

# **INTEGRATED KINEMATIC DATA ANALYSIS OF AMERICAN ELITE HURDLERS**

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# PURPOSE

- ◆ **This project consisted of collecting video records of the third hurdle clearance by elite high and low hurdlers while performing a maximal practice run at an Elite Hurdler development camp at the USOC training facility.**
- ◆ **Temporal & kinematic variables were calculated for their performances.**
- ◆ **The results were presented using an integrated data/video analysis format which were reviewed the next day with the athlete and coach.**

# METHODS

- ♦ Video records were taken with Sony Hi8 camcorder at 60 Hz from front & side views of 6 Elite High & 3 Low Hurdlers while clearing the 3<sup>rd</sup> (High) & 5<sup>th</sup> (Low) hurdle during a maximal practice run at USTAF Hurdling Development.
- ♦ 14 body points & 3 hurdle points were digitized, transformed, and smoothed using a quintic spline.

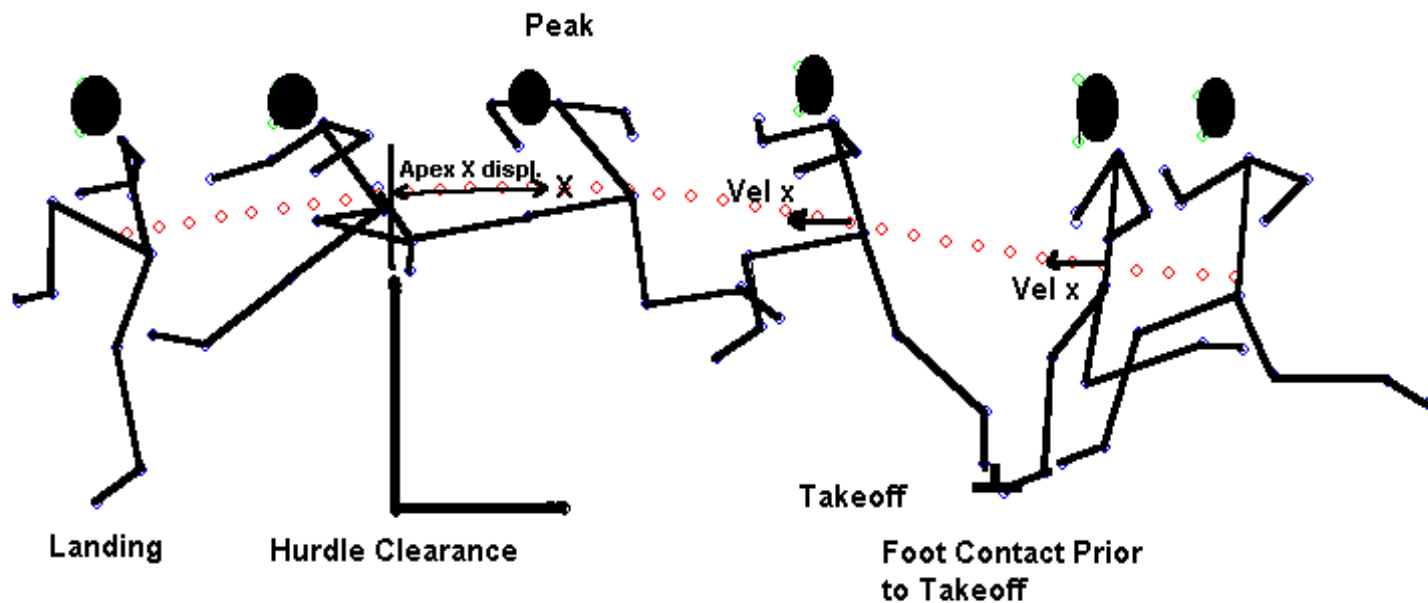
# QUANTITATIVE METHODS

- ◆ **Temporal variables calculated were:**
  - ◆ **Contact time**
  - ◆ **Flight time**
- ◆ **Kinematic variables calculated were:**
  - ◆ **CM horizontal velocity at stride contact prior to take-off,**
  - ◆ **CM horizontal velocity at take-off,**
  - ◆ **CM horizontal velocity at hurdle landing**

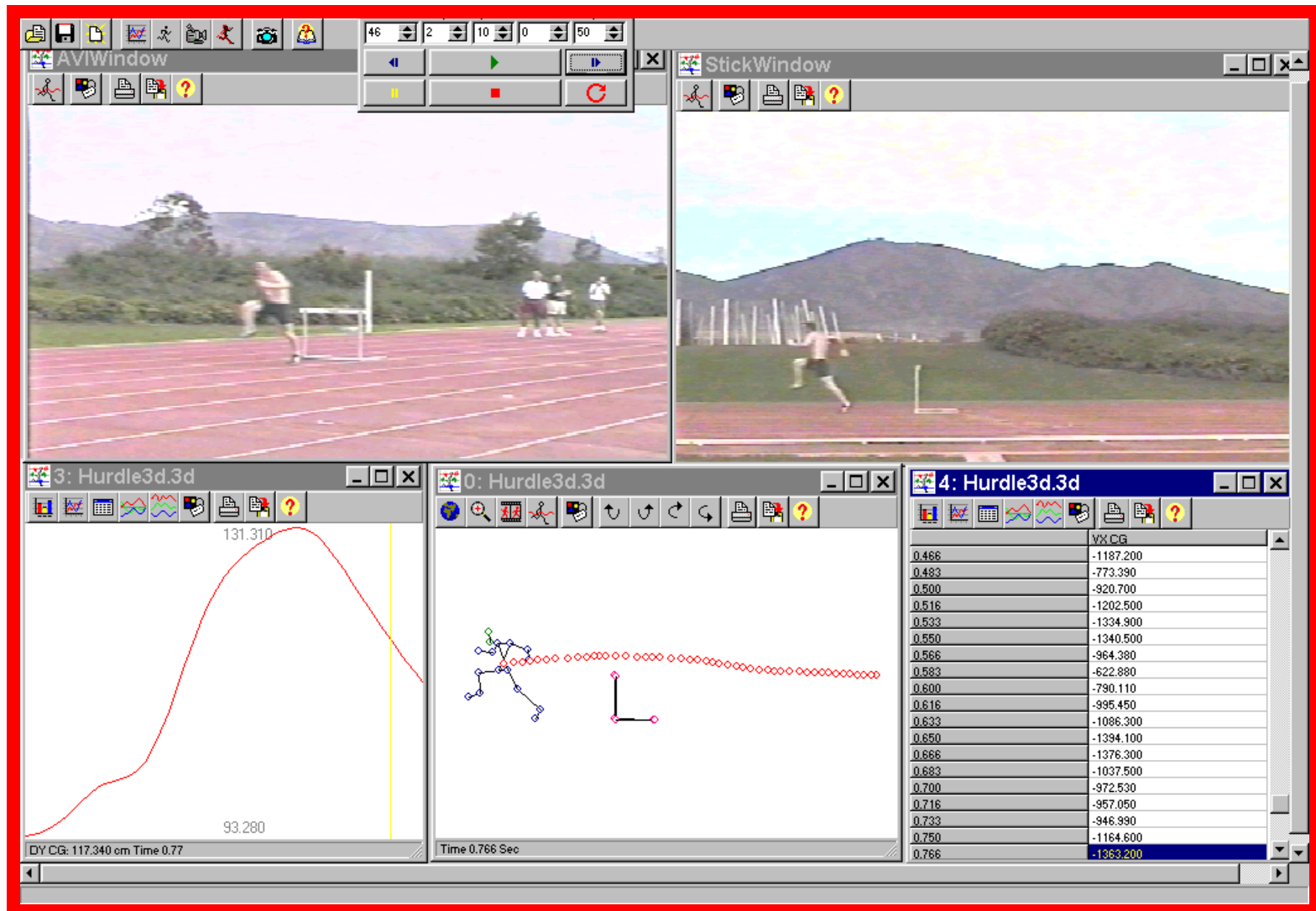
# QUANTITATIVE METHODS

- ◆ **Other kinematic variables calculated were:**
  - ◆ **CM Horizontal displacement of CM apex in comparison to hurdle clearance**
  - ◆ **Vertical CM elevation from take-off to hurdle clearance**

# Kinematic Hurdle Phases & Variables



# Hurdle Phases with Integrated Data

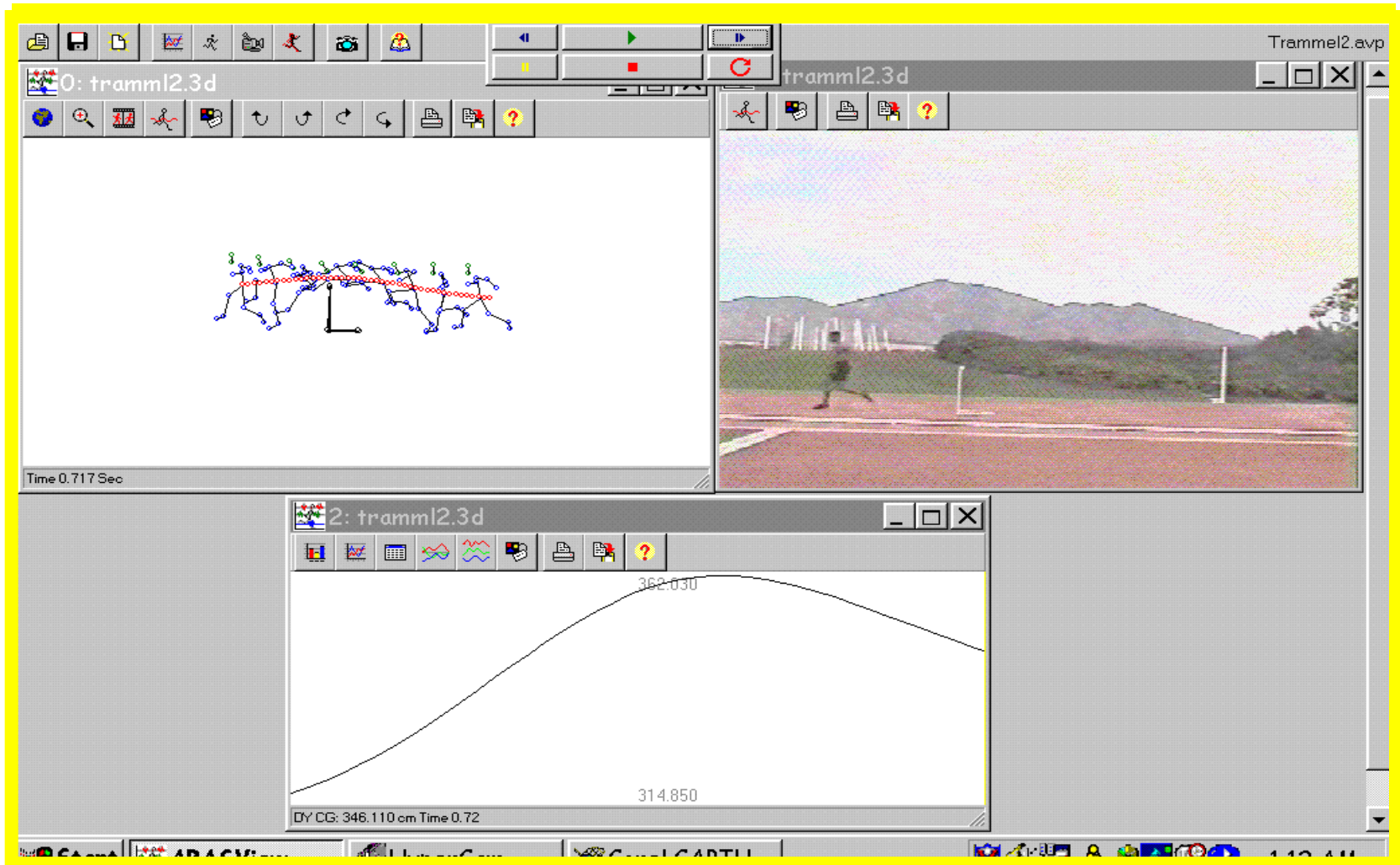


## **QUALITATIVE ANALYSIS WITH INTEGRATED DATA / VIDEO**

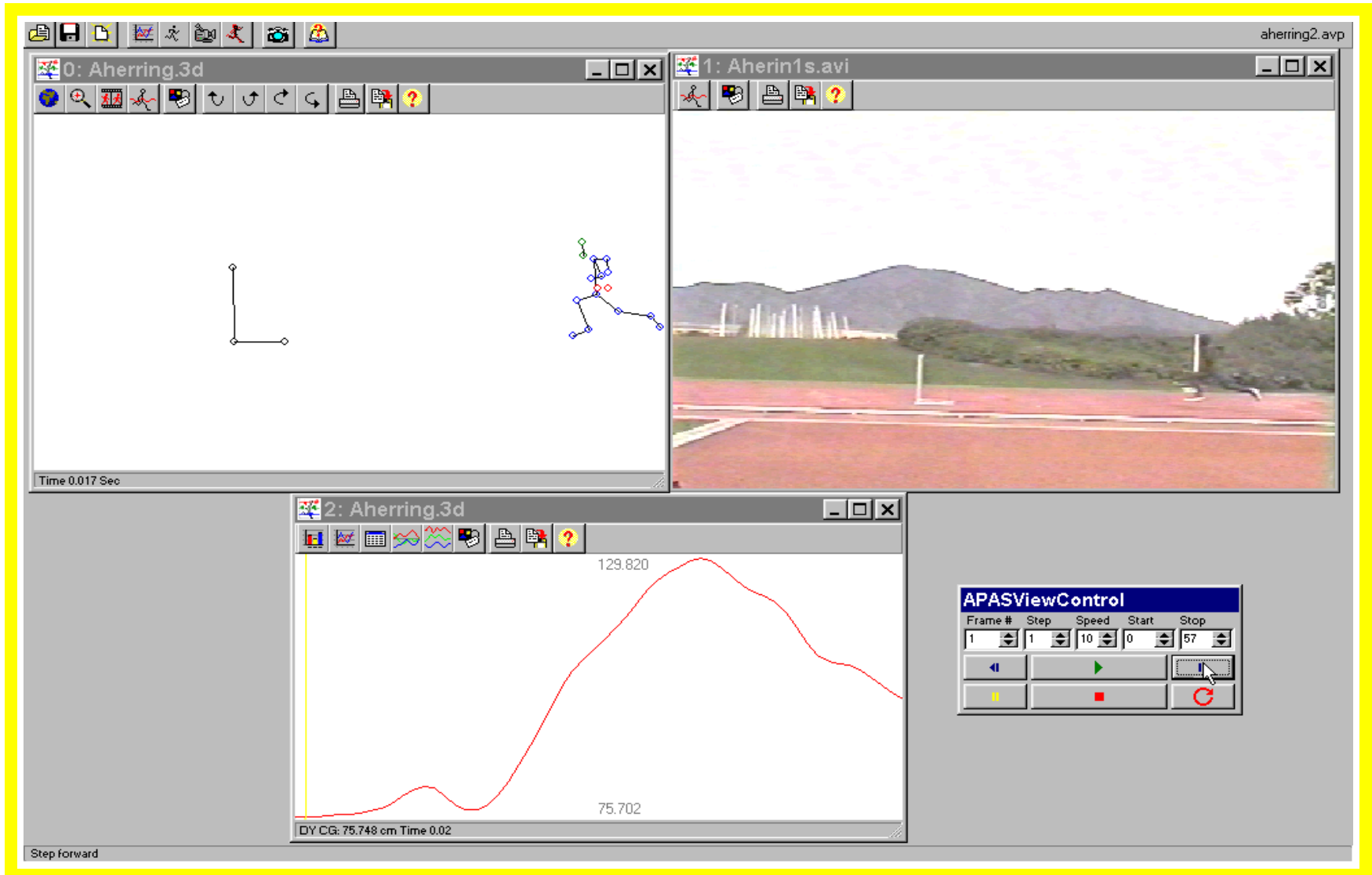
**Simultaneous data integration of video records, stick figure reconstruction, and kinematic data graphs of each hurdle trial were presented the next day to the athlete and coach for analysis.**



# INTEGRATED DATA ANALYSIS



# INTEGRATED DATA MOVIE



# RESULTS

## Temporal Data for High & Low Elite Hurdlers

Variable	High Hurdlers Mean $\pm$ SD	Low Hurdlers Mean $\pm$ SD
	.122 $\pm$ .023	.127 $\pm$ .001
	.366 $\pm$ .032	.367 $\pm$ .014

# RESULTS

## CM Horizontal Velocities for High & Low Elite Hurdlers

Low Hurdlers Mean±SD	High Hurdlers Mean±SD	Variable
0.74±0.02	1.80±0.08	
0.45±0.02	0.45±0.02	

# RESULTS

## CM Displacements for High & Low Elite Hurdlers

Low Hurdlers Mean±SD	High Hurdlers Mean±SD	Variable
14.4±2.0	18.2±2.0	
2.6±1.3	6.3±1.2	
66.9±23.9	23.2±24.2	

# CONCLUSIONS 1

- ▶ **Foot ground times reported were slightly faster than 0.135 s times found in previous Elite Hurdler project by R. Mann (1993).**
- ▶ **Flight times of .37 s were similar to those found for lesser skilled hurdlers in 1993 report but slower than .31s found for good hurdlers.**

## CONCLUSIONS 2a

- ▶ At takeoff the High hurdlers' CM slowed down  $18 \text{ cm} \cdot \text{sec}^{-1}$  while the Low hurdlers increased their CM velocity by  $26 \text{ cm} \cdot \text{sec}^{-1}$
- ▶ The deceleration seen at takeoff would be indicative of an overstride prior to takeoff.

## CONCLUSIONS 2b

- ▶ At landing the High hurdlers experienced a slight increase in CM horizontal velocity  $5 \text{ cm} \cdot \text{sec}^{-1}$  and the Low hurdlers slowed down significantly  $-85 \text{ cm} \cdot \text{sec}^{-1}$  at contact because of their early takeoff.



## **CONCLUSIONS 3a**

- ▶ **High hurdlers elevated their CM 18 cm and Low hurdlers' CM rose 14 cm at hurdle clearance from takeoff position, while hurdle height difference is 8 cm.**
- ▶ **High hurdlers found a more effective method to negotiate the taller hurdles than Low hurdlers.**

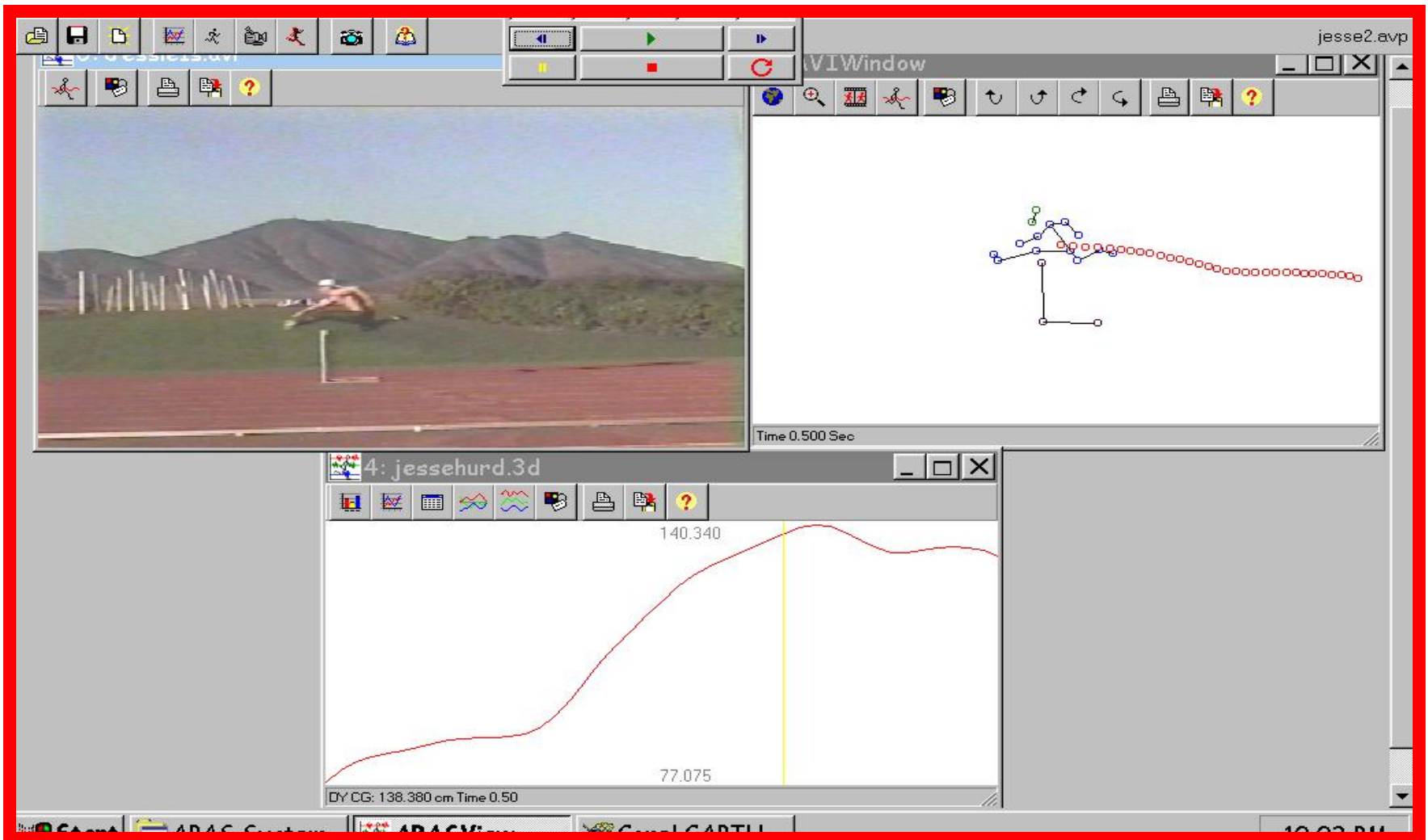
# CONCLUSIONS 3b

- ▶ **High hurdler's CM peaked 23 cm before the hurdle while Low hurdlers peaked 66 cm prior to the hurdle.**
- ▶ **Both groups of hurdlers need to develop better CM flight trajectories so that the apex coincides with the hurdle, resulting in less elevation and shorter flight times.**

# **DATA INTEGRATION CONCLUSION**

- ▶ **Simultaneous integration of video, stick figures and data was found to be an effective visual coaching tool for hurdling technique analysis for the providing immediate feedback to the athlete and coach.**

# SIMULTANEOUS INTEGRATION OF VIDEO, PATHWAY TRAJECTORIES & DATA



# COMPARATIVE TECHNIQUE ANALYSIS

TramArnold.avp

1: Arnold3s.avi

2: 2dhurdle.3d

3: arnold2.3d

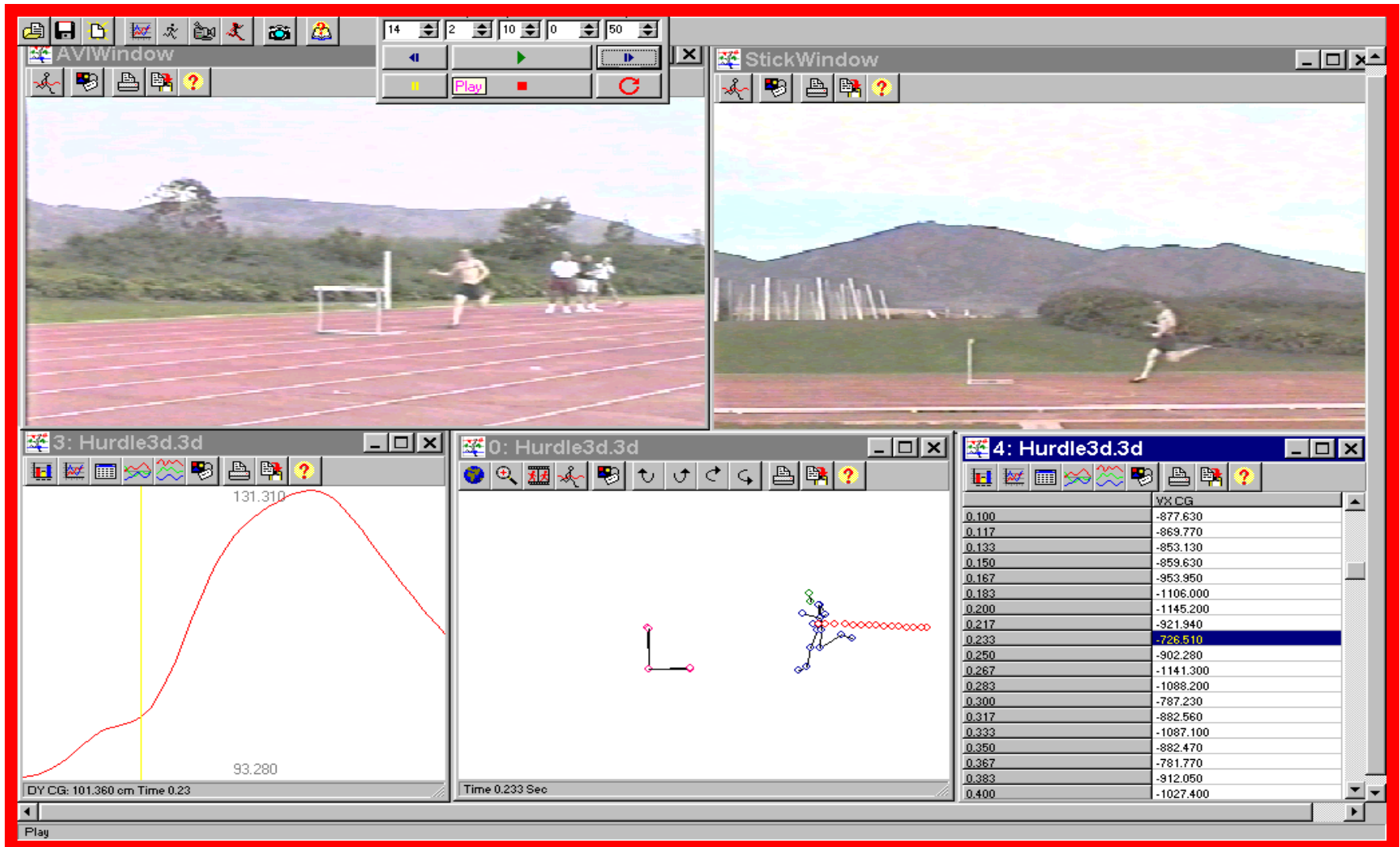
Frame # 33 Step 1 Speed 10 Start 0 Stop 36

Time 0.550 Sec

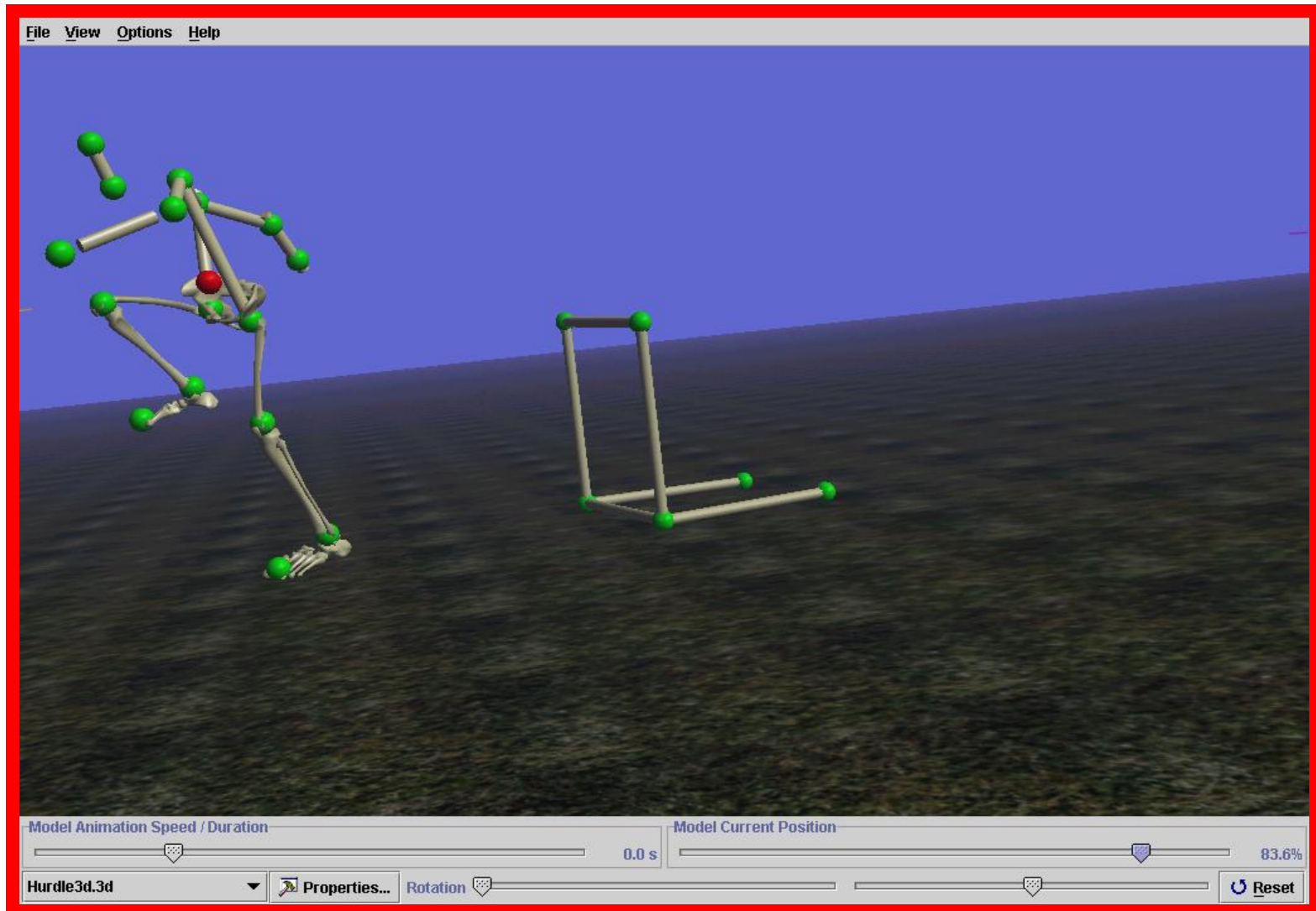
Time 0.600 Sec

Play

# TECHNIQUE ANALYSIS FROM MULTIPLE PERSPECTIVES



# INSTRUCTIONAL TECHNIQUE DEMONSTRATIONS



# **Acknowledgements**

**We would like to thank the United States Track and Field Association for their support of this project for the Elite Hurdler Development program and the USOC training facility at San Diego.**



**Thank you for your attention.**