Performance Support in Finnish Javelin Throw

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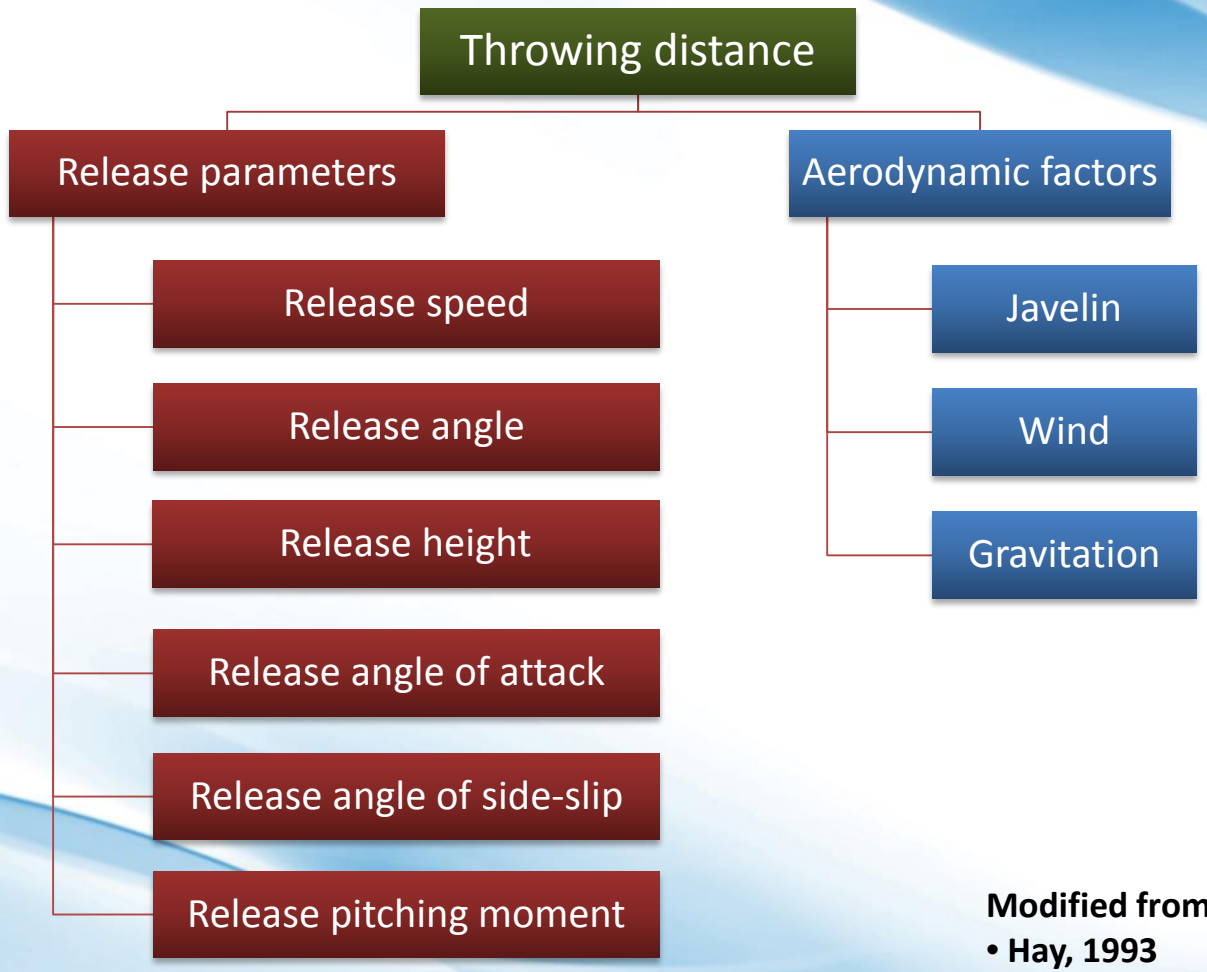
- The history of javelin research in Finland
- Different methods and feedback
- Individual Throwing Techniques
- Way to Rio 2016

Introduction

Factors affecting to throwing distance



Modified from:

- **Hay, 1993**
- **Morriss and Bartlett, 1996**

Javelin research at 1990s

- The whole 90’s very active time
- Special project during 1991-1999
- 78 athletes, totally 315 throws analyzed
- 3D motion analyses, ”throwing gate”, speed radar

Javelin research at 1990s

Javelin research at 1990s

- Javelin gun was developed
  - For testing javelin flight characteristics
  - From an old anti-aircraft gun
  - Pneumatic launch
- Extensive model testing with the gun 1995-1998
  - Diff. between and inside javelin models
  - COG tests for women's javelin
  - Change of IAAF rules for womens javelin 1999 (3 cm change of COG)
- The gun again in action in 2008 for the modern models

Javelin research on the 21st century

- Technique analyses again starting in 2004
  - Gradually increasing year by year
  - Latest years
    - 2-3 training camps
    - 2-3 competitions per year analyzed
- During 2005-2016
  - Totally 753 throws analyzed
    - 207 competition throws
    - 458 training throws
  - 552 for men and 231 for women

Methods and feedback: Traditional motion analysis

- For measuring
  - Javelin release parameters
  - Body movements during throwing
- Basic 3D motion analyses since 1991
- Frame rate development
  - 1990s: **100 / 60 fps**
  - 2004-2006 **125 fps**
  - 2008 -> **250 fps**
  - 2014 -> **200 fps**

Methods and feedback: Traditional motion analysis

- In competitions
  - 2-3 throws/athlete
  - Digitazing the whole body landmarks + javelin
  - About 30 different variables
  - Results in 1 week after competition
- Accurate and systematic info about competition throws
- Coaches wating impatiently release speed values and other results…

Methods and feedback: Traditional motion analysis

- In training camps
  - 4-8 throws/athlete from one training session
  - Digitazing only javelin + some extra points
  - 9-18 different variables
  - Results in 8-24 hours
- Fewer variables – better understanding and usability
- Feedback faster, but still… it should be instant

Methods and feedback: Fast motion analysis

- For instant feedback about release parameters
- Used from 2013 once a year in April indoor
- Using Simi Motion
- Reflecting markers on the javelin + autodigitizing
- Results for the release parameters in 2 min.

Methods and feedback: Fast motion analysis

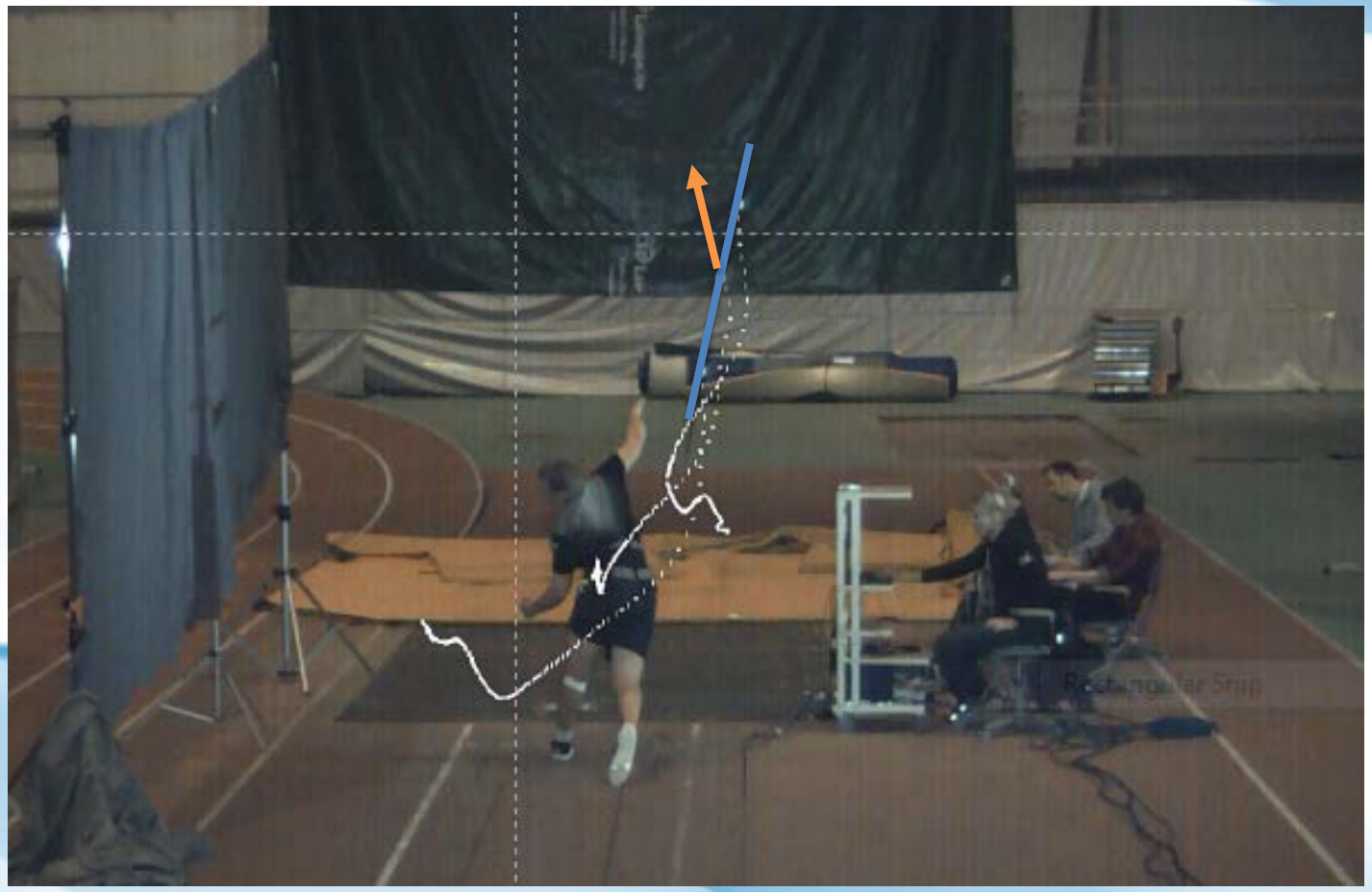
- Concentrating on the control of the javelin

Methods and feedback: Fast motion analysis

- Concentrating on the control of the javelin

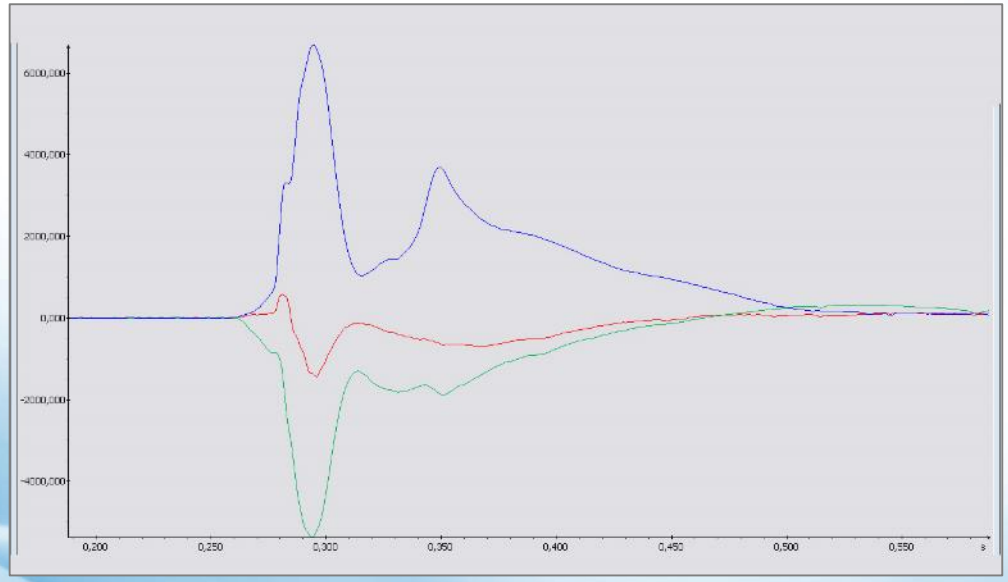
Methods and feedback: Fast motion analysis

- Concentrating on the control of the javelin

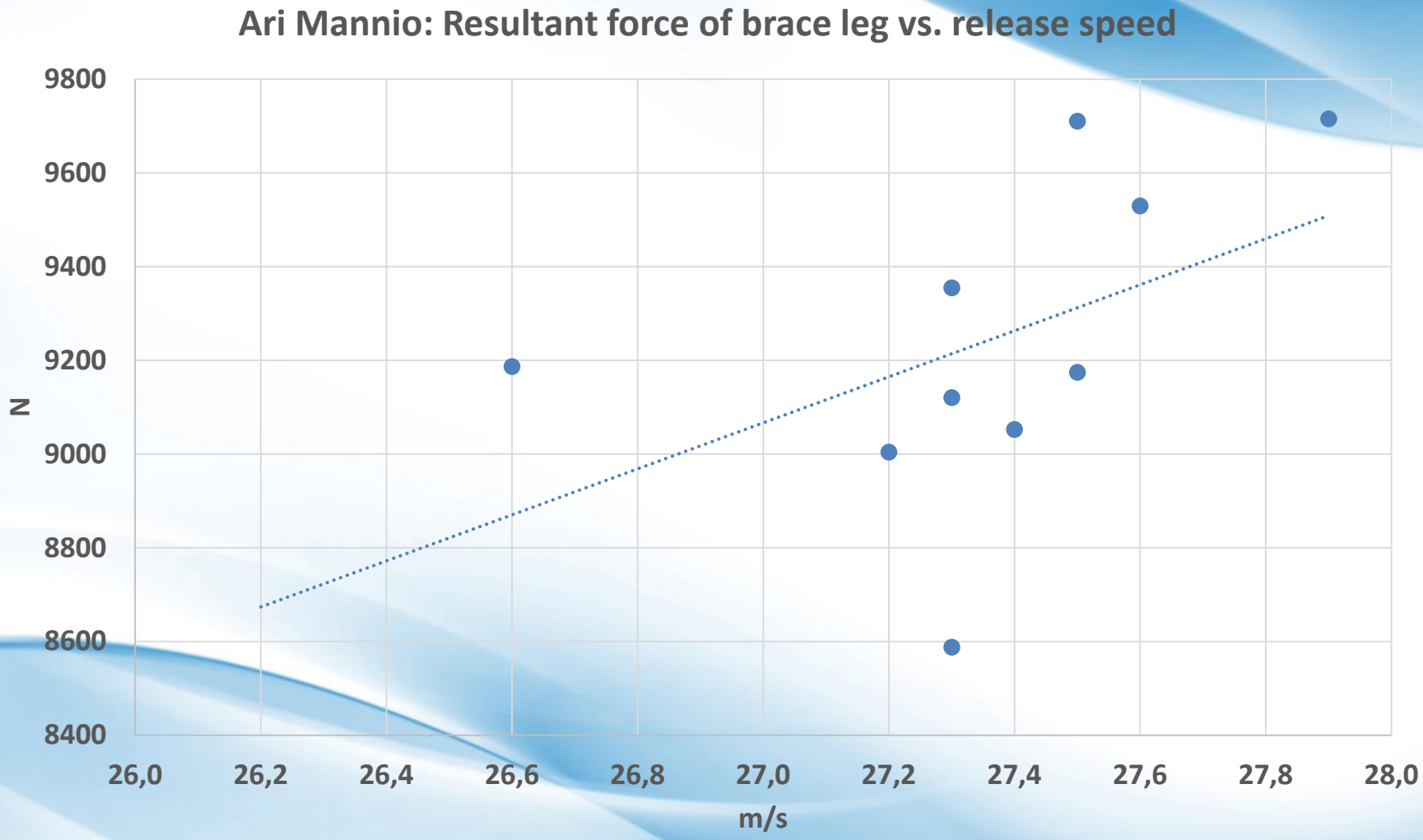


Methods and feedback: Force plates

- For getting accurate information about force production in 3D
- Together with fast motion analyses indoor
- So far, mostly visual and qualitative feedback than systematic statistical results



Methods and feedback: Force plates

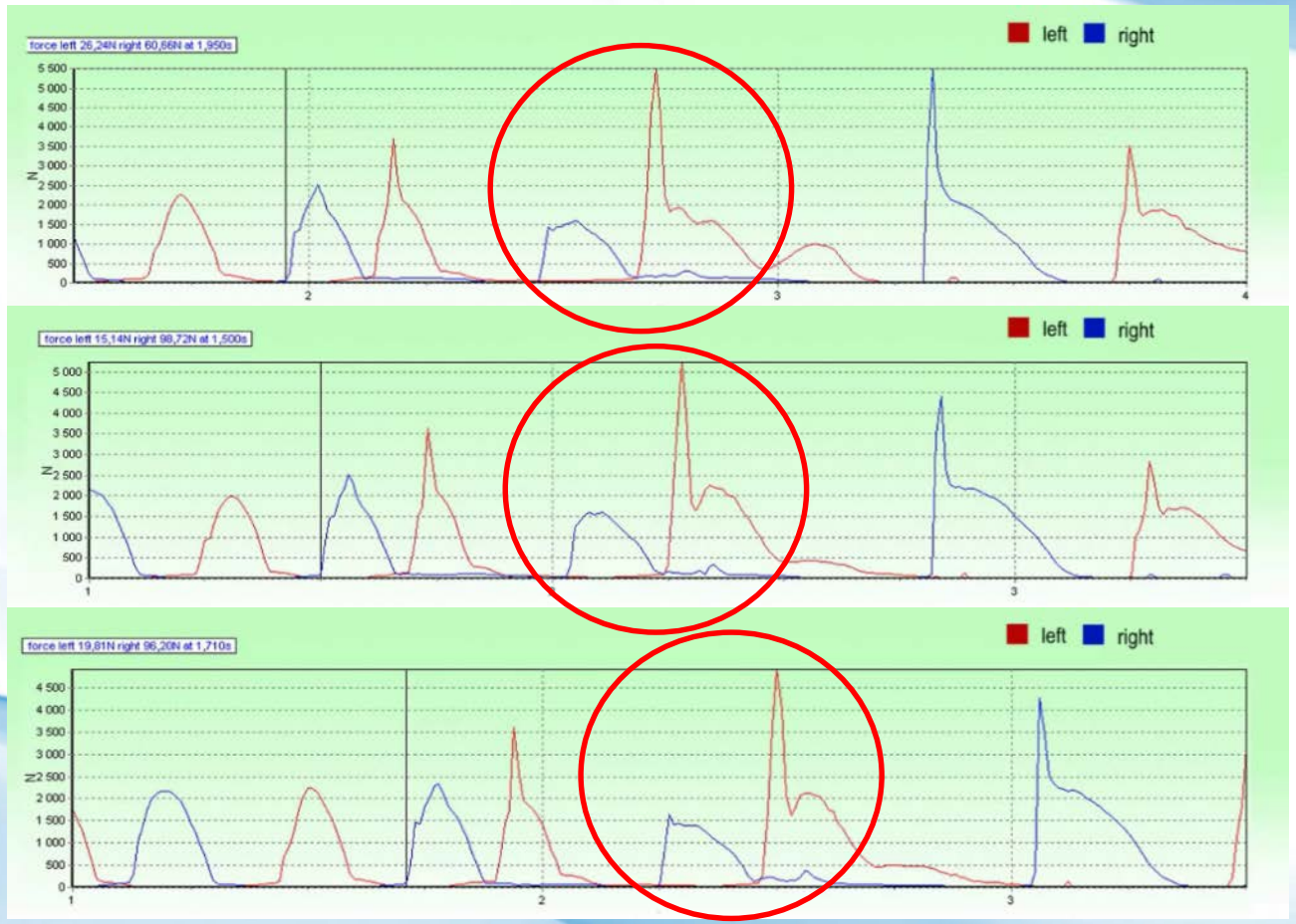


Methods and feedback: Pressure insoles

- For analyzing pressure distributions and force production
- Novel Pedar system
- 99 recording units/insole
- Sampling rate 100 Hz
- Received data:
  - Pressure distributions under feet
  - Calculated total forces
  - Timing and force profiles
- Insoles used twice at two different training camps 2011

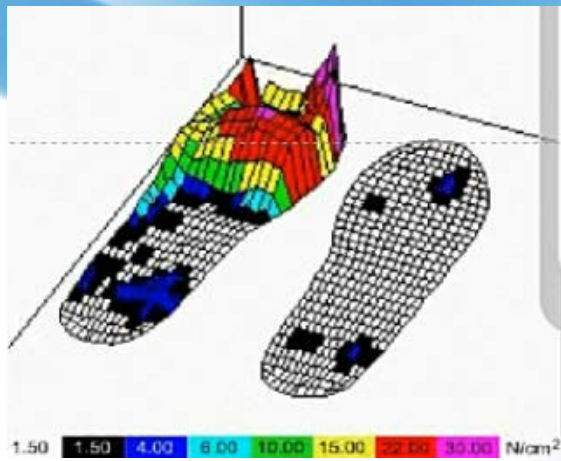
Methods and feedback: Pressure insoles

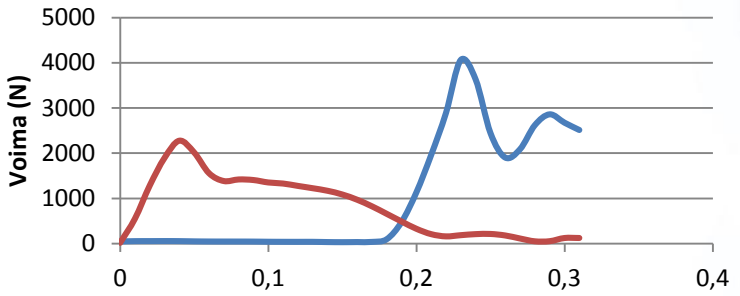
- Force production curves of throwing steps:

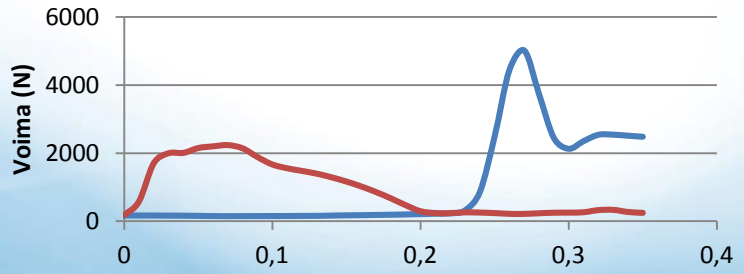


Methods and feedback: Pressure insoles

- Individual visual analyzing propably the most rewarding way
- Pressure distributions not very useful
- Insole measures pressure, so calculated total forces represent only vertical forces!
  - Horizontal forces even more important in javelin

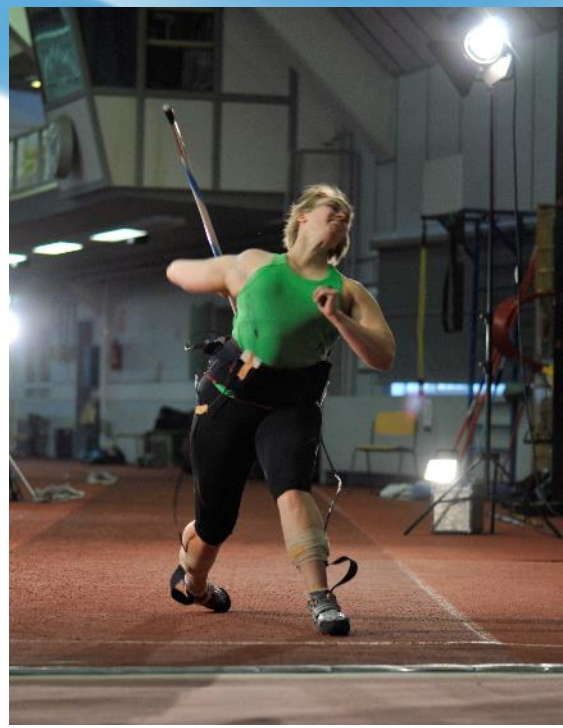




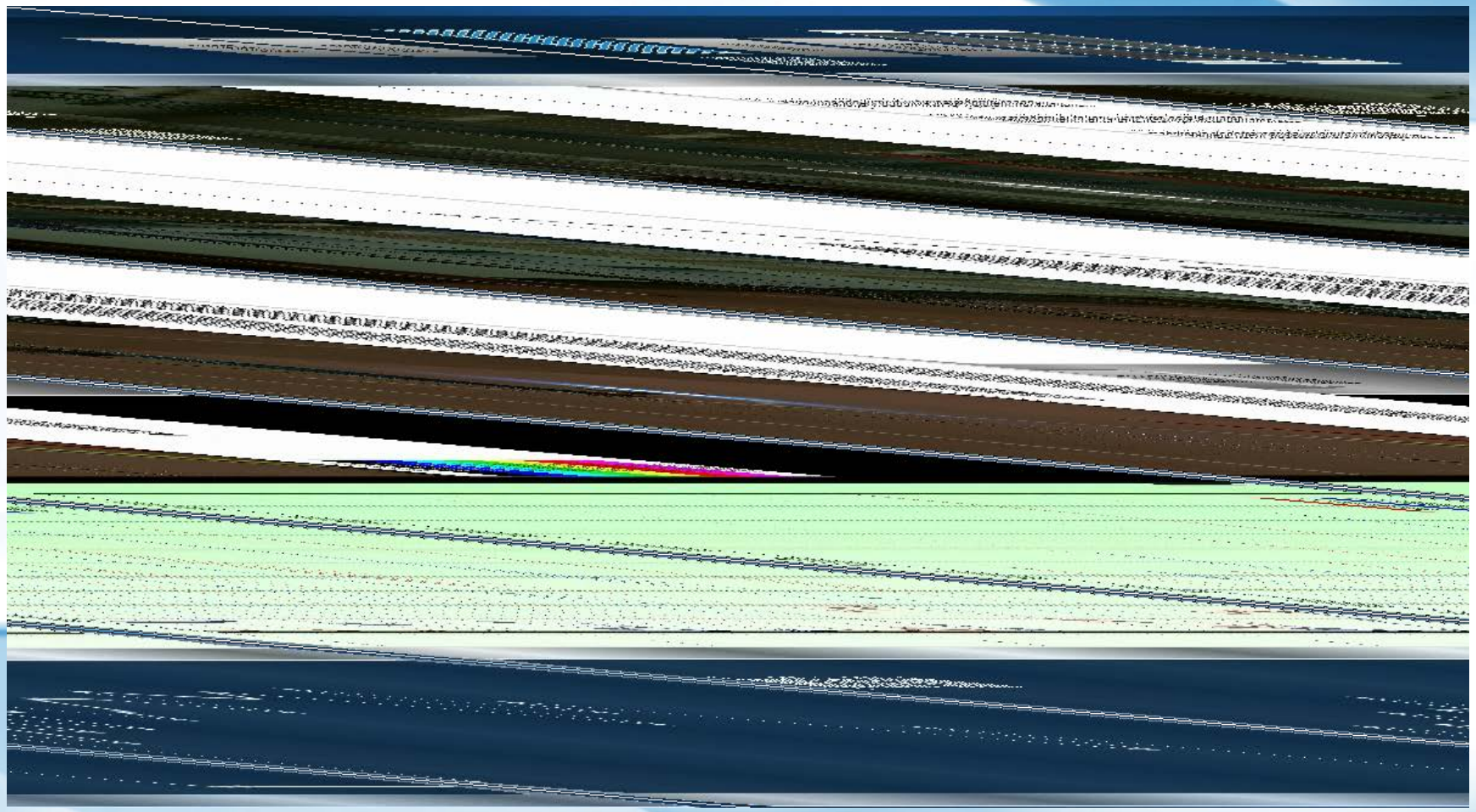


Methods and feedback: Speed radar

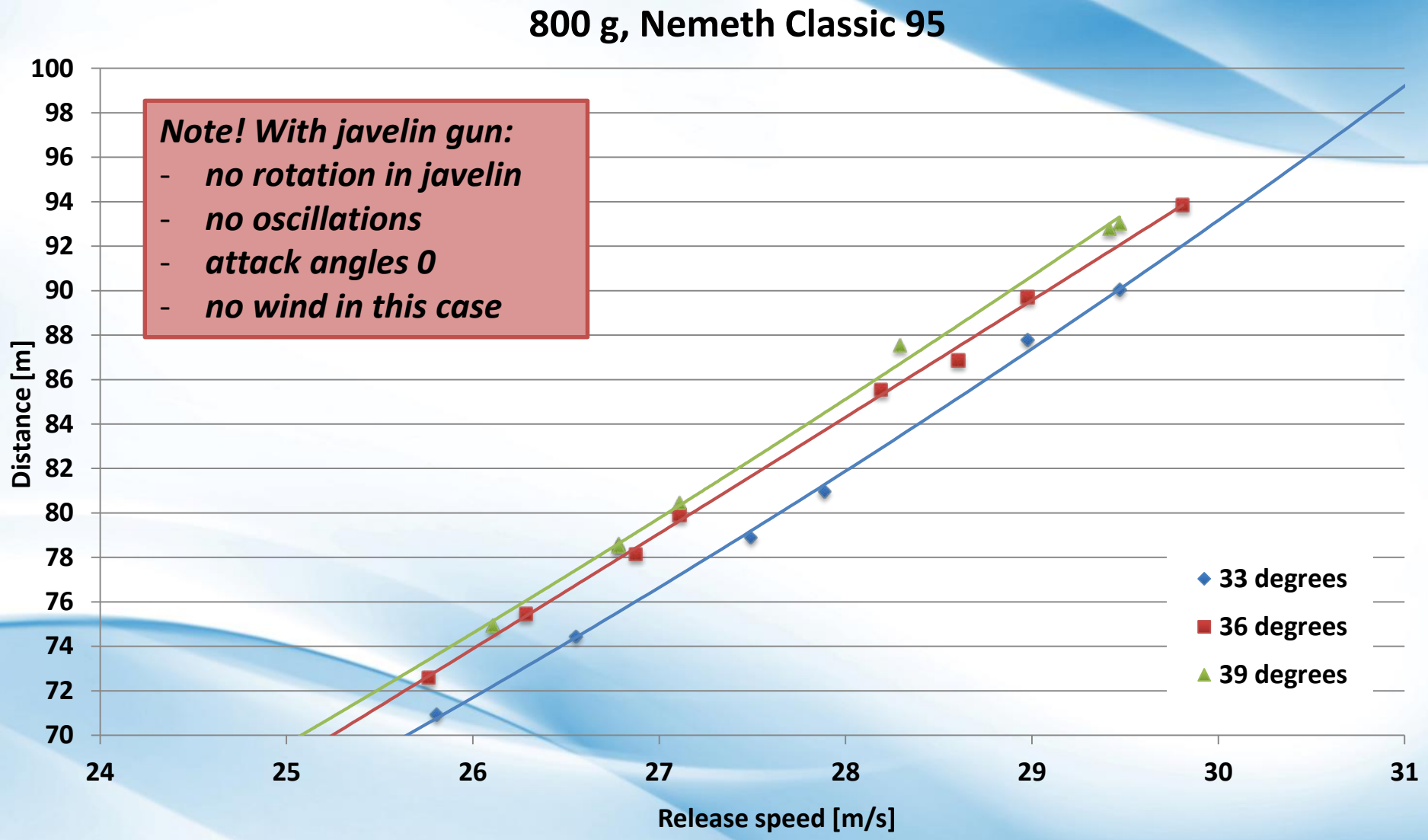
- For getting the approach speed
- Reliable variable would be the speed of the COM
  - But, it needs full body digitizing
- So, speed radar was used in 2012 couple of times (also in 1990's)
- From behind or from the front view
- BUT too much problems and noice in signal for getting usable data



Methods and feedback: Ultimate player



Javelin flight analytics 2008



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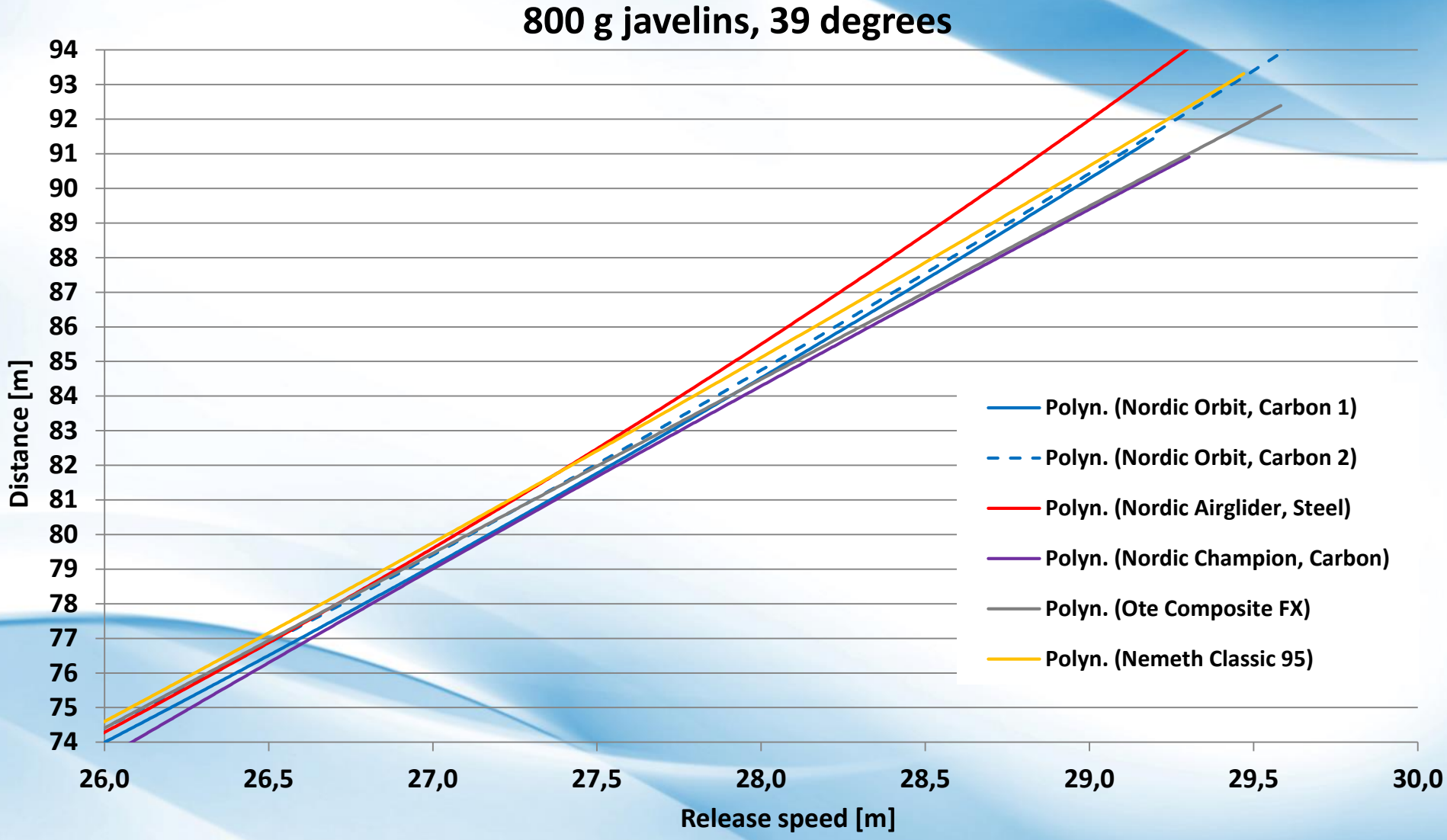
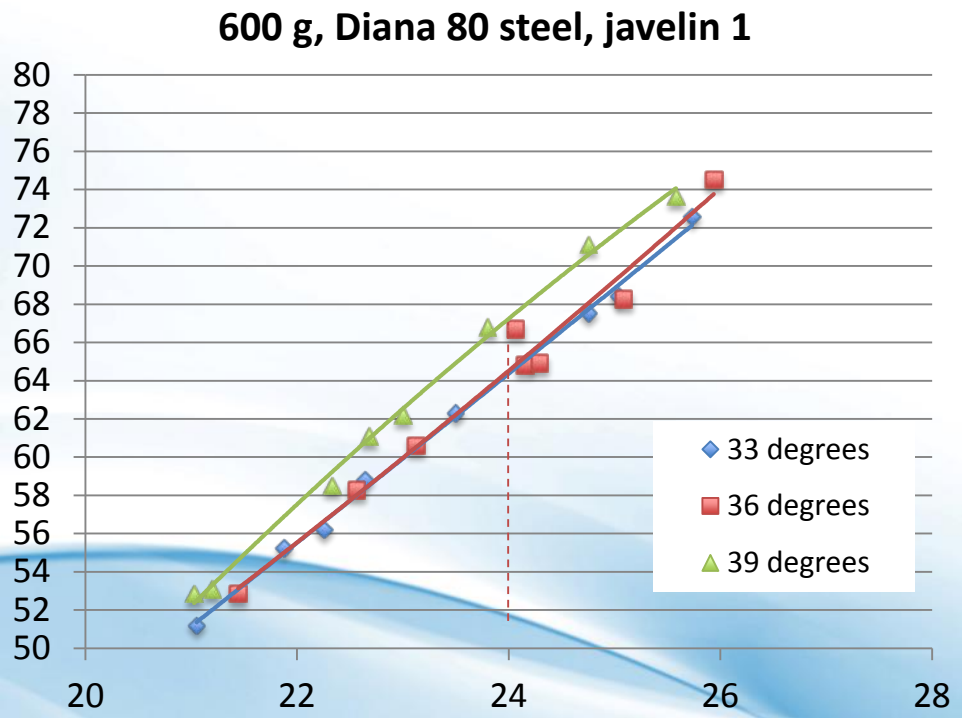
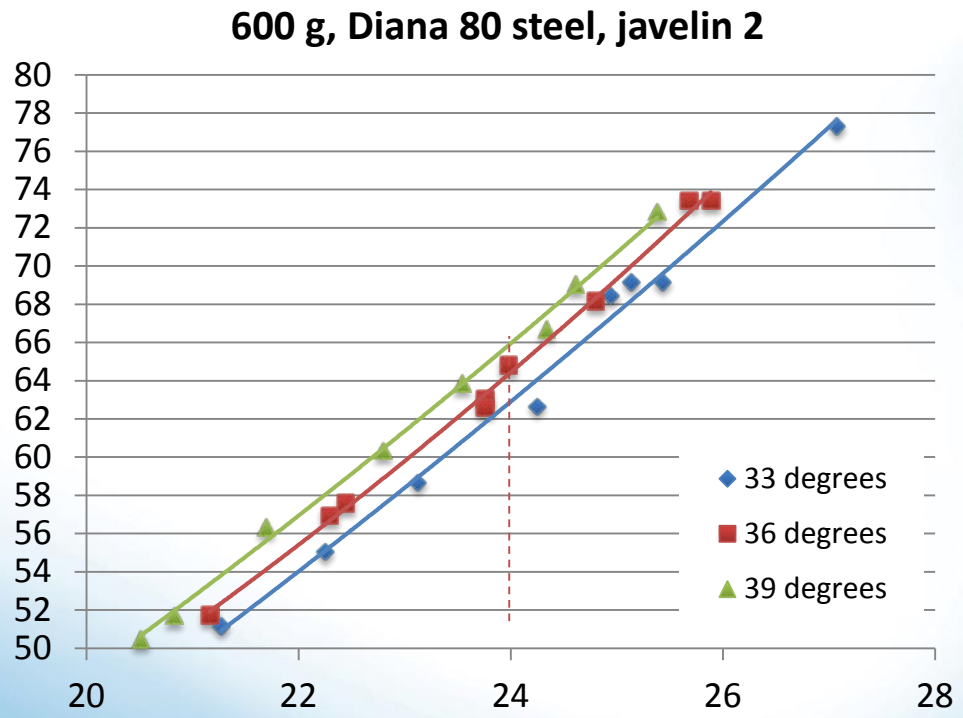


Javelin flight analytics 2008

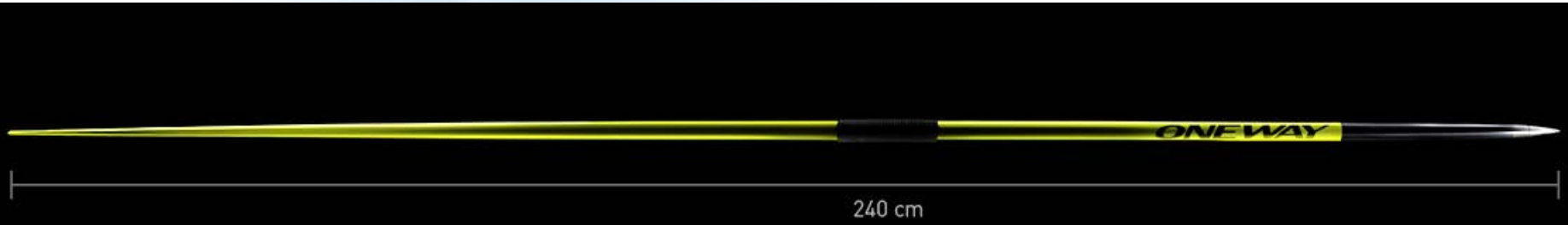
- There are differencies within the same javelin model between ”individuals”



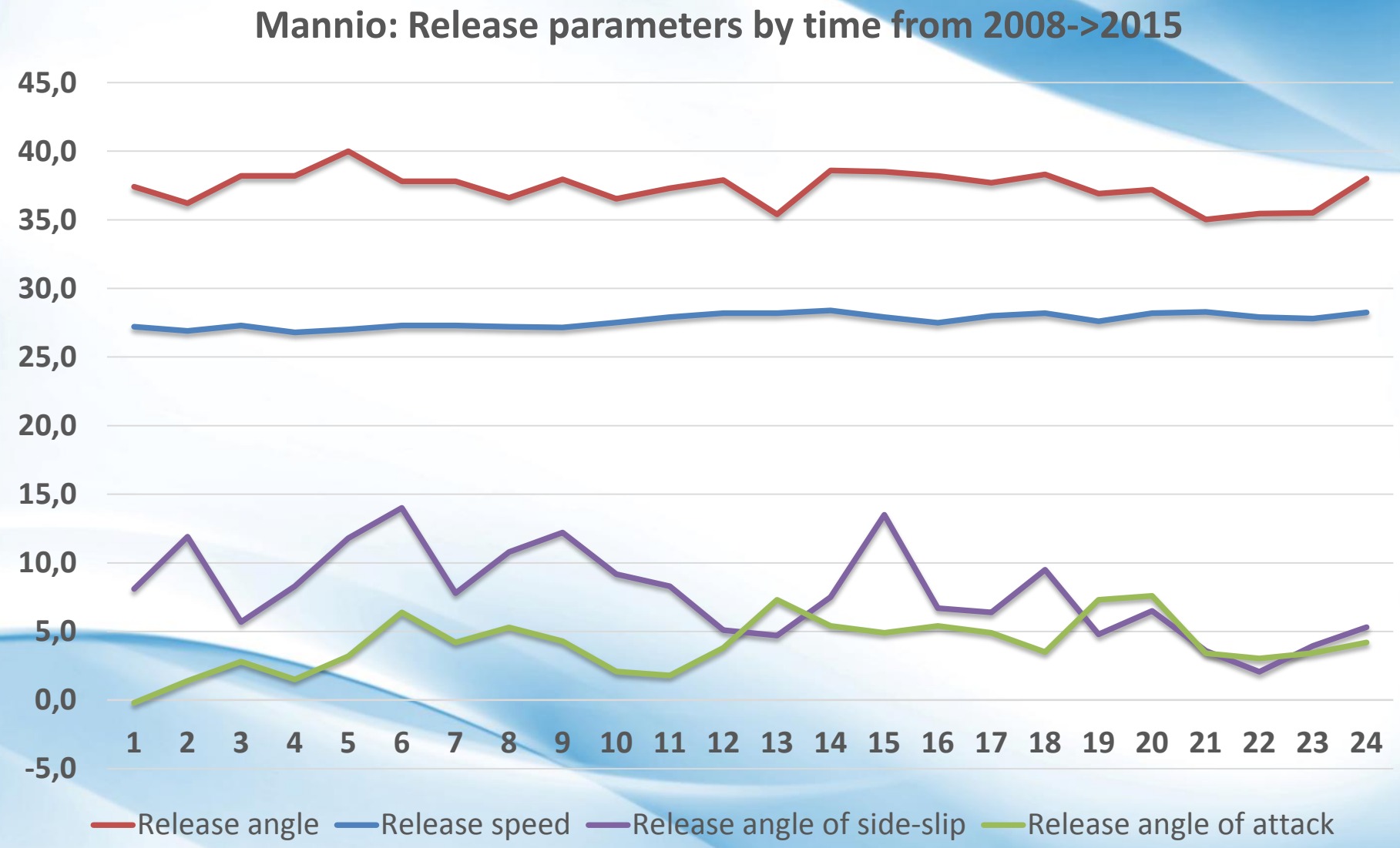


The new Finnish carbon javelin ”Angon”

- Developed by One Way Sport
- Co-operation with One Way and Tampere Univ. of Technologies
  - Goal to have a javelin stiff enought but easy to throw
- A lot of testing in practice with Finnish throwers
- Javelin gun shows that it’s very stable in air and flight distance comparable to other carbons.
- http://www.onewaysport.com/angon/



Individual results



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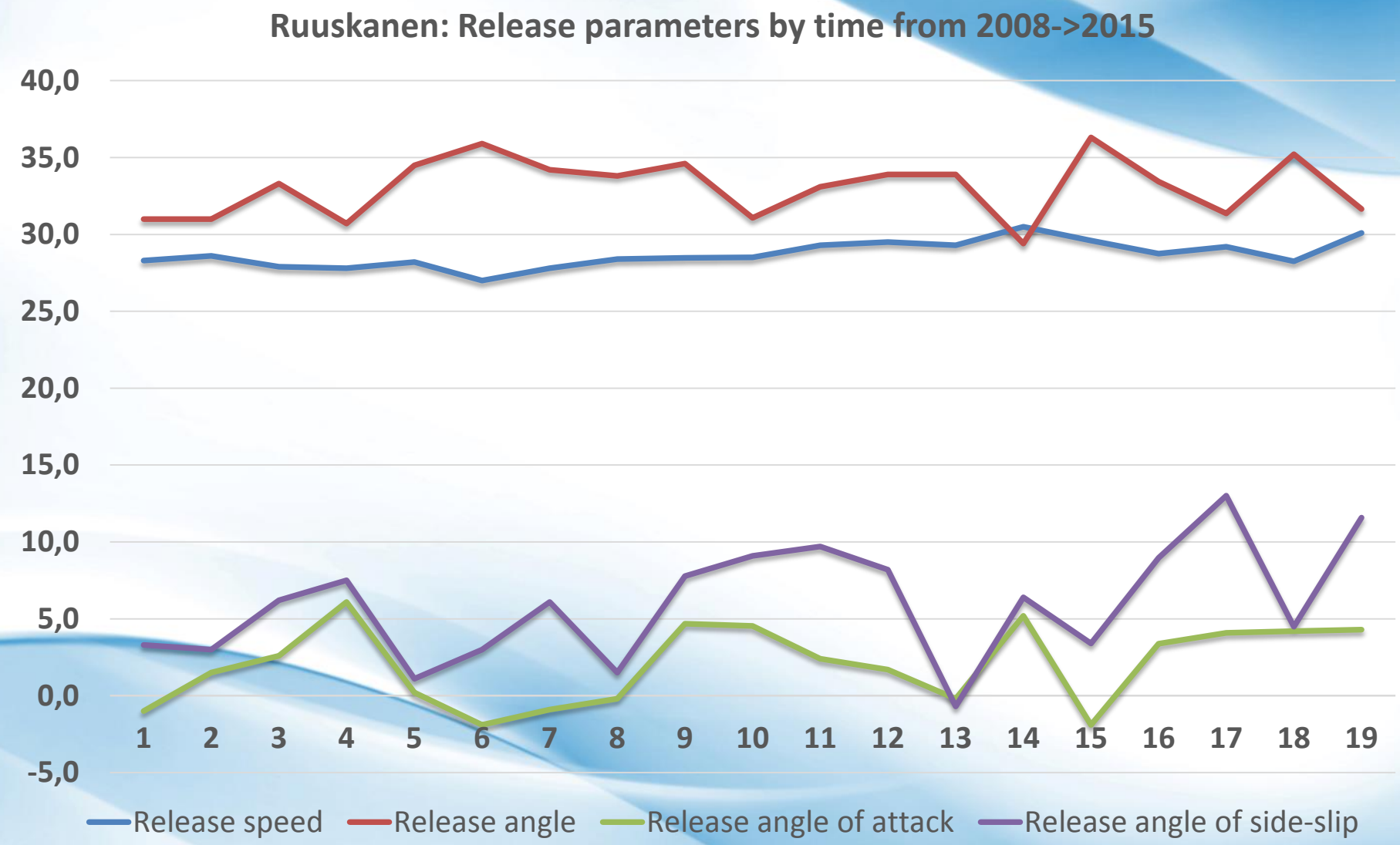

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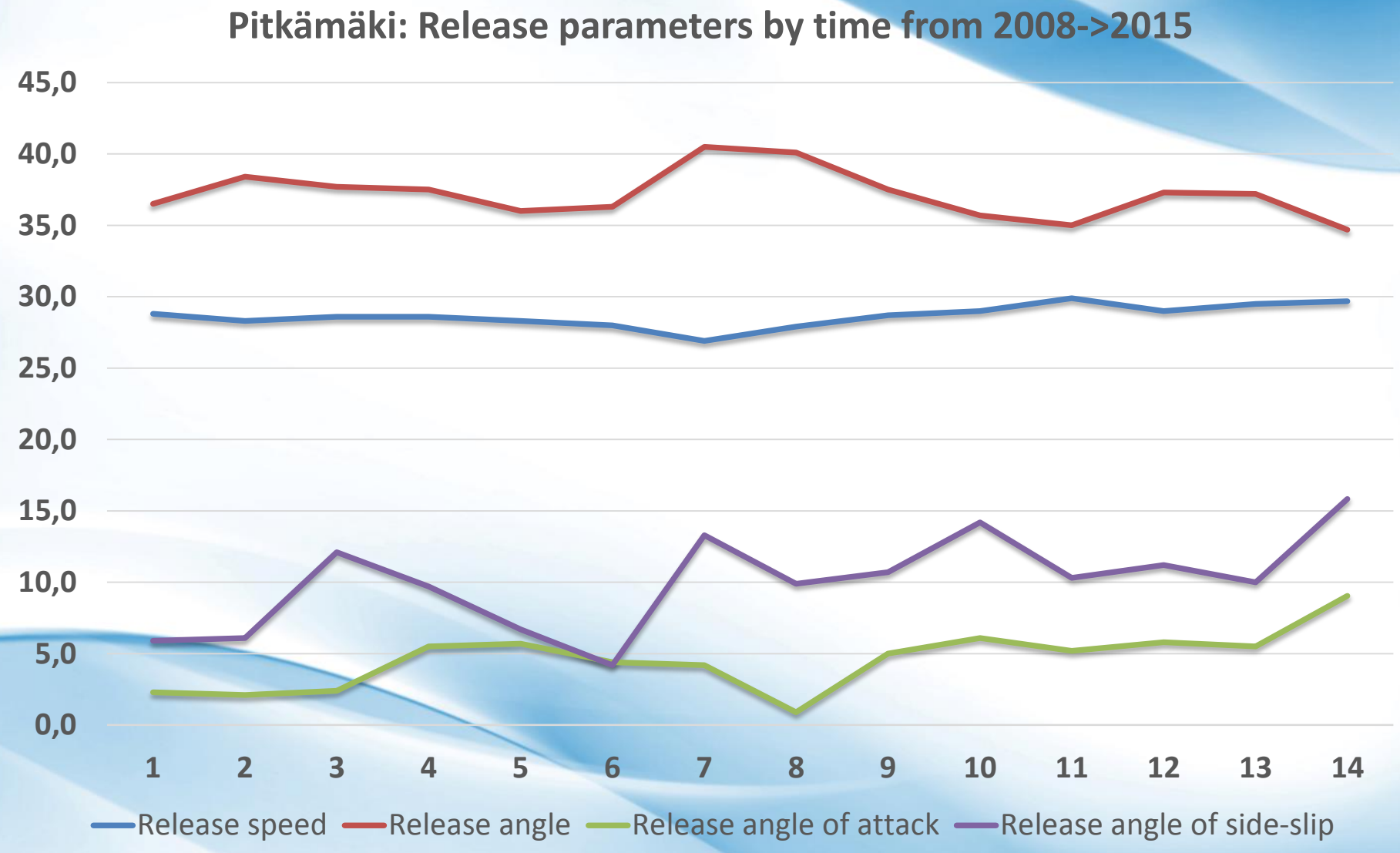
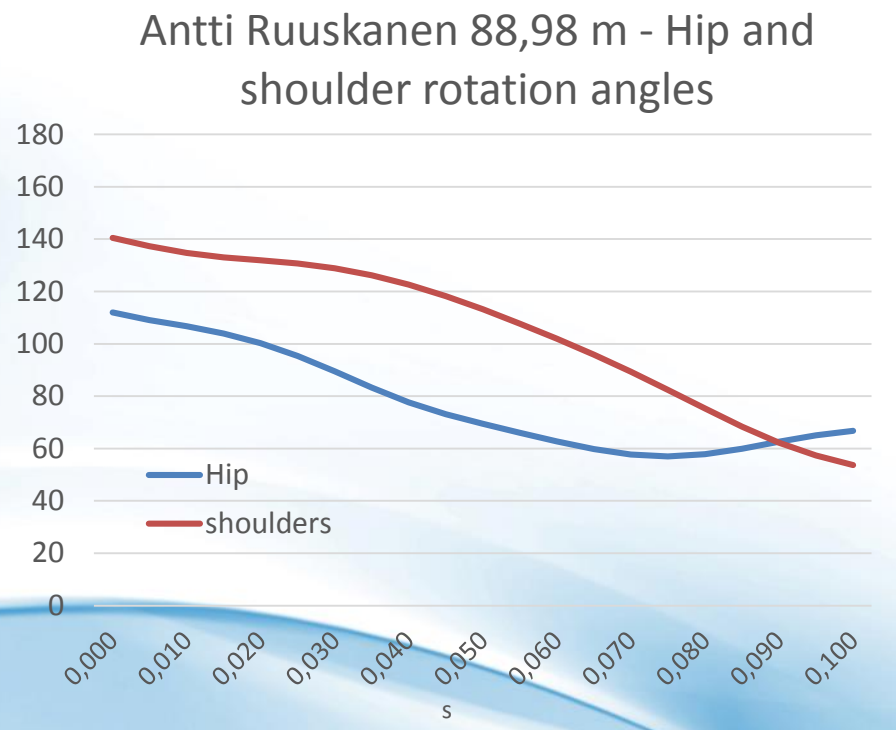
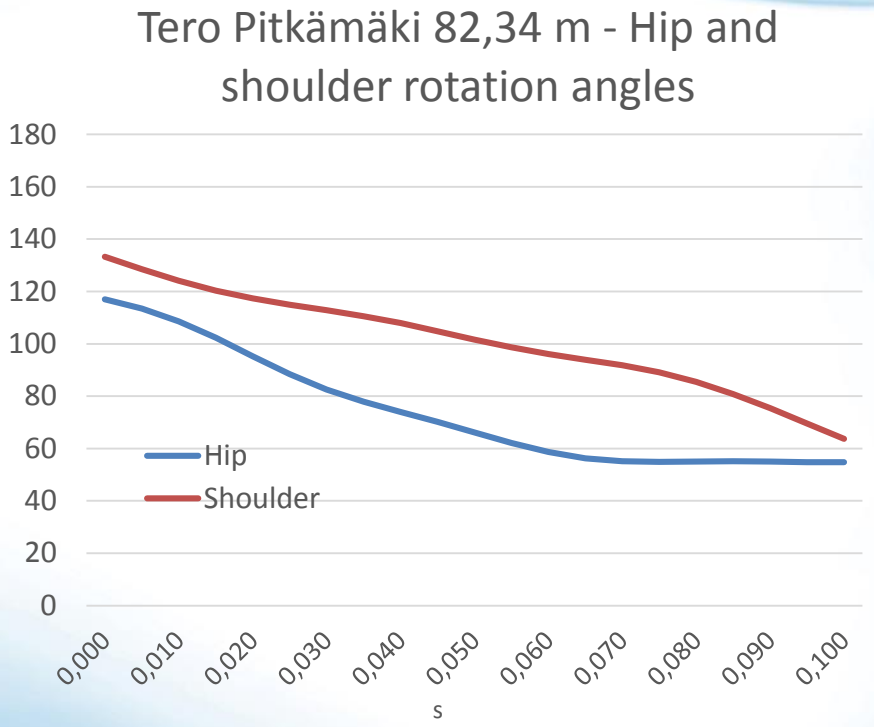


Individual results

- Hip and shoulder rotation in pulling phase

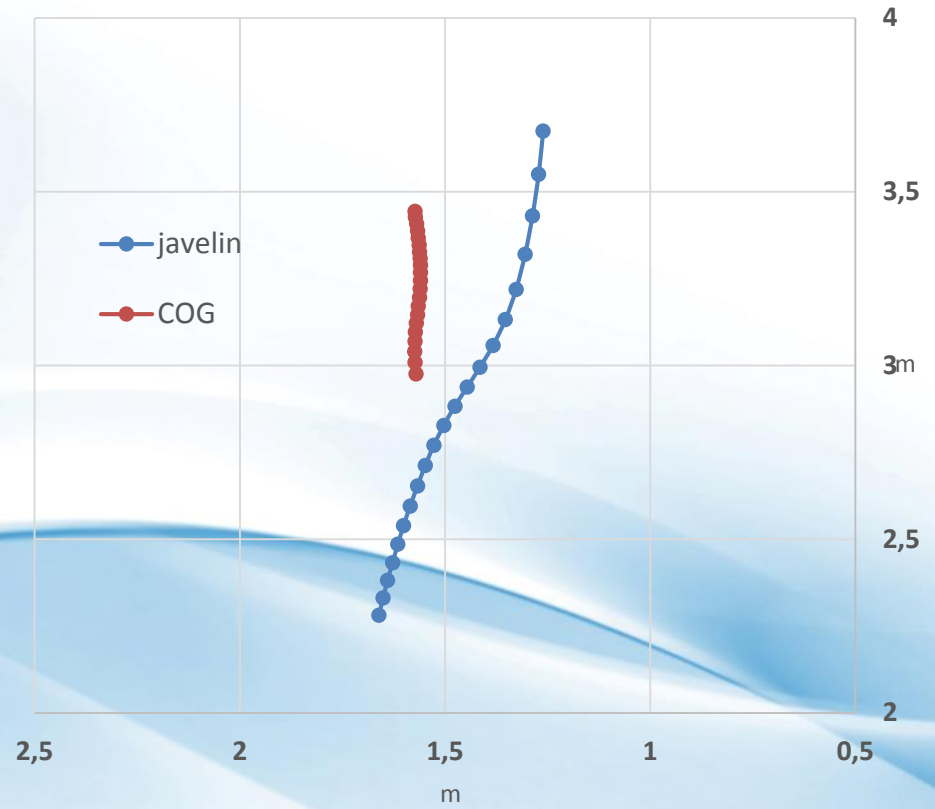




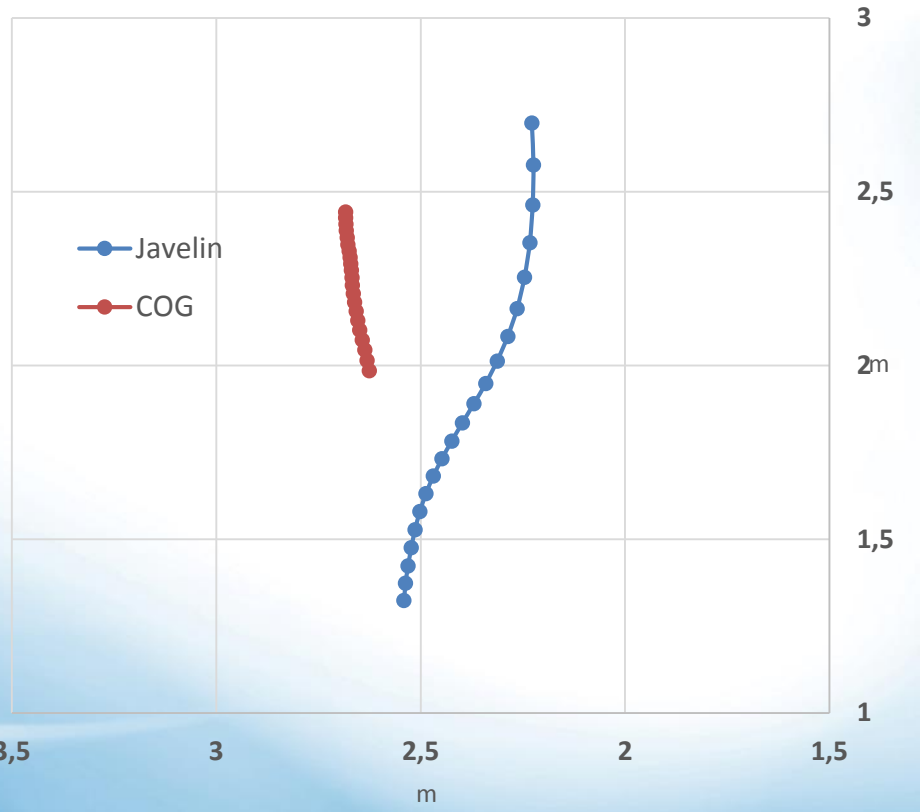
Individual results

- The path of the javelin

Antti Ruuskanen 88,98 m - Path of the javelin from above

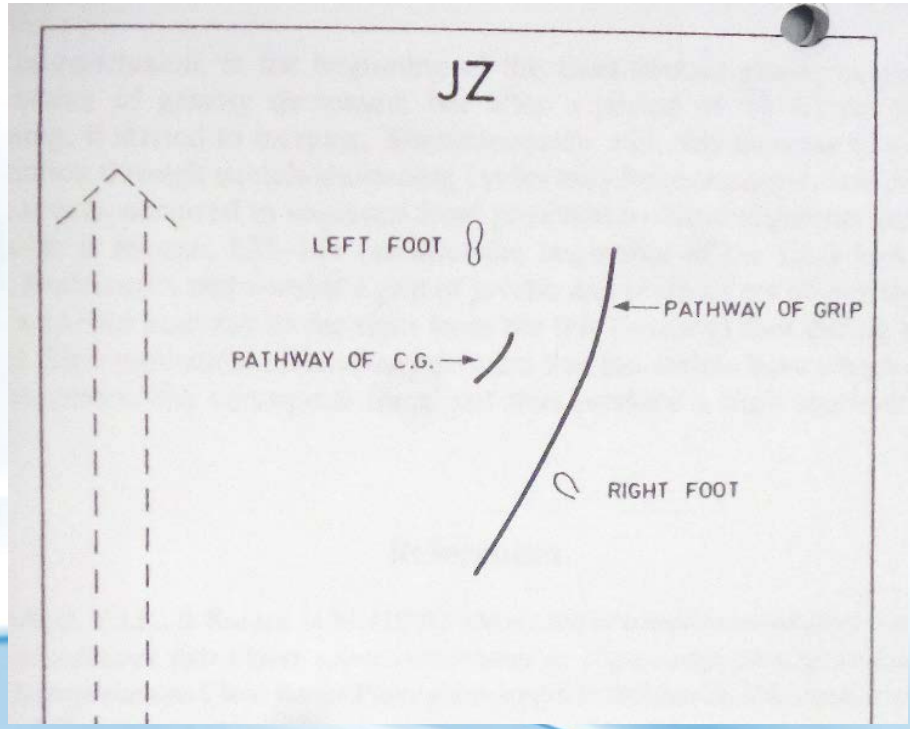


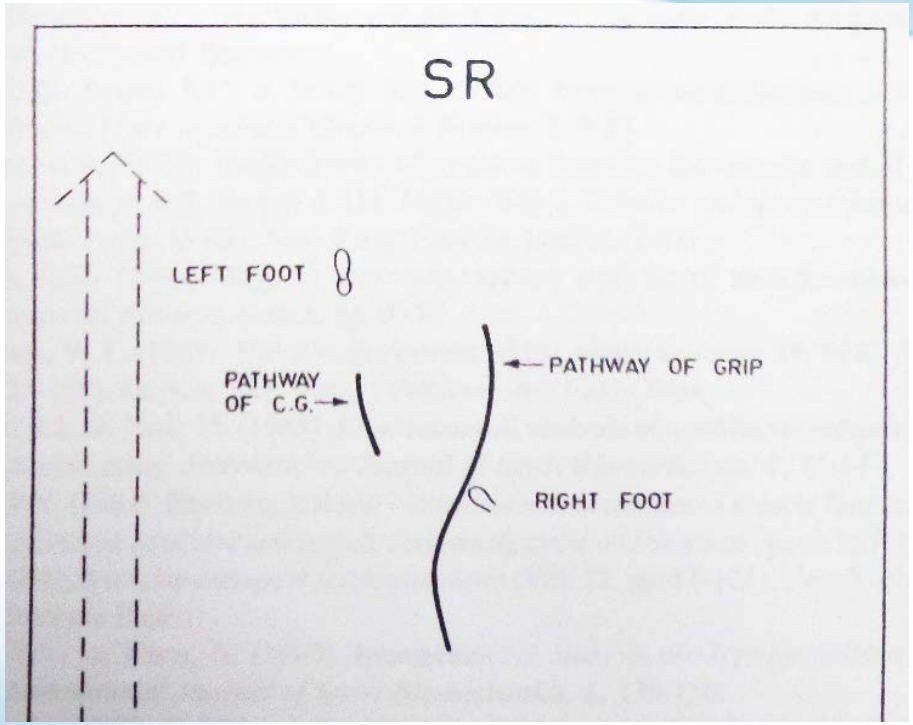
Tero Pitkämäki 82,34 m - Hip and shoulder rotation angles



Individual results

- Path of the javelin: Zelezny (89,66) and Räty (86,60) in Barcelona 1992 (Mero et al.)





Forces better along the long axis af javelin.
Propably smaller attack angles.

Extra speed by shortening the radius at the end of the throw.
Bad attack angles produced easier.

Individual results

- The path more straight in the longest throws?
  - Zelezny, Yego, Röhler…

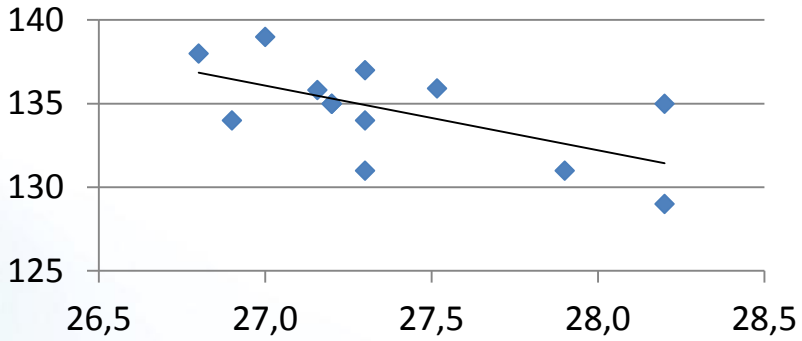
Individual results

Individual results

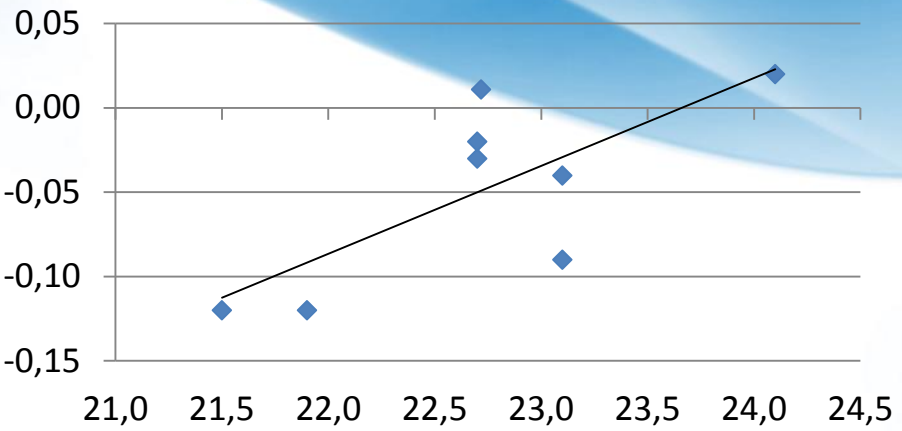
Individual results

Individual results

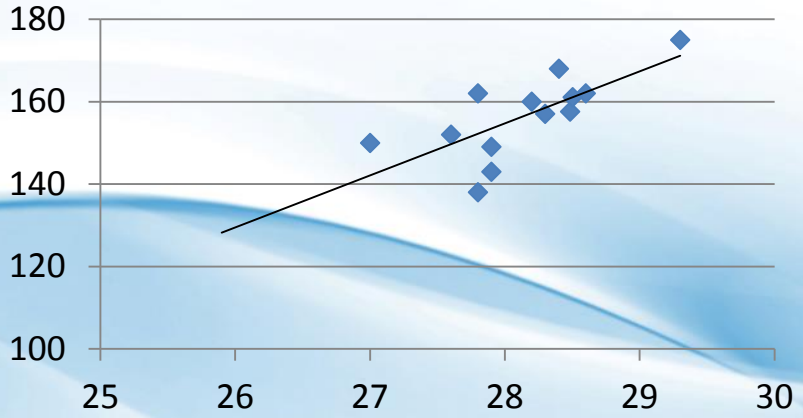
Mannio: Right leg knee angle at final foot contact



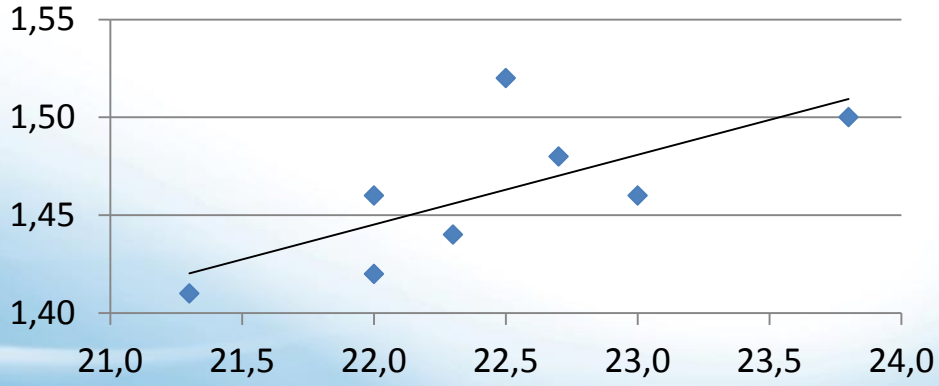
Utriainen: Release point of the javelin



Ruuskanen: Knee angle at release

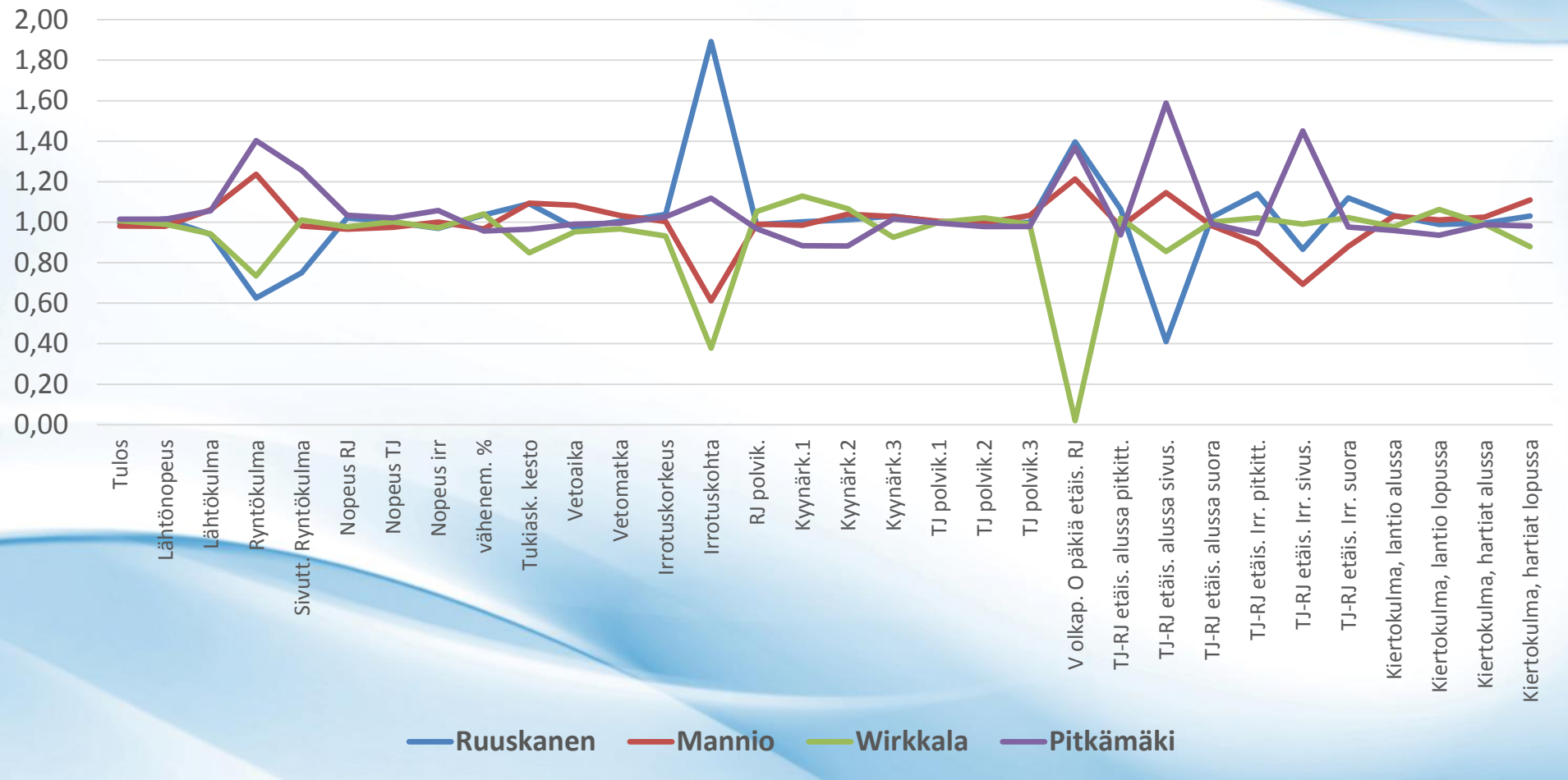


Sormunen: Distance btw left and right at moment of final foot contact

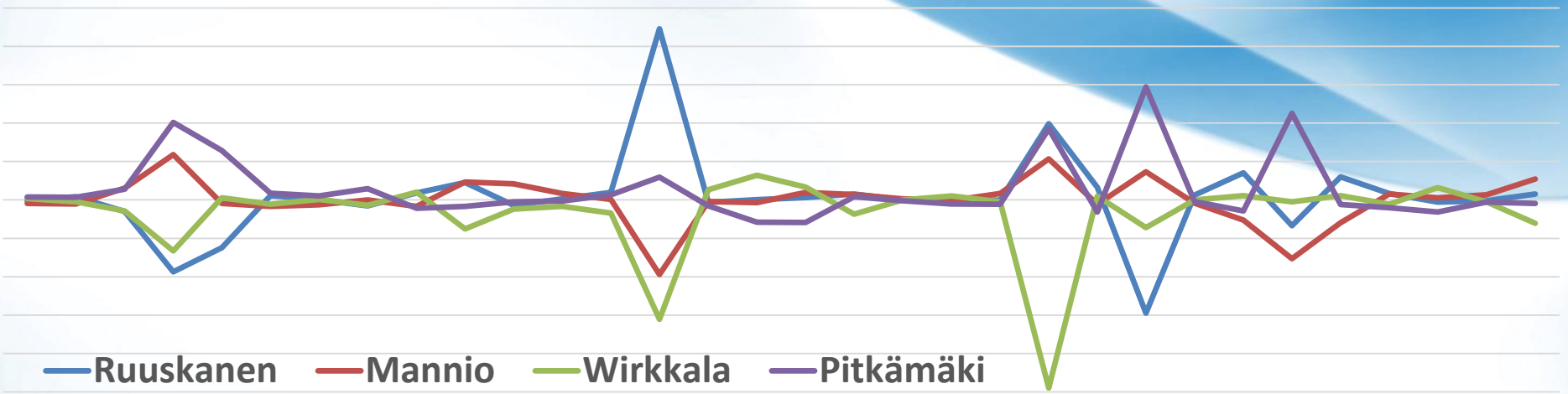


Individual differencies

4 male throwers, over 80 m: Individual averages compared to group average (9-24 throws/athlete)



Individual differencies



- Variables that differ between throwers:
  - Angle of attack and side-slip
  - Point of the release compared to support leg
  - L shoulder – R foot distance at R leg touch down
  - L-R foot distance sideways during pulling phase

Individual differencies

- Variables that are very constant
- And their approximate values for average 81 m throw
  - Release speed 28,3 m/s
  - Approach speed 5,9 m/s
  - Pulling distance 1,72 m
  - Pulling time 0,107 s
  - Right leg knee angle 135 degrees
  - Support leg knee angle 175/158/161
  - Length of the final step 1,60 m
  - Hip rotation angle (start/end) 116/80 degrees

Way to Rio 2016

- Goals (from 2014)
  1. Efficient throwing performance
  2. Good control of the javelin
  3. Individually optimal technique
- Deeper co-operation
  - Biomechanists ”to be the part of the family” in throwing team
- Training camps
  - Biomechanist present at camps
  - Fast feedback + self-evaluation of the throwers

Thank you!