BIOMECHANICAL SPORT ANALYSIS THROUGH DATA INTEGRATION

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PURPOSE

USE OF SYNCHRONIZED INTEGRATED VIDEO AND KINEMATIC DATA FOR SPORT ANALYSIS OF:

- DISCUS THROWING
- BASKETBALL FREE THROW SHOOTING
- HIGH JUMPING.

Project 1
Discus Throwing

The best and worst discus attempts by A. Washington (USA), 4th place competitor at 1996 Atlanta Olympic Games were analyzed from 2 camera views
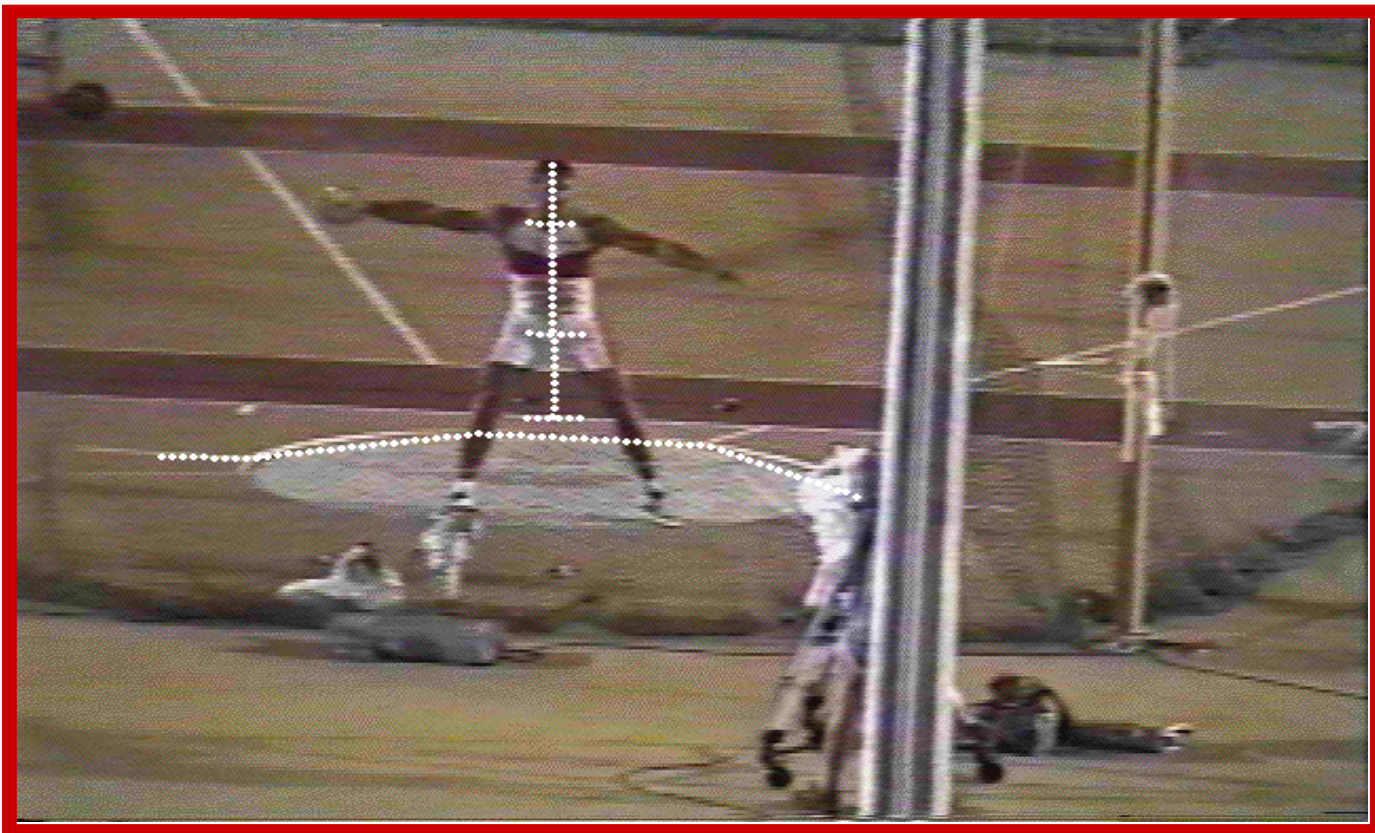
Camera Views

PROCEDURES

21 data points were digitized and transformed to real distances and smoothed at 10 Hz frequency cut-off with an second order Butterworth digital filter.
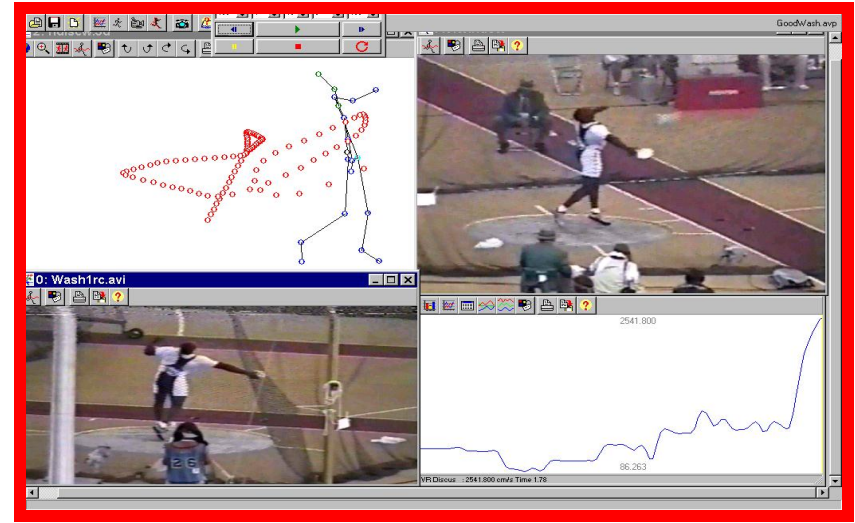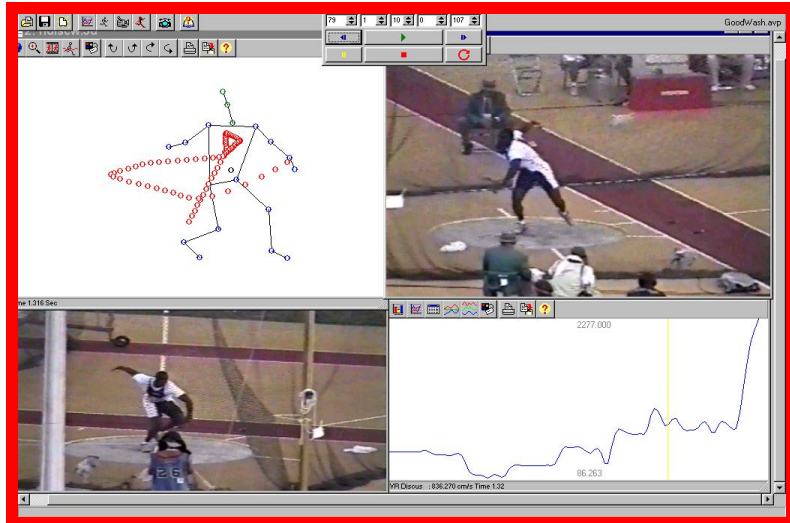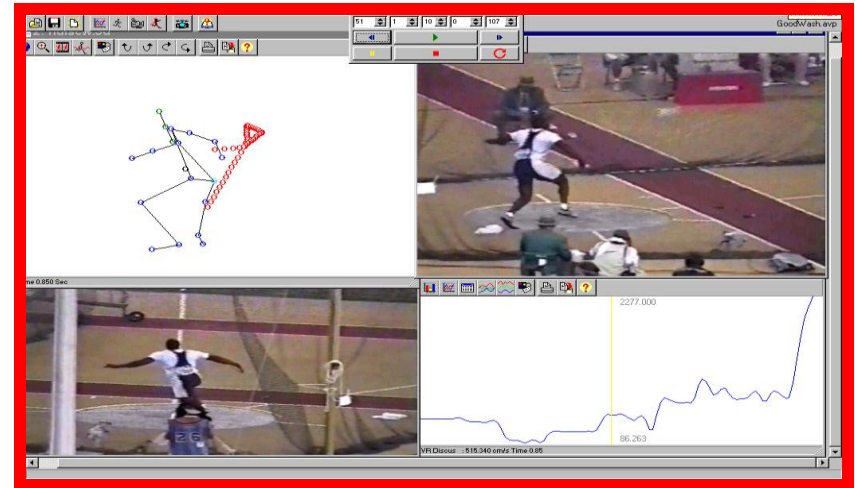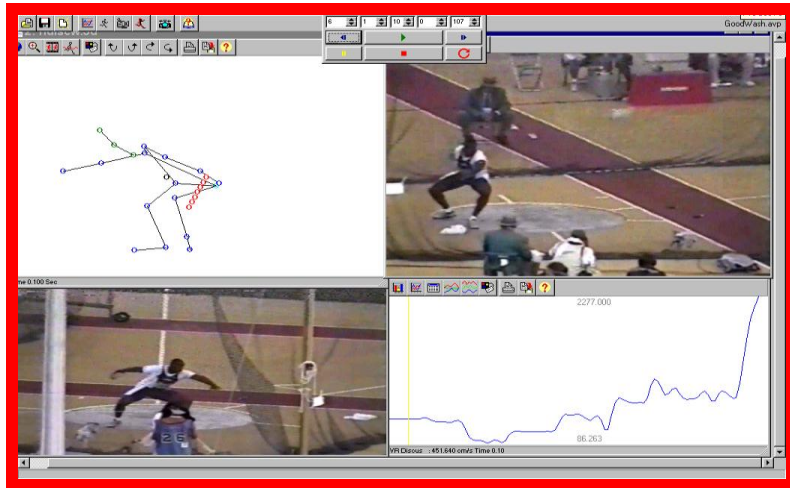
Calibration Cube

Washington Throwing Kinematics

Attempt	Distance m.	Velocity cm•sec^{-1}	Projection Angle rad (deg)	Release HT cm	Move Time sec
Best Throw	65.4	2541V_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 APAS view
Data Integration

Technique Comparison
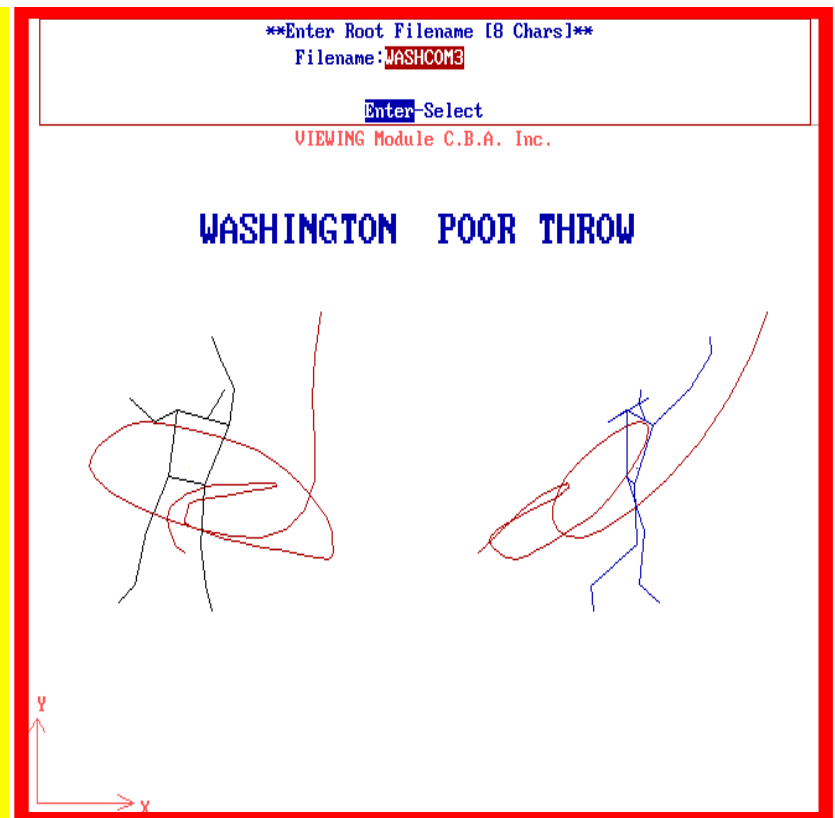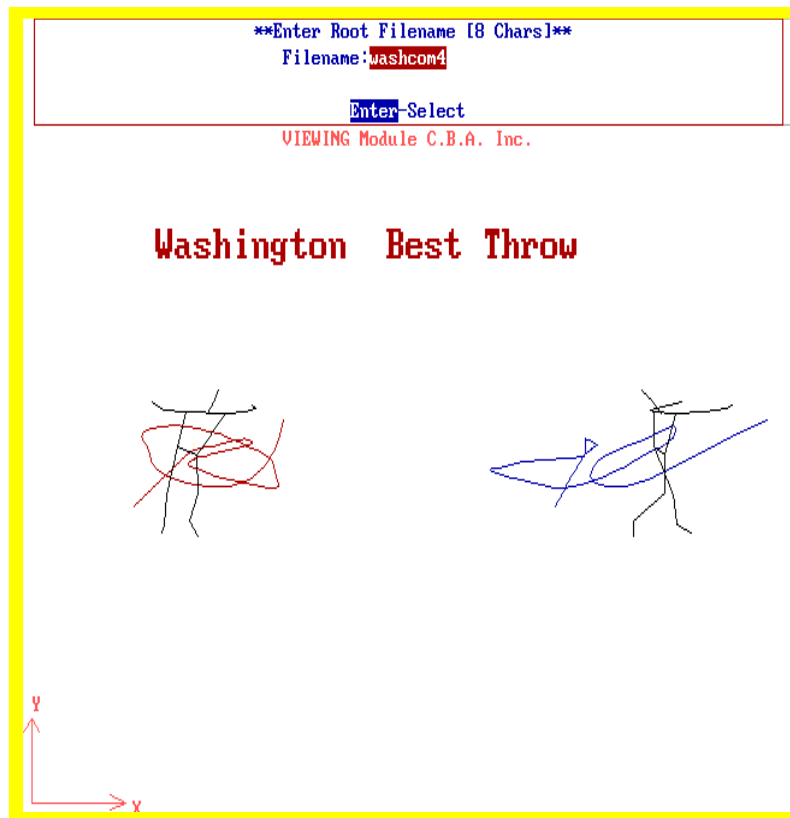
Poor Throw

Best Throw

Washington

DISCUS THROW KINEMATICS

Horizontal Shoulder Angular Velocity

Attempt	Max Angular Horizontal Shoulder Velocity rad•s^{-1}	Shoulder Ang Velocity at Release rad•s^{-1}
Best Throw	26.1	13.7
Worst Throw	20.1	11.2
% Change	-23%	-18%

Discus Conclusions

- The poor attempt had a -4% slower resultant disc velocity and a decrease of 43% in horizontal velocity.

- The poor attempt was released at 100% steeper angle.

- Horizontal angular shoulder velocity was 18% slower at release for the poor throw.

Analysis Results Reviewed with Athlete at Olympic Training Session
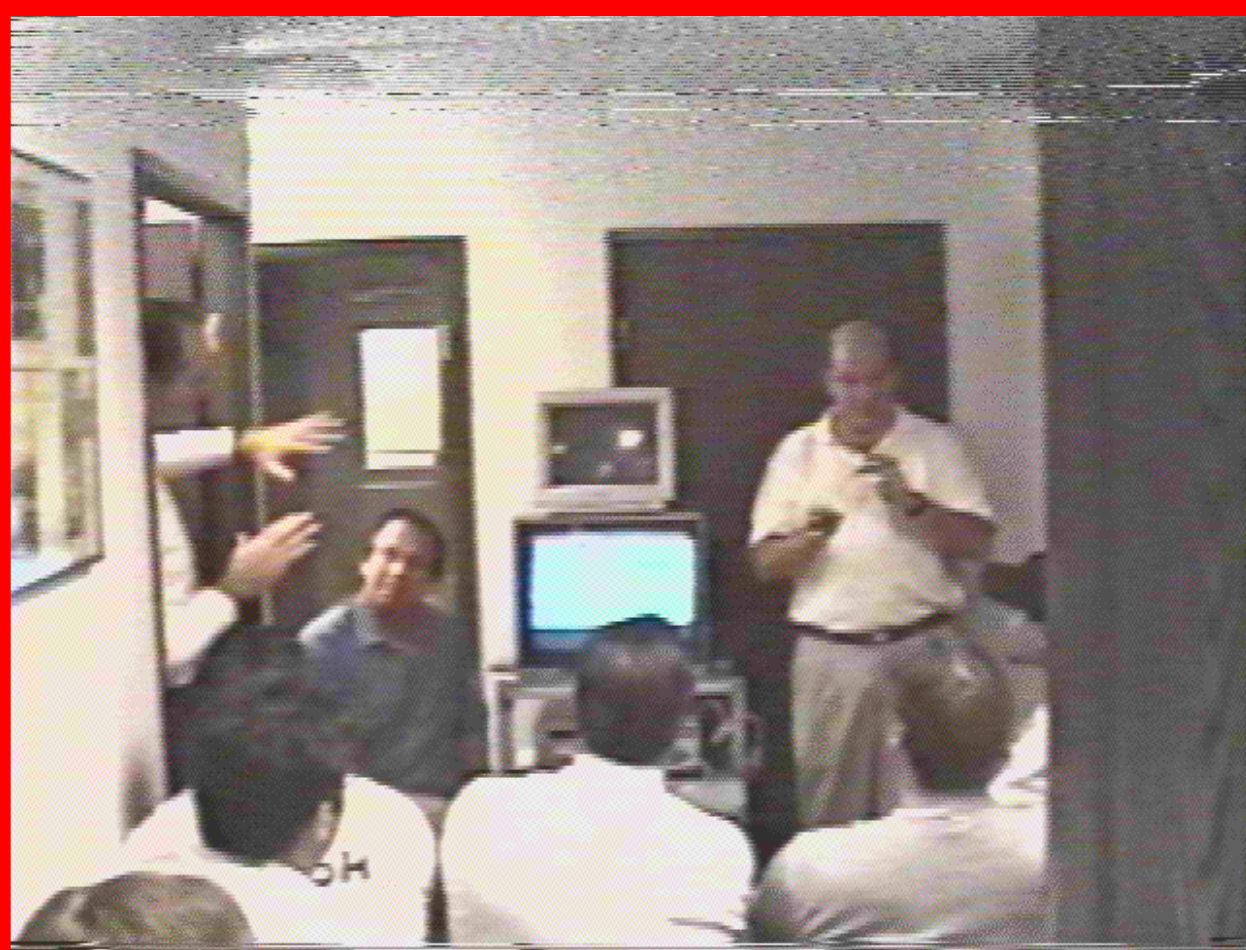
Project #2
Basketball Free Throw Shooting

- Video records from frontal & sagittal   views were taken of Indiana State University Women's Basketball Team while shooting free throws during conference competition.

- Data was digitized, transformed, and digitally smoothed (10 hz) to real distances.

Shooting Variables Calculated

- From the 3-D information, the athlete's ball projection velocity and angle for a successful and missed attempt.

- The shooter's elbow and shoulder angular velocities were calculated along the sagittal plane
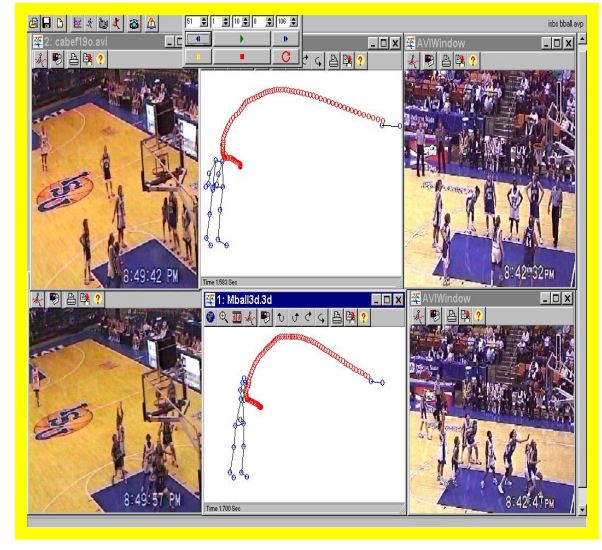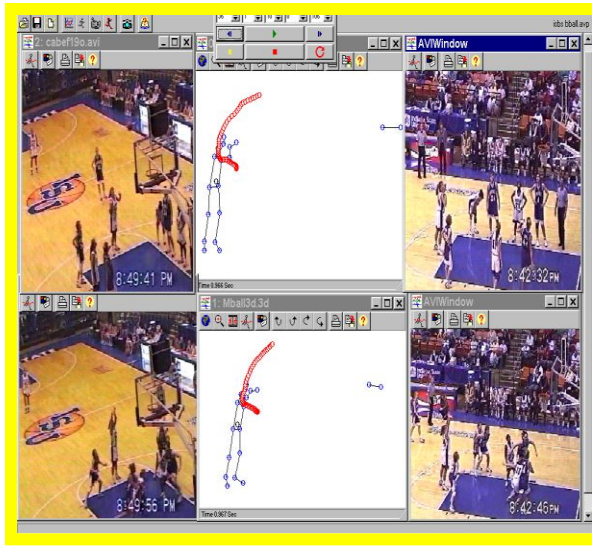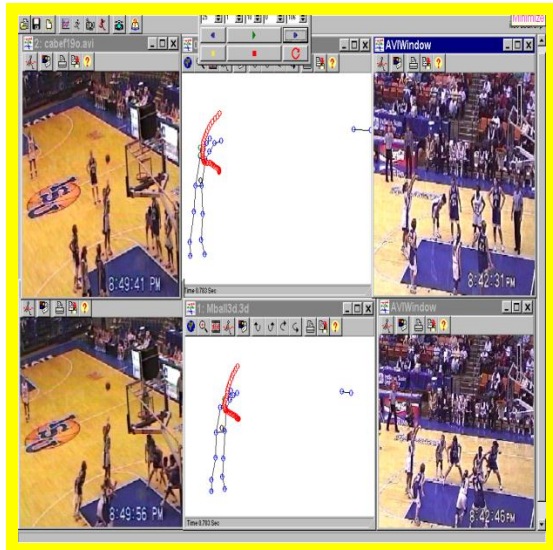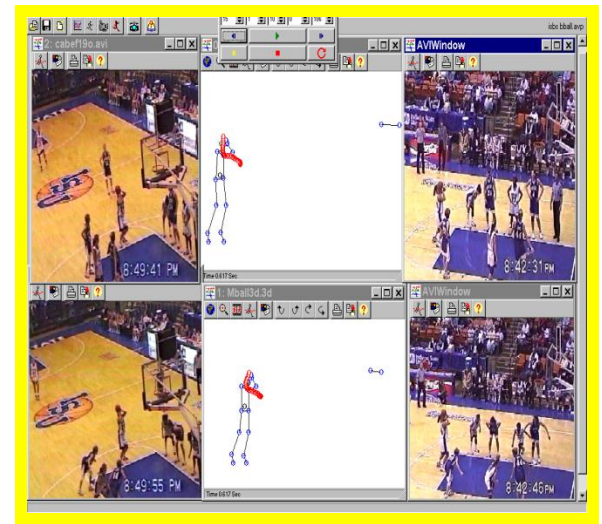
Shooting Trajectory Data

Attempt	Ball Proj Velocity cm•sec^{-1}	Ball Release Angle rad
Shot Made	399	1.1
Shot Missed	489	.9
% Change	+23%	-18%

Joint Angular Velocities

Attempt	Shoulder Angular Velocity rad•sec^{-1}	Elbow Angular Velocity rad•sec^{-1}
Shot Made	8.8	15.2
Shot Missed	11.1	29.2
% Change	+26%	+92%

Shooting Data Integration
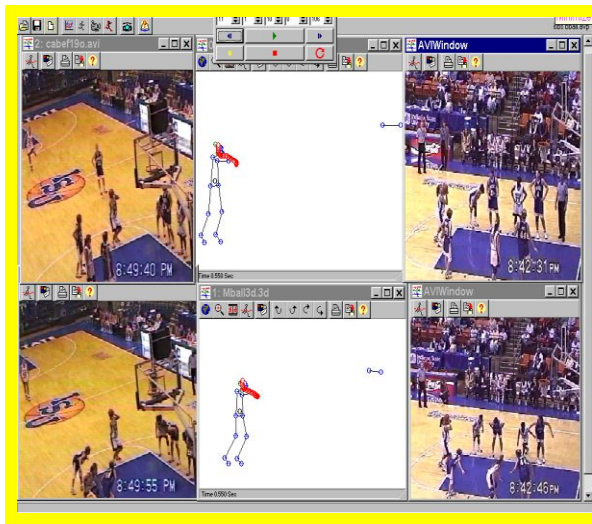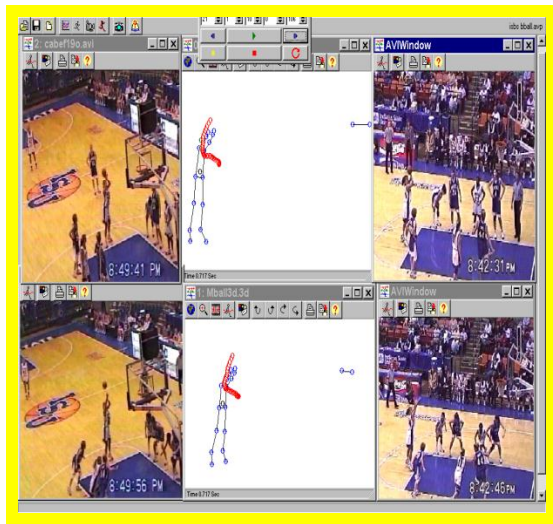
CONCLUSIONS

- **The missed shot was caused by a fast release velocity, flat release angle.**

- **Angular velocities were higher for the missed shot. Faster shoulder (26%) and elbow (92%) angular velocity was determined for the missed shot.**

- **The shooter pulled their hand back at release**

ISU BBall view Demo

Project #3
High Jumping

- **Simultaneous video records from a front right and left side viewing perspective were collected of a high jumping practice attempt (2.29m) of an elite collegiate high jumper.**

- **Data was digitized, transformed, and digitally smoothed at 10 Hz.**

- **The vertical displacements and vertical velocities of the body CM were calculated.**

- **Integrated data analysis of video and kinematic data was performed.**
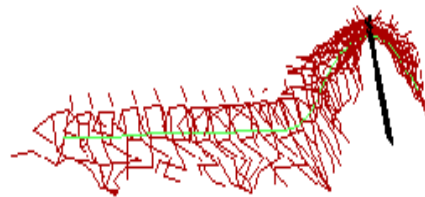
High Jump CM
Vertical Velocity

High Jump Technique

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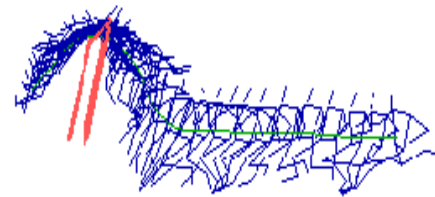Filename:hjumppat

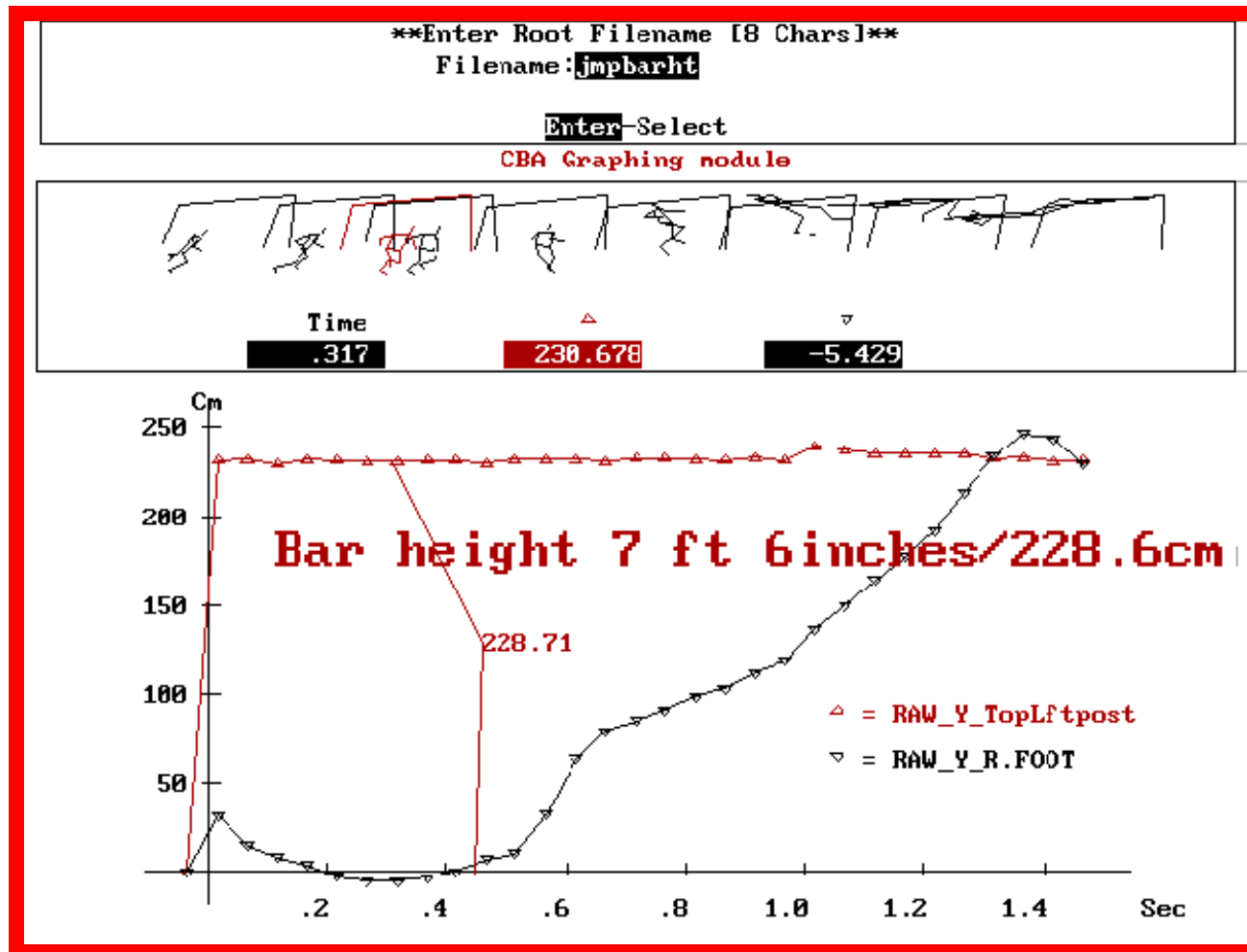Enter-Select
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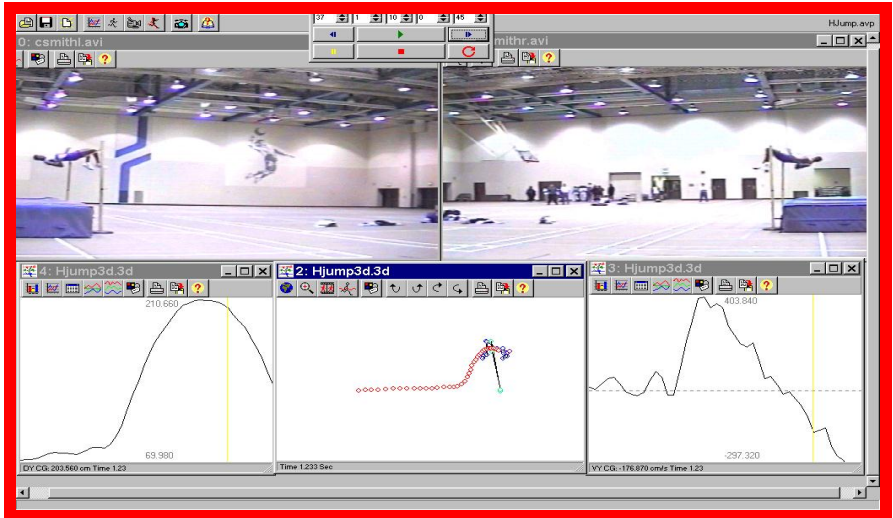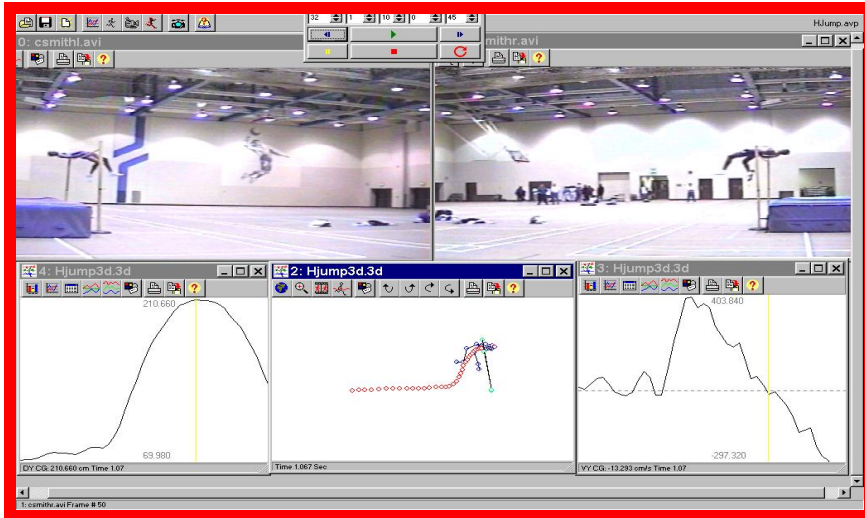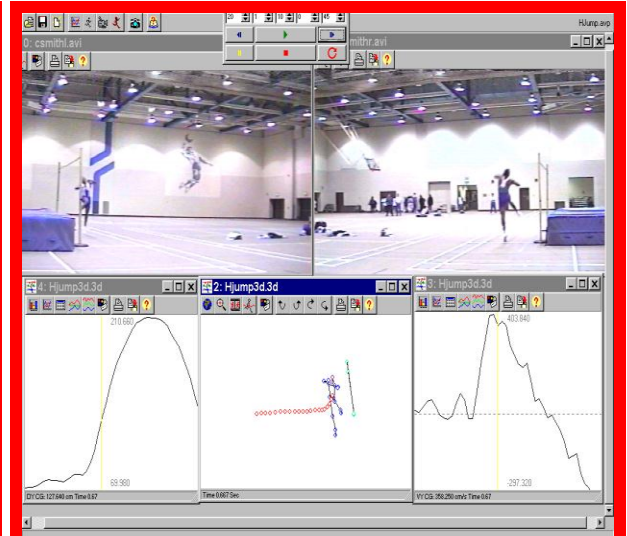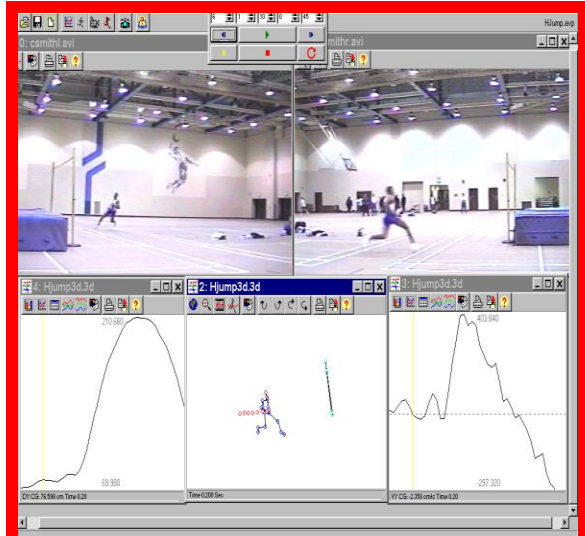
High Jump Smith 7ft 6 in

View from Right

View from Right

Jump Height Verification
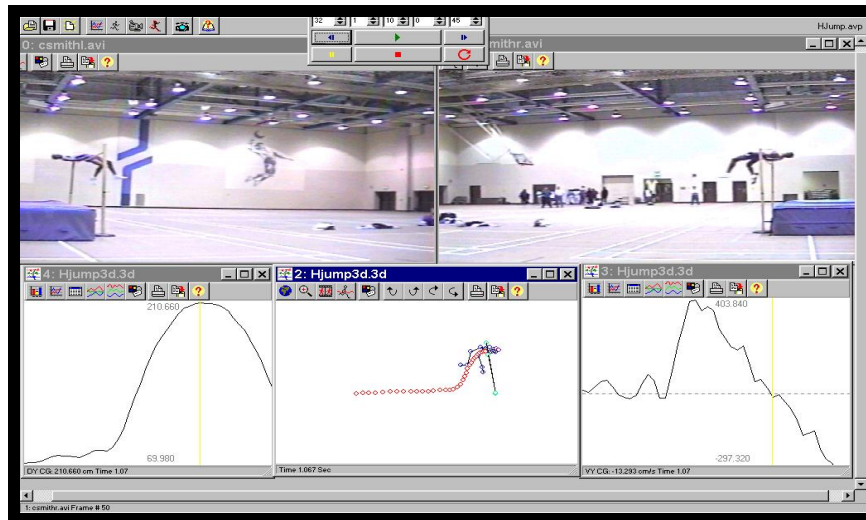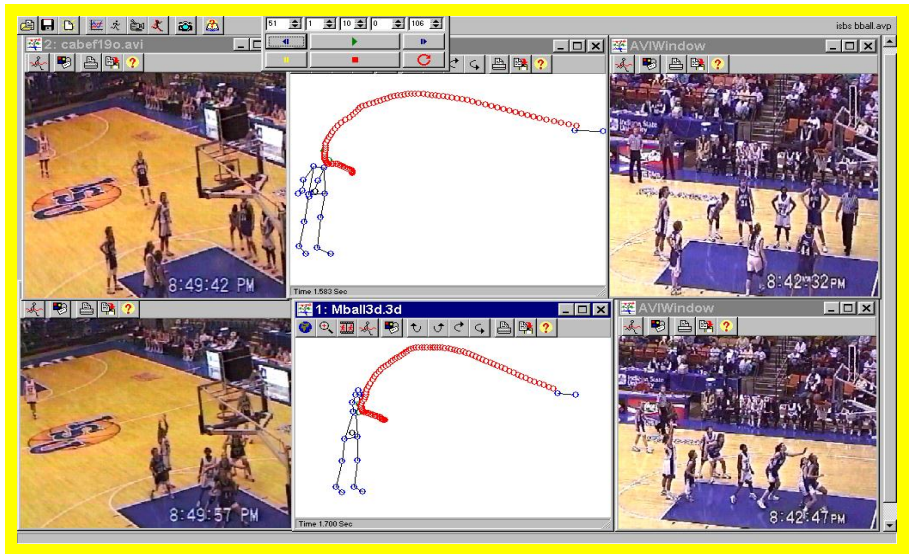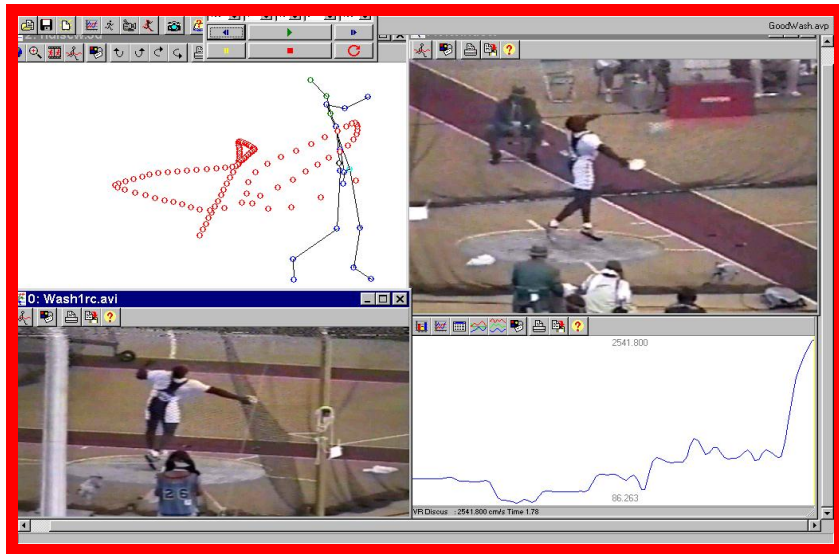
High Jump Integrated Data

Conclusion

- **The high jumper's takeoff occurred too far out from the bar but he adjusted his projection angle to peak over the bar.**

- **The high jumper's CM was at its apex during bar clearance. The CM passed 18 cm below the 2.28 m bar height.**

- **The jumper utilized a hip pike- hip drop maneuver to facilitate leg clearance**

High Jump APAS view Demo

Project Conclusion

Integration of kinematic data and video views on a synchronized time base using the Ariel APAS view software is an effective method to visually and quantitatively to analyze sport performance.

Thank You