The Ariel Performance Analysis System (APAS)

By
Gideon Ariel, Ph.D.
MOVEMENT ANALYSIS CAN BE APPLIED TO:

- Athletics
- Industry
- Medicine
- Space
ALL APPLICATIONS UTILIZED SIMILAR QUANTIFICATION TECHNIQUES
Basic Components of Motion Analysis System

- Notebook computer
- Portable VCR
- External monitor
- Video cameras
- Force plate
- EMG
- Portable printer
- Optional A/D devices
NEW TECHNOLOGIES
For Your Professional Toolbox

- Computerized Video Analysis [Kinematics]
- Force Plate [Kinetic Ground Reaction] 3D
- Dynamic EMG
- Internet Interface
Analysis of Performance Require:

Video Recording
Digitizing the Data
  Manual
  Automatic
Transformation of the Data
  2D - Two Dimensional
  3D - Three Dimensional
KINEMATIC PROCESSING STEPS

DATA ACQUISITION
FRAME GRABBING
TRANSFORMATION
SMOOTHING
DATA ANALYSIS
Video Recording and Digitizing the Data
Reidel Gold Medal
Data Transformation
Smoothing of the Data
Filtering Algorithms
- Cubic Spline
- Digital Filter
- Quintic Spline
- Fast Fourier Filter
- Segment Constraint
KINETIC
FORCE PLATE
GROUND REACTION FORCES
Analog Data Input

- Force Plates
  - Horizontal force
  - Lateral force
  - Vertical force

- EMG Data
  - Muscle Activity
  - Timing of Muscular firing

![Graph showing force plate data]
FORCE PLATE

A-D BOX
NORMAL GROUND REACTION

CBA Analog Module

A = FX-1
B = FY-1
C = FZ-1

Y = 64.382
Y = -63.068

Lb

0.5 1.0 1.5 Sec
Capability of Monitoring 32 Channels of EMG
PHOTOGRAMMETRIC TRANSFORMATION WITH PANNING

K.A. Stivers, G.B. Ariel, J. Wise, M.A. Penny, A. Vorobiev, A. Gouskov, N. Yakunin
Panning Head

- optical angular encoder
- selection of the bar width and position within the frame
- transformation of the encoder impulses to the video signal - the bar width proportional to the panning angle length
- video output to the camera's EVF/Character Generator Terminal
Panning Calibration

Left calibration object

Right calibration object
The Biomechanical Project at the Atlanta Olympic Games, 1996

Sponsored by the International Track and Field Coaches Association
by
Gideon Ariel, Ph.D.
Wingate Institute
History was made at the Atlanta Games by utilizing the Internet to provide Biomechanical data immediately for use at remote sites.
The purpose of the research conducted at the XXVI Olympiad in Atlanta was to expand the biomechanical applications and the interactive capabilities of the Internet to make sport performances rapidly available to everyone.
Under the auspices of the International Track and Field Coaches Association, the track and field events which were performed at the Atlanta Olympics in 1996, were selected to illustrate these procedures because these activities uniquely captivate an enthusiastic world-wide audience.
The Internet has opened a new frontier for research and international cooperation on multifaceted studies.
The Cyber Coach
LONG JUMP TECHNIQUE: POWER OR SPEED?

A. VOROBIEV, G.B.ARIEL, I, TER-OVANESSIAN
## Comparative Kinematic Characteristics

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

last strides of the approach
Change of the Height of CM

last strides of the approach
Angular Displacement

hip joint
Angular Velocity

hip joint

![Graph showing angular velocity of the hip joint.](image)
Why YOU should select the Ariel Performance Analysis System for YOUR Movement Quantification needs?
THANK YOU