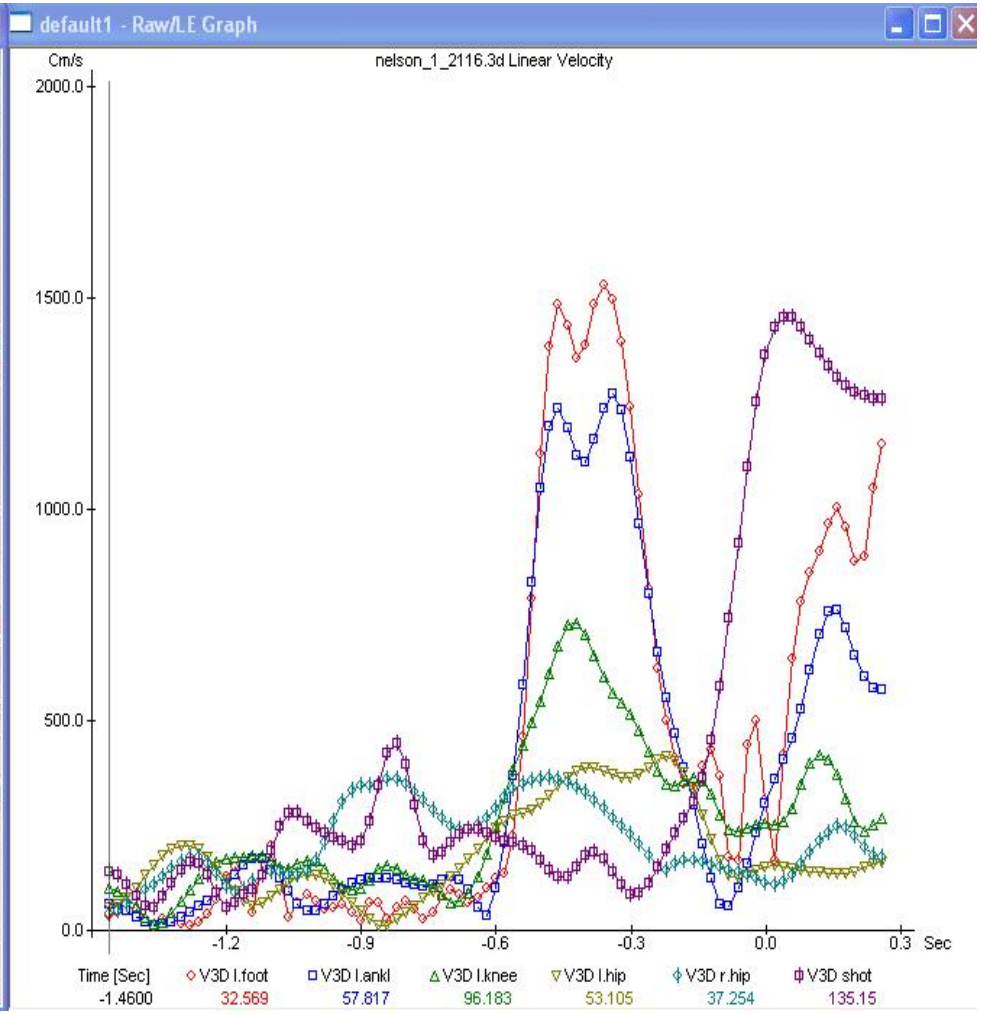
Belongog Winning Throw



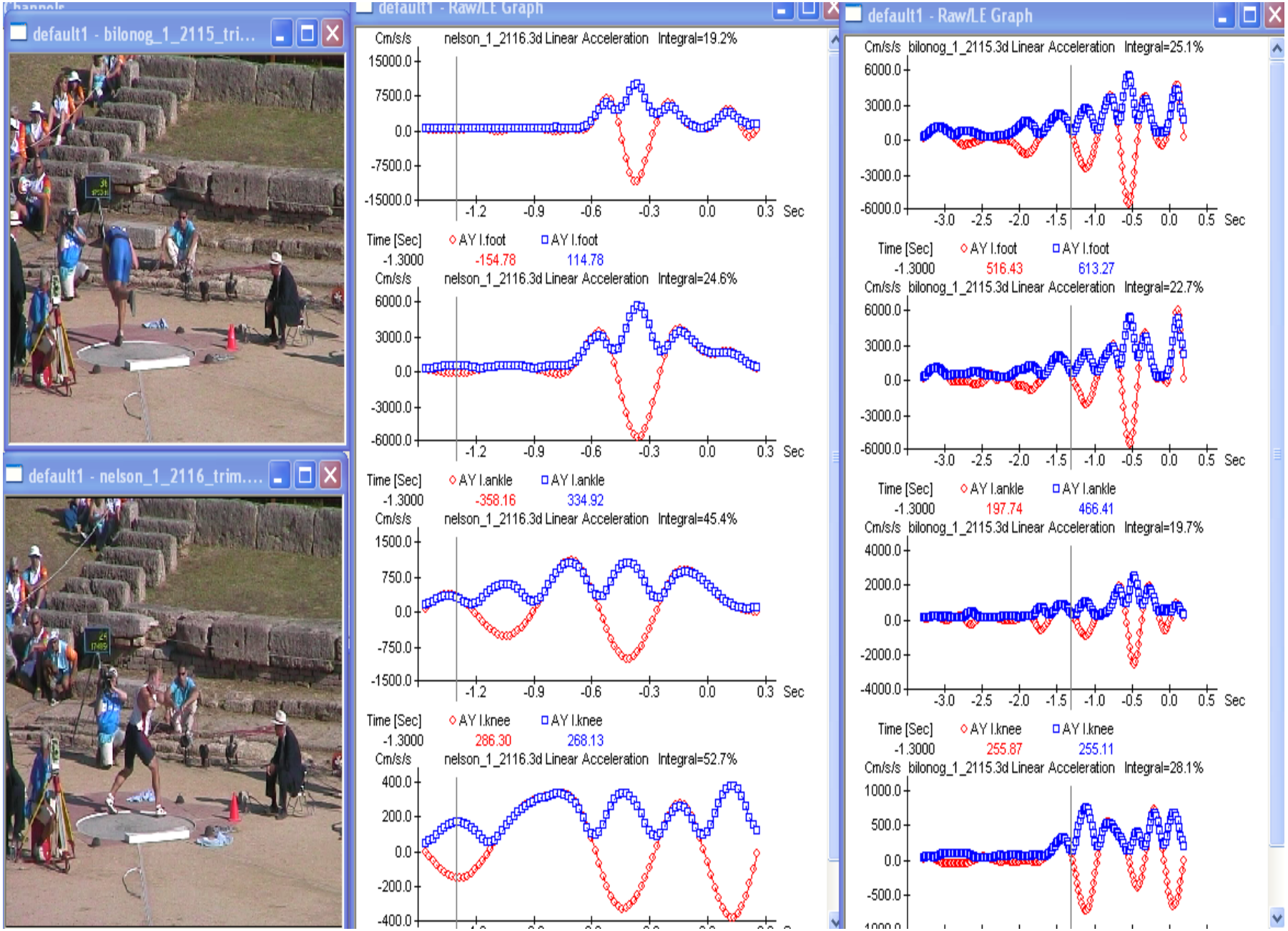
Nelson

Nelson Best Throw

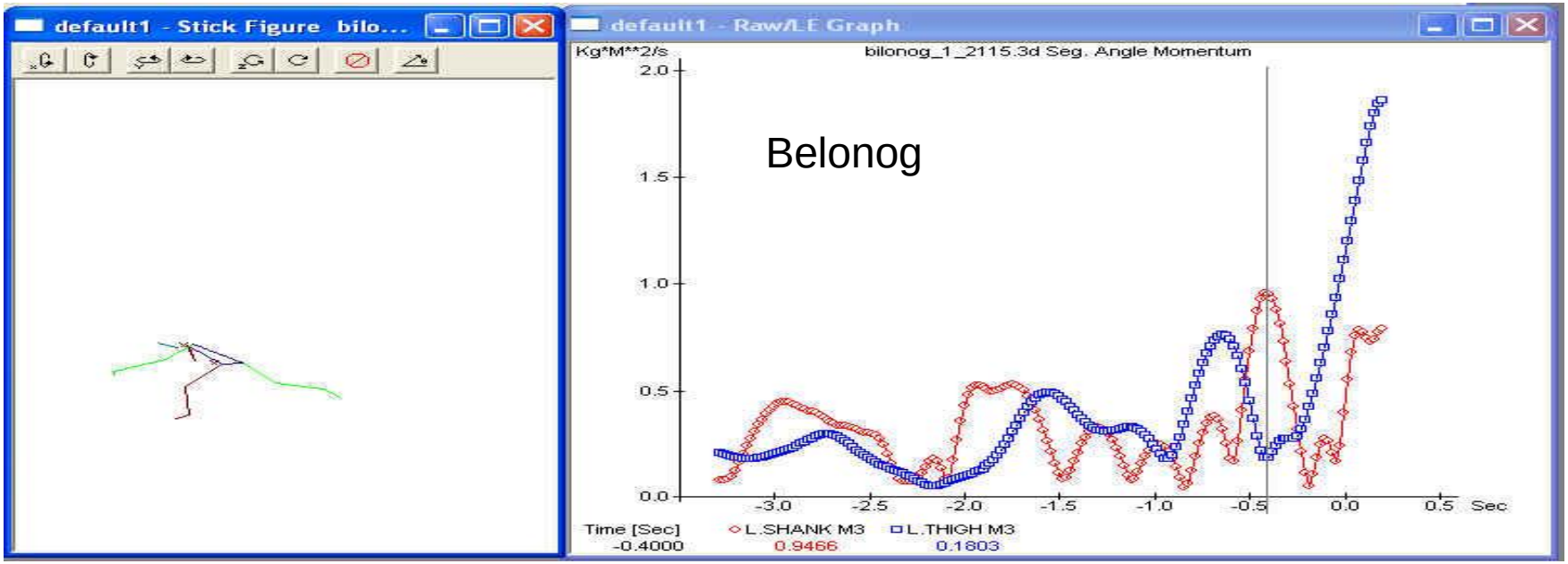


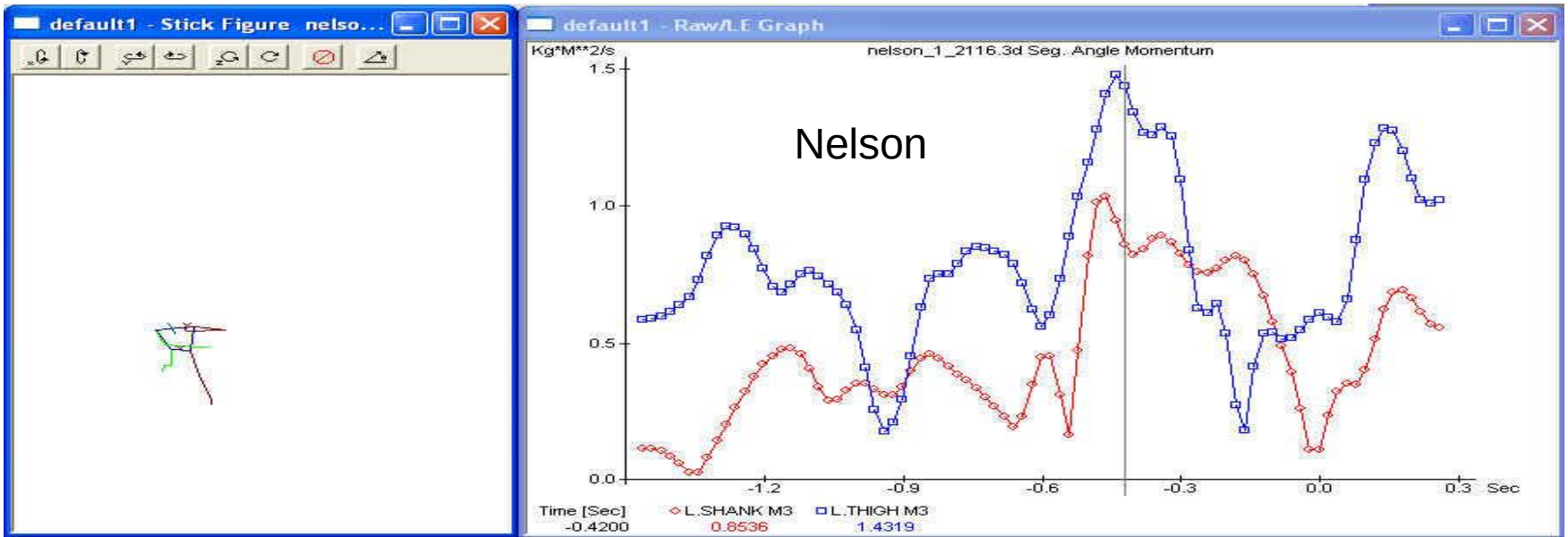


Belonog – Nelson comparison



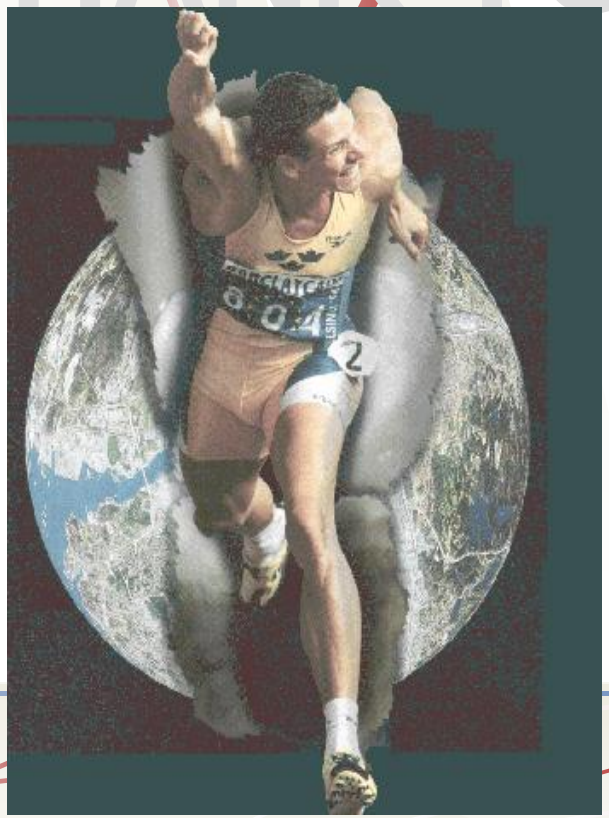
Angular Momentum for left Thigh and Shank





Discussion: The shot put distance depends on a variety of factors. The angle in which the athlete can achieve the optimal acceleration of his/her arm segments would represent an optimized performance. Factors that influence optimal performance would be the release height, release velocity, and release angle. Segmental acceleration depends on the technique that allow optimal combinations of the above parameters. Nelson and Yuriy both obtained the same throwing displacement, but Nelson was able to generate 7.2% faster shot projection velocity with 9.4% lower release height, and both competitors putted at the same projection angle. From the present analysis it was determined that Adam Nelson was closest to achieving optimal performance for his movement parameters

What is wrong in this movement?

You cannot shoot a cannon out of a canoe

THANK YOU