Kilpa- ja huippu-urheilun tutkimuskeskus KIHU
Jyväskylä

Research in Finnish Javelin Throw on 21th Century

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www.kihu.fi

Contents of this presentation

1. Some basic of biomechanics of javelin throwing
2. Research by KIHU on years 2004-2011
3. Challenges on scientific research and support
4. The future on javelin research

Javelin throwing

- Very complex performance having several variables, which all affect to the throwing distance
- Same result can be achieved with many different techniques or styles

Factors affecting to throwing distance

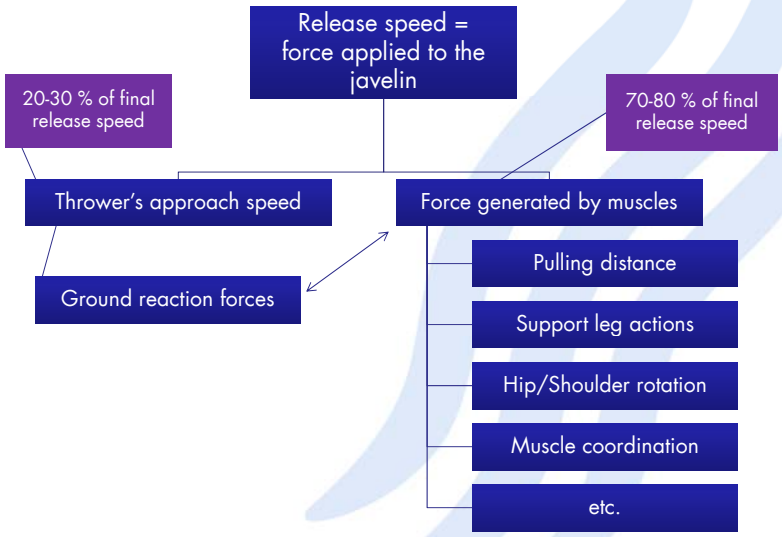
- Throwing distance
  - Release parameters
    - Release speed
    - Release angle
    - Release angle of attack
    - Release angle of side-slip
    - Release pitching moment
  - Aerodynamic factors
    - Javelin
    - Wind
    - Gravitation

Modified from:
- Hay, 1993
- Morriss and Bartlett, 1996

Release speed

- Release speed is the strongest factor affecting to flight distance
- There are several results of high correlations between release speed and throwing distance
  - Viitasalo & Norvapalo 2003 r = .75
    Helsinki 2005 r = .89
    Osaka 2007 r = .94
    KIHU 2008 r = .78
- So, the question is… How to maximize release speed with the given individual?

What makes "release speed"



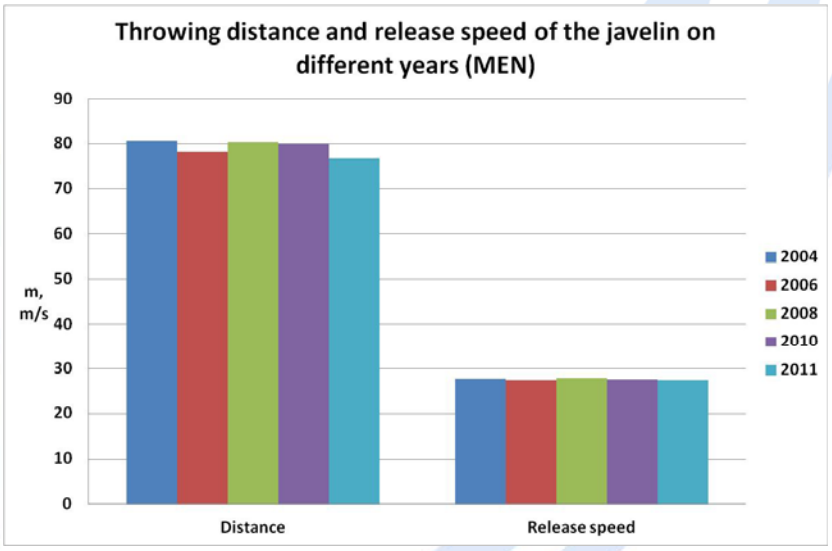
Javelin research 2004-2011

- The whole 90's was very active time for biomechanical research in javelin
- Technique analyses since 2004
  - 2004: one competition
  - 2006: one competition
  - 2008: one practice, two competitions
  - 2010: one competition
  - 2011: two practice, two competitions
- Totally 183 throws for men, 81 for women
  - …of which 129 and 49 with throwing distances
  - …of which 69 and 42 throws in competitions

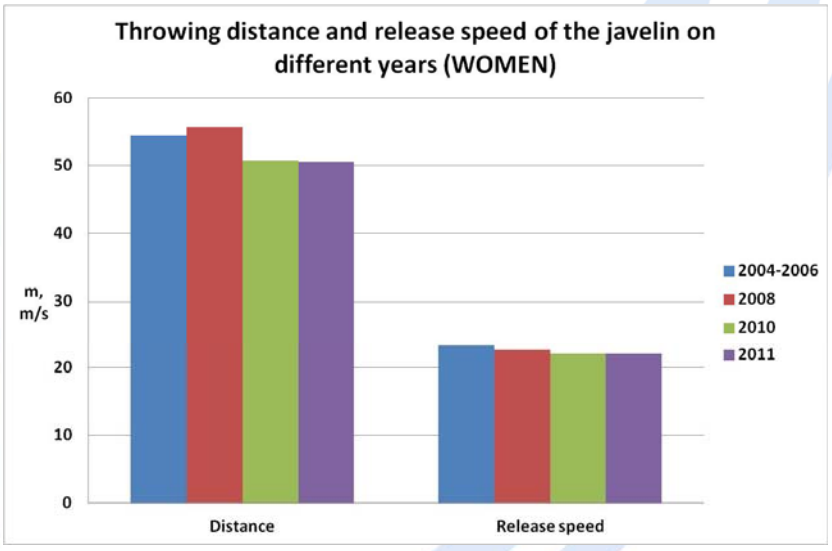
Javelin research 2004-2011

- High-speed imaging from SIDE and BACK view
- Used frame rates:
  - 2004-2006 125 frames/s
  - 2008 -> 250 frames/s
- 1-3 throws/athlete from one competition analyzed
- Digitazing the whole body landmarks + javelin (3 points)
- 26 different variables calculated from each competition (2008 ->)
- Results in 2 weeks after competion

Results on competitions 2004-2011



Results on competitions 2004-2011



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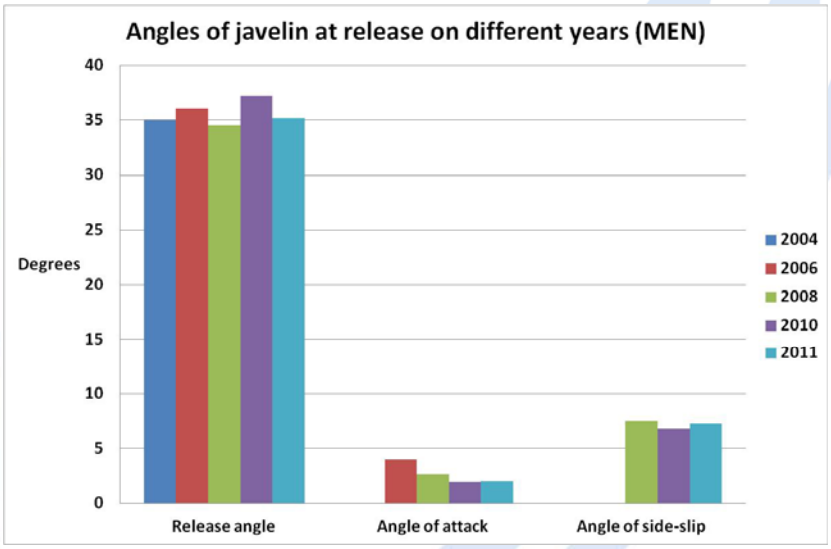

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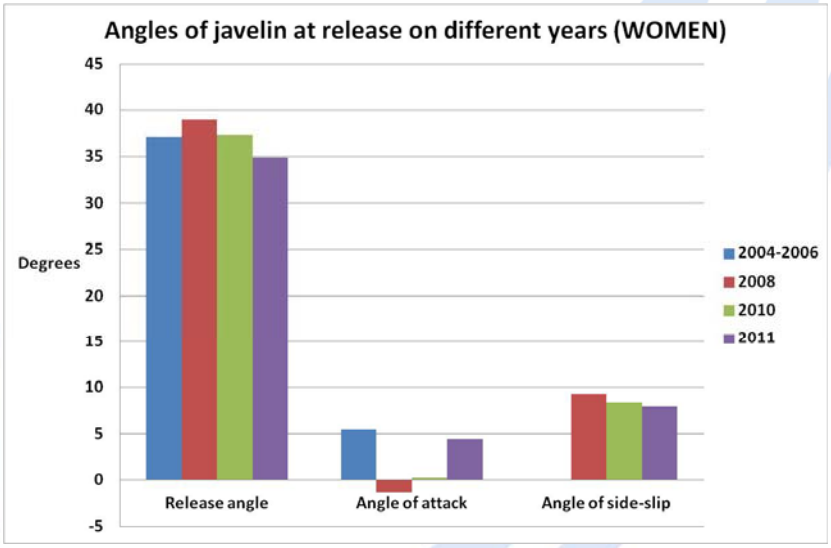

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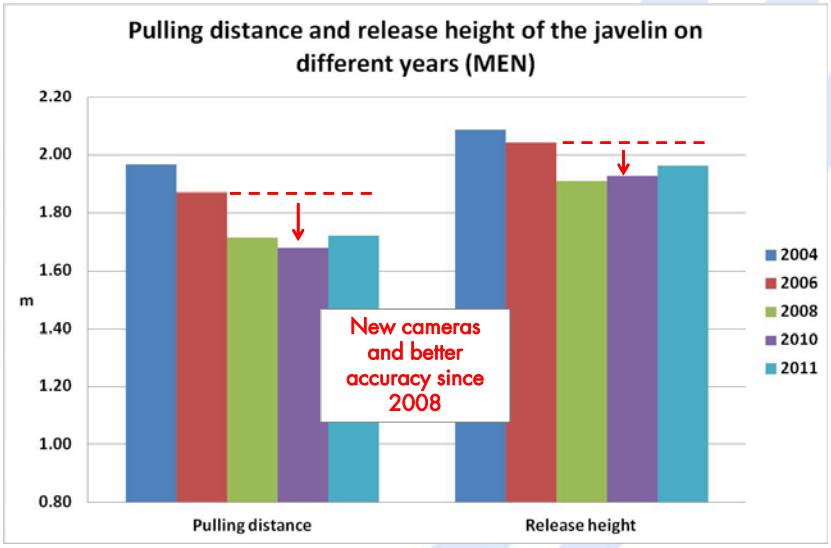

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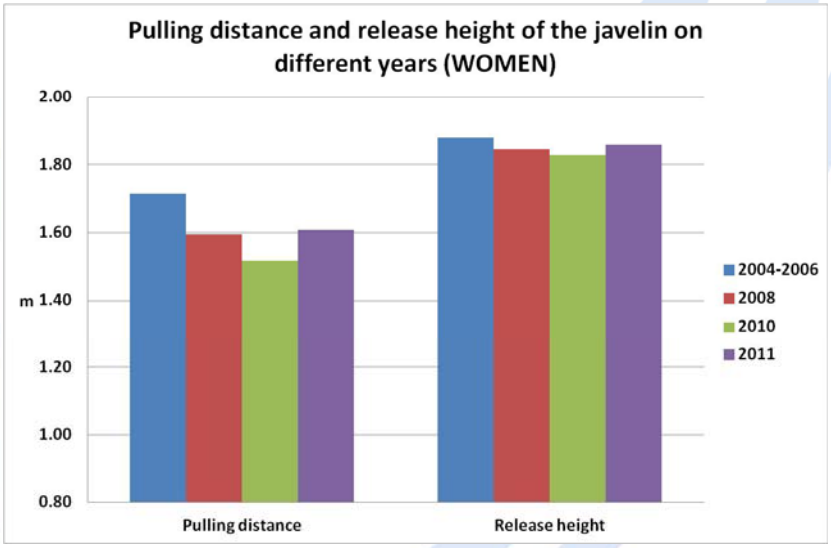

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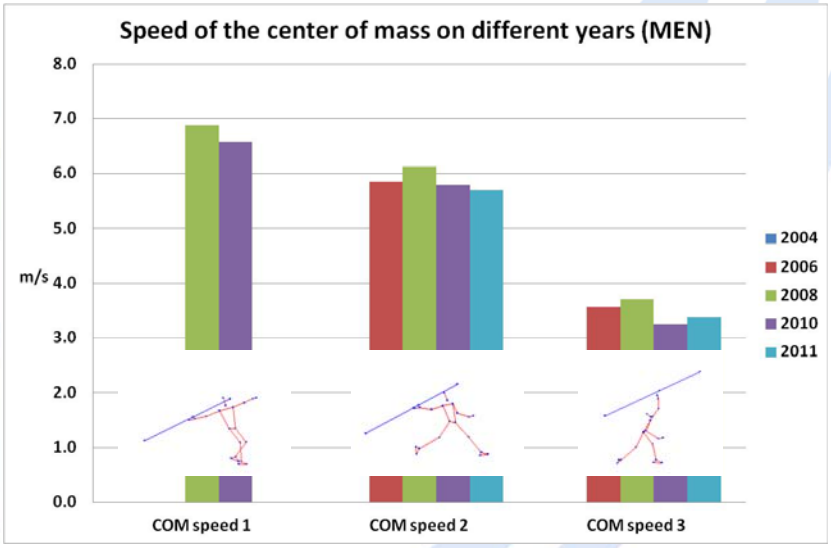

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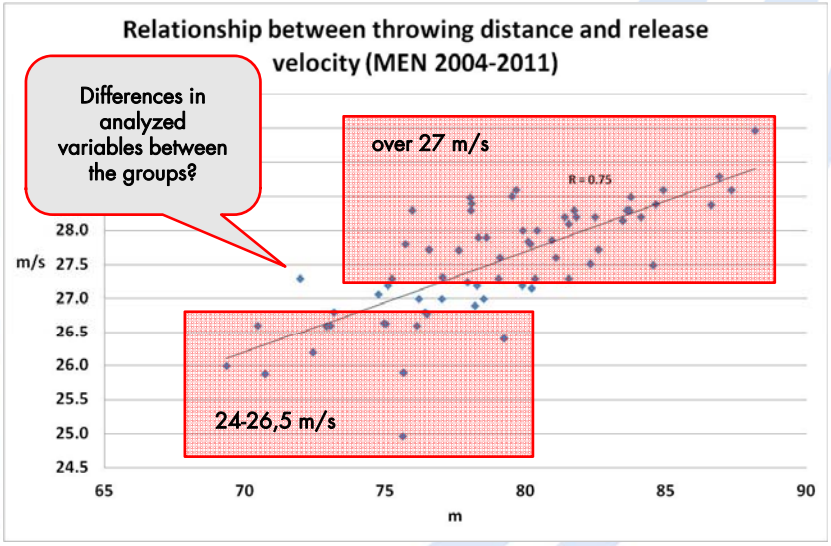

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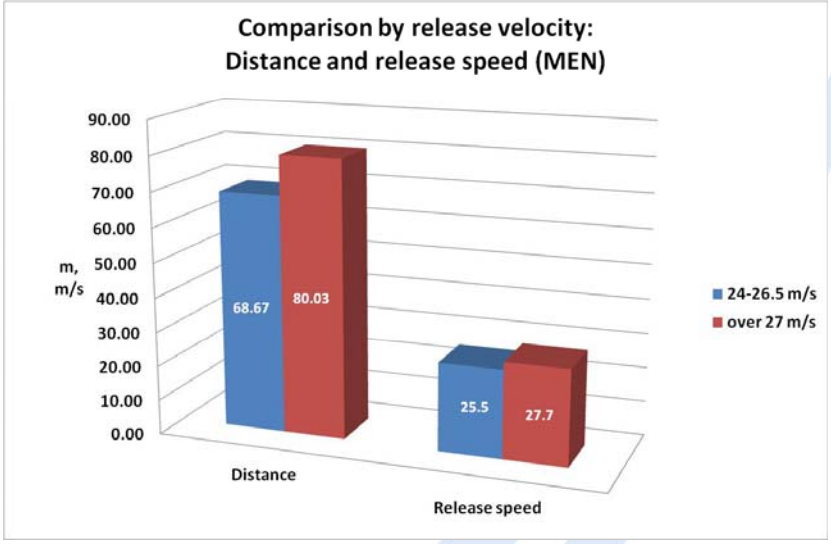

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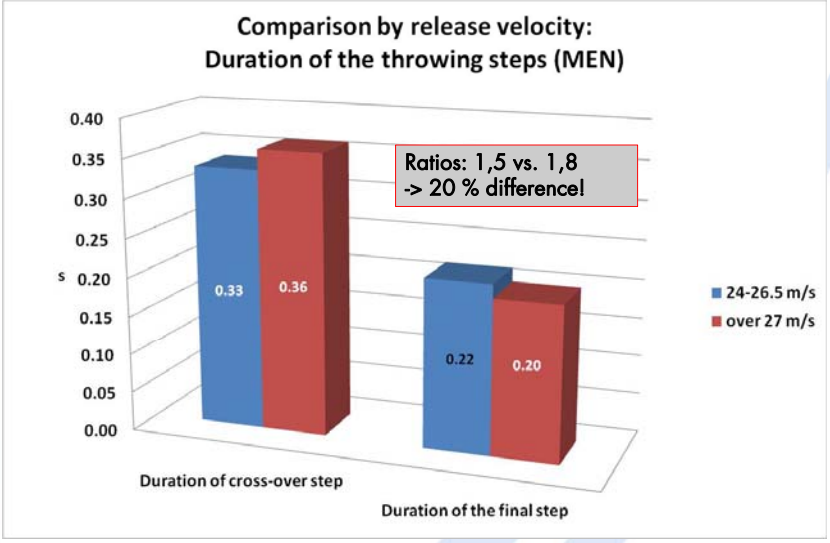
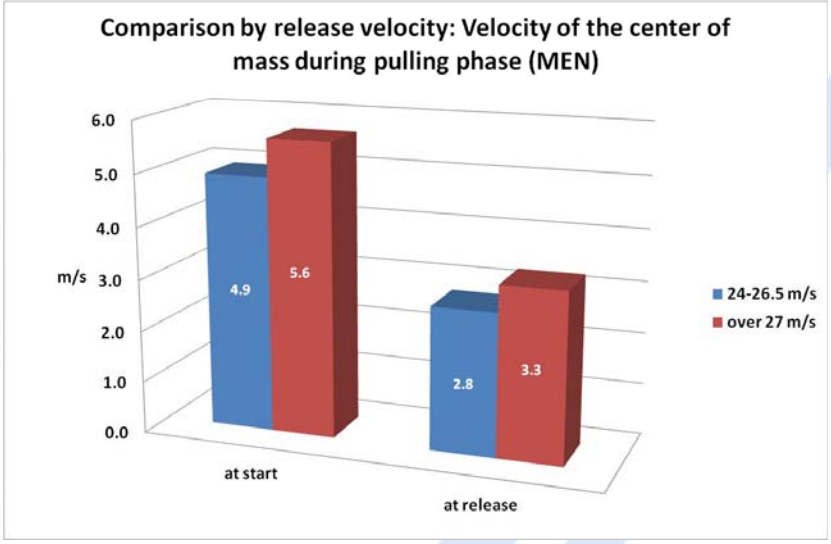


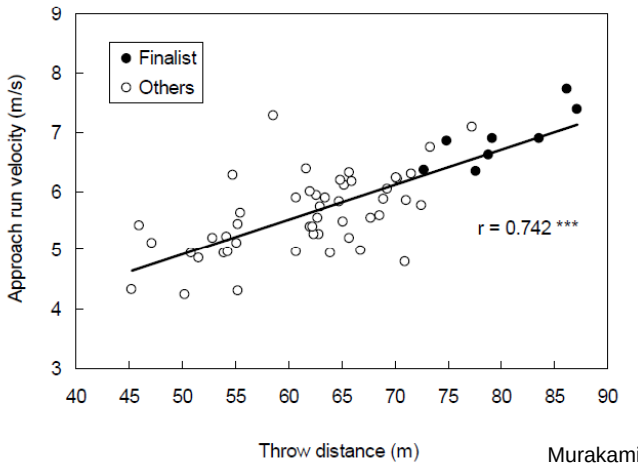
Ratios: 1,5 vs. 1,8
-> 20 % difference!

Results on competitions 2004-2011



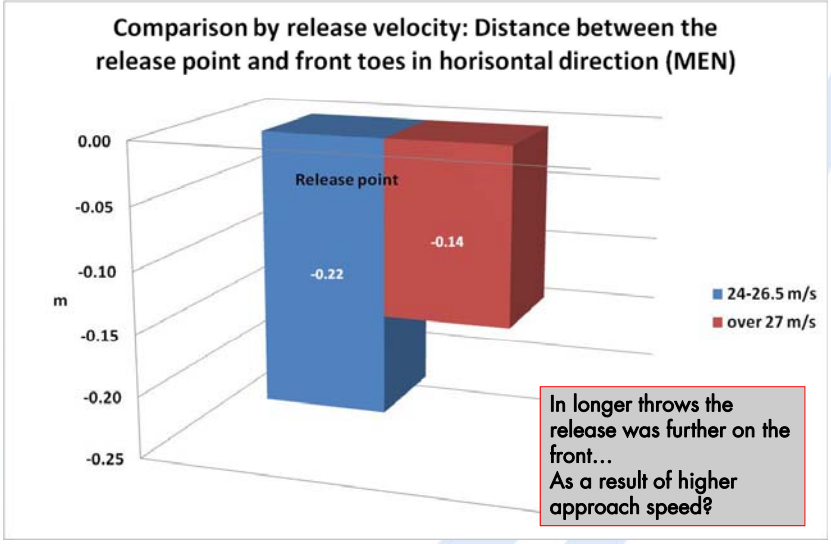
Run-up speed vs. throwing distance

Male throwers (Helsinki 2005 + Japanese ones):



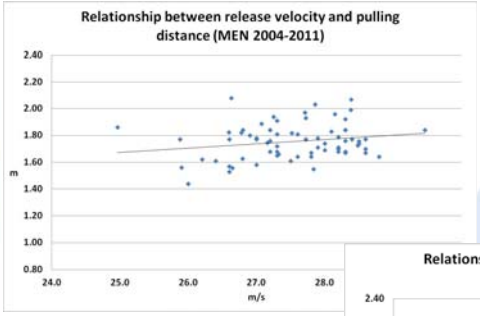
Murakami et al 2006

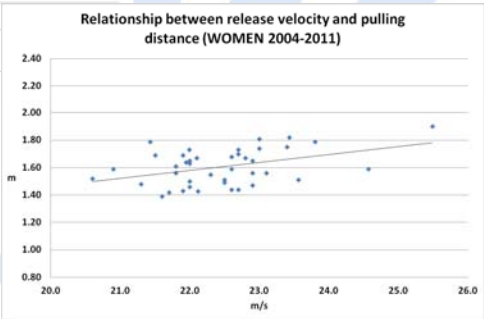
Results on competitions 2004-2011



In longer throws the release was further on the front…
As a result of higher approach speed?

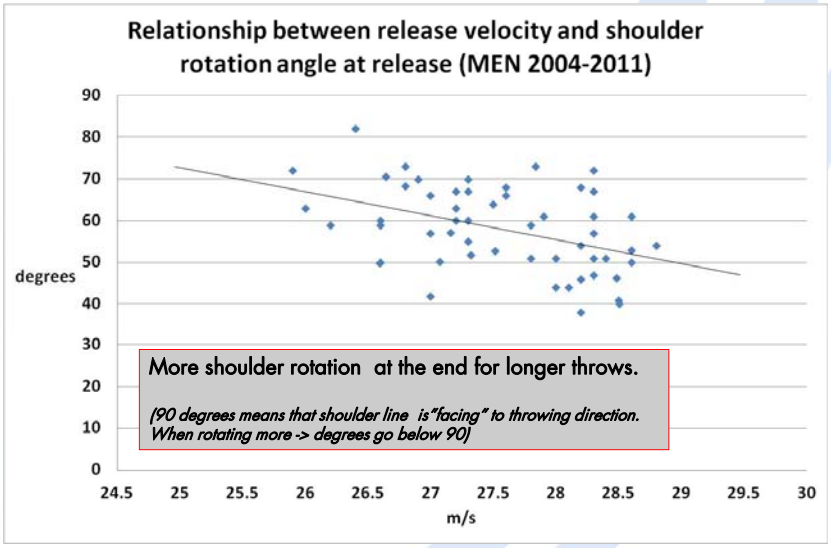
Results on competitions 2004-2011





Pulling distance seem to have some effect on release velocity.

Results on competitions 2004-2011



More shoulder rotation at the end for longer throws.

(90 degrees means that shoulder line is "facing" to throwing direction. When rotating more -> degrees go below 90)

Research on training situations

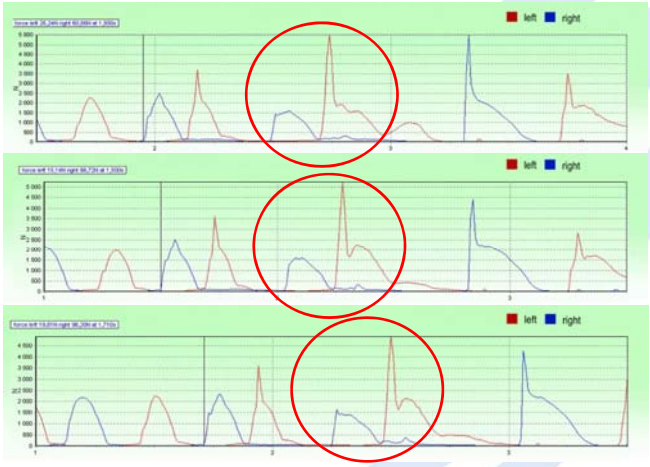
- Possibility to do more complex measurements
- Faster biomechanical feedback is useful for example in training camps
- Pressure insoles used for measuring pressure distribution and force production during the final steps of the throw.
- Insoles used twice in 2011
  - Indoor at Kuortane in March
  - Outdoor at Portugal in May

Pressure insoles - measuring

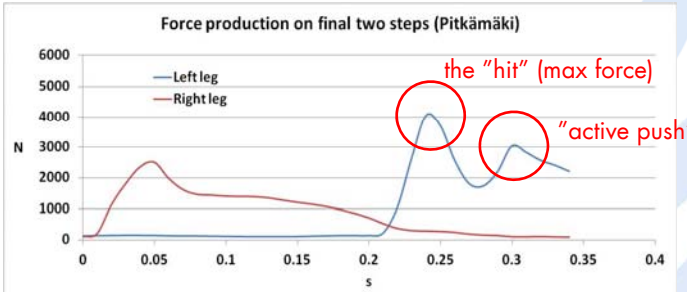
- Special insoles attached into throwing shoes
- 99 recording units/insole
- Sampling rate 100 Hz
- Fast feedback of the data possible
- Received data:
  - Pressure distributions under feet
  - Calculated total forces
  - Timing and force profiles
- But, results not comparable to force plate values.

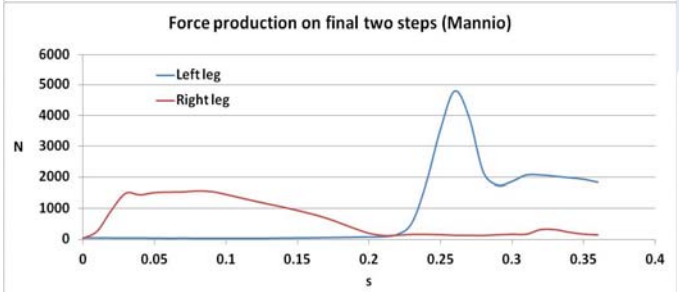
Pressure insoles - results

- Force production curves of throwing steps:



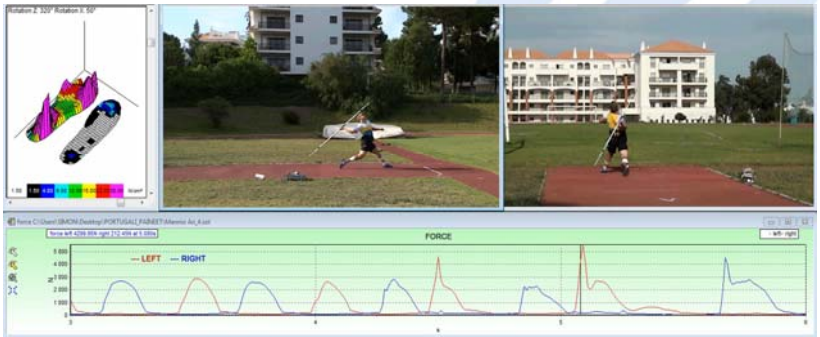
Pressure insoles - results





Pressure insoles - results

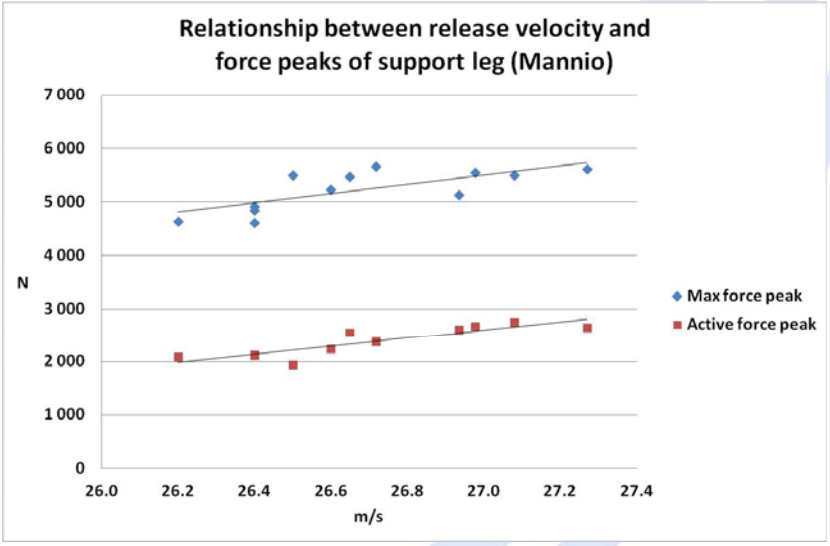
- Pressure distribution, force and video combinations
  - Versatile information in one video
  - Step by step on view



Pressure insoles – Using results

- No group level correlations found between pressure or force values and release speed
- Individual visual analyzing propably the most rewarding
- Some statistical relationships can be found on individual level

Pressure insoles – Using results



Challenges in applied research

- Complex movement -> what are the most relevant variables to measure and follow systematically?
  - Too many different variables is just confusing
  - Group-level variables don't correlate very well in top-level
  - Individual analyzing and follow-up is important
  - Optimal technique for each individual!

Challenges in applied research

- In training situation immediate feedback needed for techniqal improvement
  - Pressure insoles works well for this need
  - For release parameters and kinematics high-end motion analysing system needed
- Measuring and analyzing has to be continuous, not only1-2 times per year/athelete

The future in javelin research in Finland
-> Helsinki and London!

- More intensive co-operation between researchers and coaches + athletes
- Training measurements 2-3 times during spring + 2 competition analyses in early summer 2012
- Development of motion analyses system -> faster feedback
- Better understanding of pressure data
- Individual development

Thank You for Your Attention!