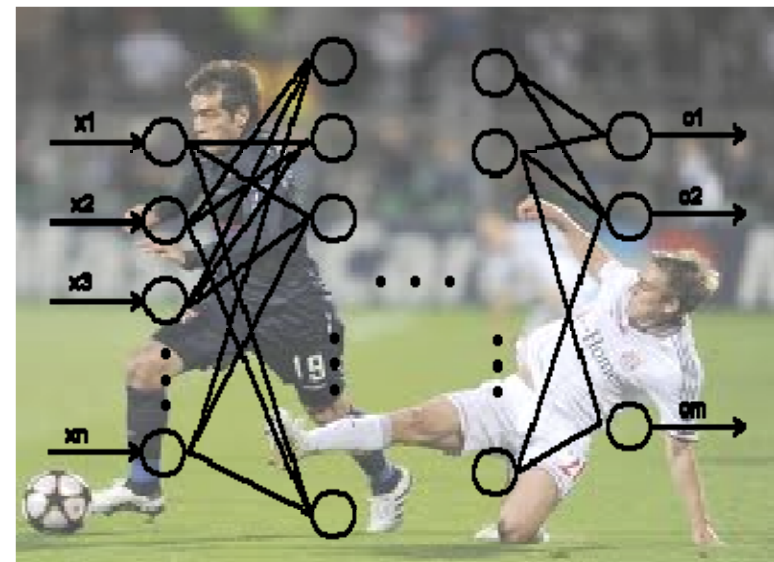


Innovations and technologies for athletes' training in Elite Sport Centers

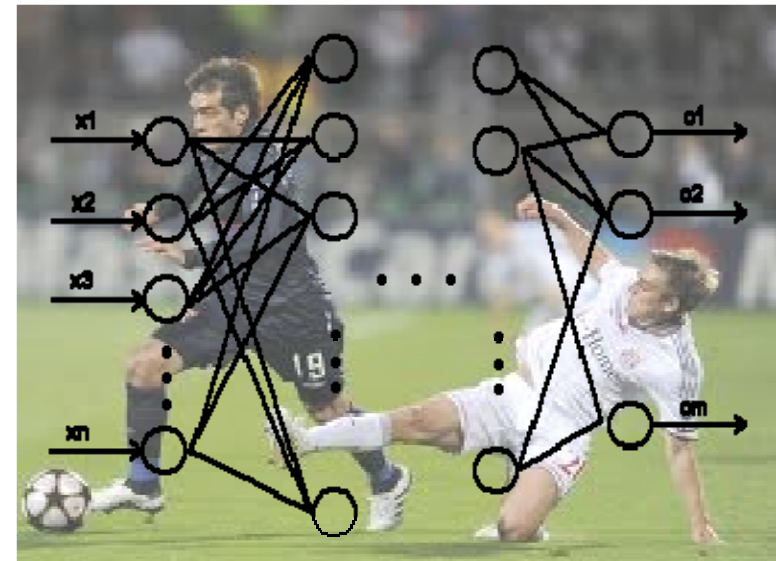
Prof. Dr. Martin Lames
Chair for Performance Analysis and
Computer Science in Sports
TU München, Germany

VII Forum on Elite Sport – ASPC
Paris, August, 28th – September 1st



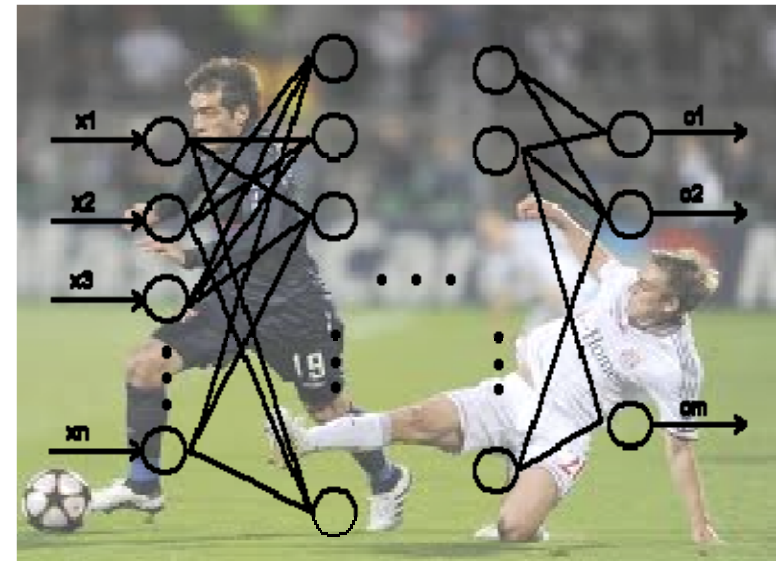
Program

1. Sports science and technological innovations
2. Position detection in game sports
 1. Technology and practical use
 2. Reliability and validity
3. Perspectives



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Innovation cycle in sport

1. Innovation
new technologies new theories new knowledge
digital video talent/expertise brain organization
2. Estimation of potential for sports
3. Implementation of pilot projects
4. Implementation of routine service

Innovations

- Partly from sports science, mostly from other sciences
- Demand of keeping track with what is going on in many areas
 - Who will do that?
 - Efficient communication channels?

Estimation of potential

- „Fig leaf“ function of scientific innovations
- „Nice to have“ vs. substantial improvement of practical work
- Criterium: advantages for my athletes in international sports competitions
- Spectrum of competencies
 - Understanding of innovation
 - Understanding of training process
 - Understanding of sports organization

Implementation

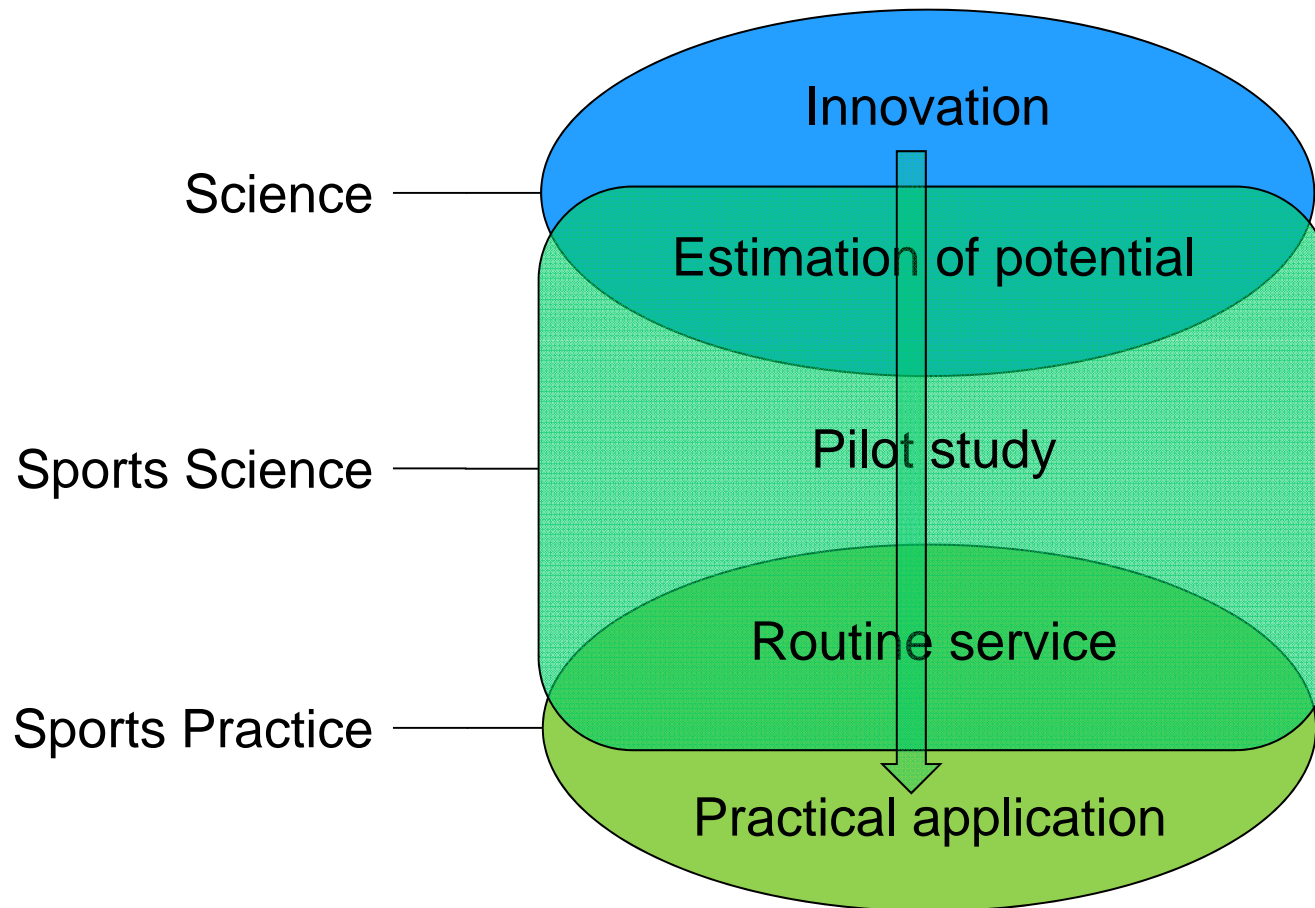
Pilot study

- Funded by research funding
- Close interactions between researchers and users
- Focus on effects

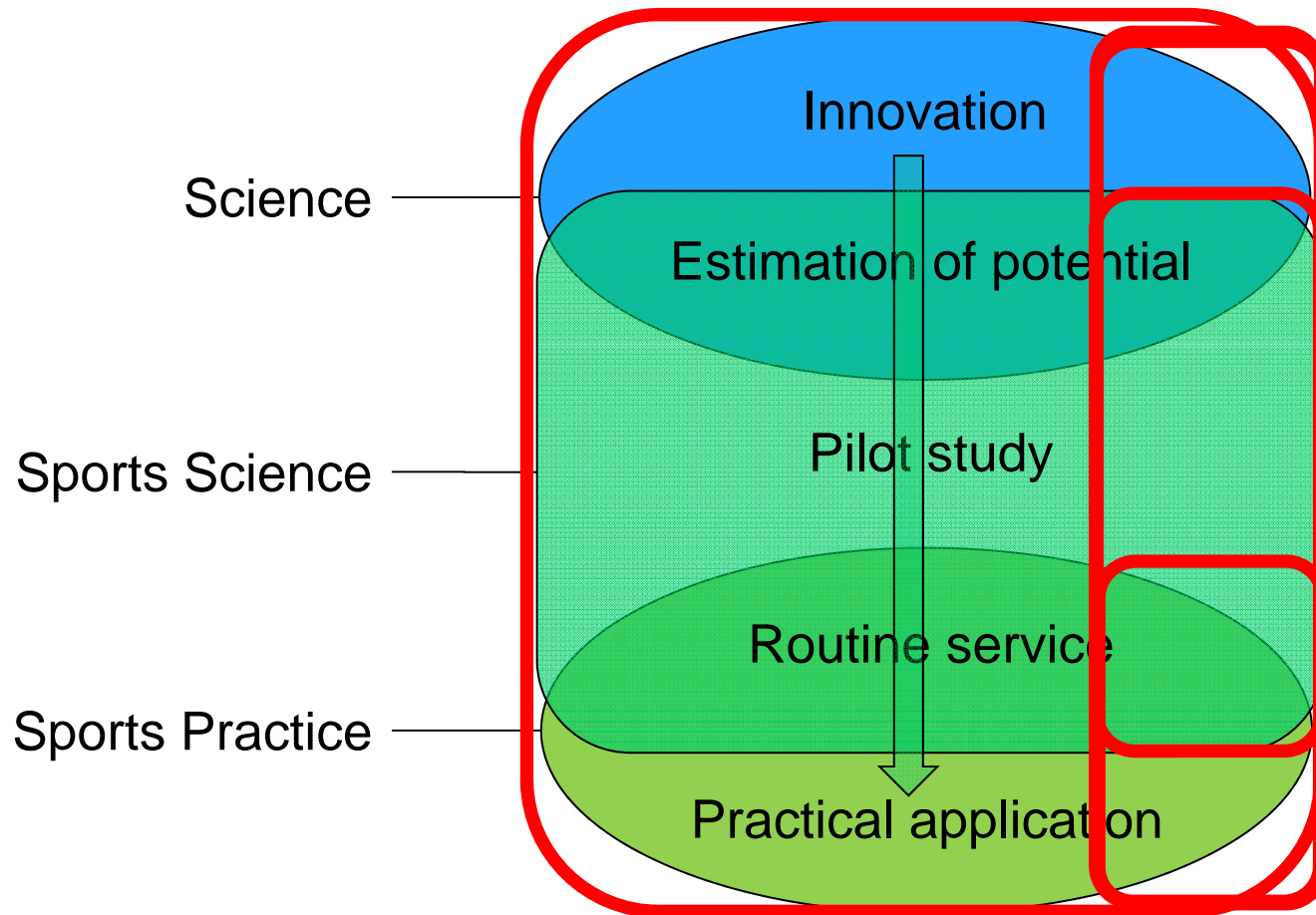
Routine service

- Funded by sports organisation
- Run autonomously by users / scientific service staff
- Focus on cost-benefit relation

Innovation cycle



Role of training centers/national sports institutes

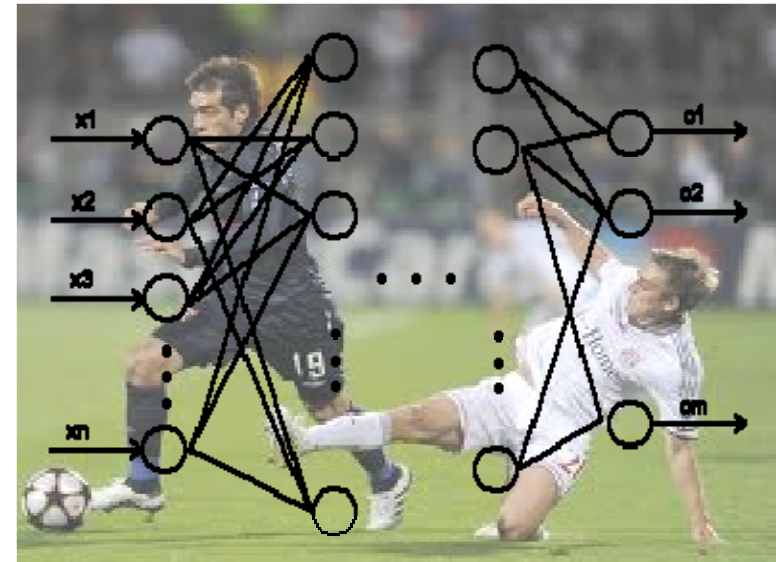


Innovations vs. conventional training

- Two sources for winning performances:
 1. Perfectly organized conventional training system **plus**
 2. Innovations that give the decisive advantage
- National institutes have to care for both, but
 - Practitioners prefer investments in conventional training („homework“)
 - Scientists are interested almost exclusively in innovations

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Position detection

- 10-20 companies worldwide offer position detection in sport
- Widespread service in professional game sports, especially football (soccer)
- Germany: Association of professional football clubs provides clubs with statistics on actions and positions (and sells these statistics to other customers)

Technologies

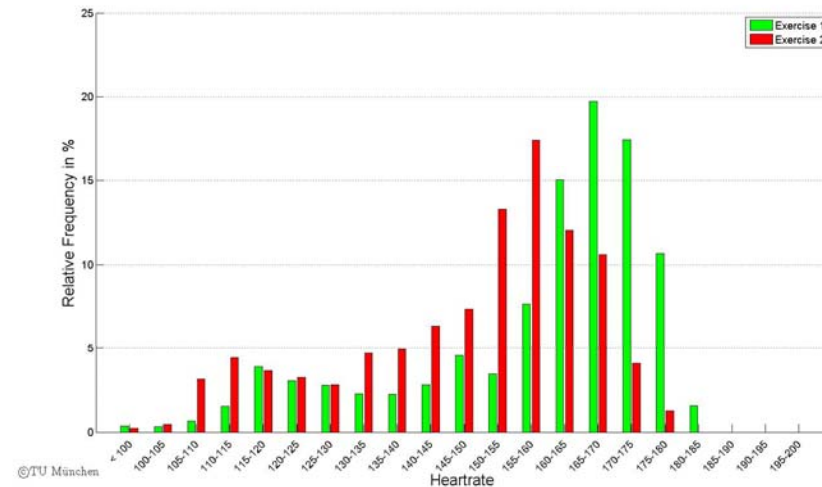
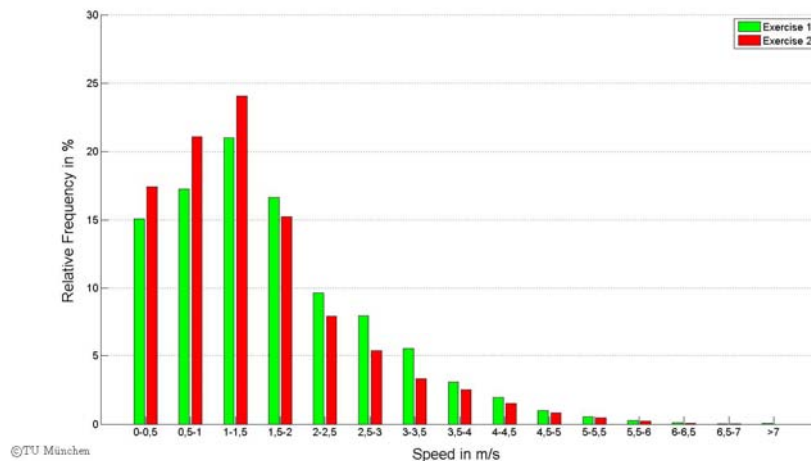
- Radar
 - Expensive, high precision, objects need to wear active tags
 - Applications in speed skating, football (training), football (Ball), moto cross
- GPS
 - Cheap, low sample frequency, objects need to wear antennas, problems with indoor sports
 - Applications in skiing, sailing, car racing, many others
- Video based image detection
 - Only technology without tags fixed to objects
 - Potential for detecting not only positions but 3D-objects as a whole
 - Applications in football, field hockey, American football, baseball and others

Typical statistics in football match analysis

- Total distance covered
- Distance covered in speed intervals, e.g.
 - <0.2 m/s standing
 - 0.2-2 m/s walking
 - 2-4 m/s jogging
 - 4-5.5 m/s running
 - 5.5-7 m/s high-speed running
 - >7 m/s sprinting
- Frequency of speed intervals
- Heat maps

Application in football training

- Comparison of small sided games (5 vs. 5) with different intervals:
 - 5*4 min, 1 min break
 - 4*5 min, 1.5 min break

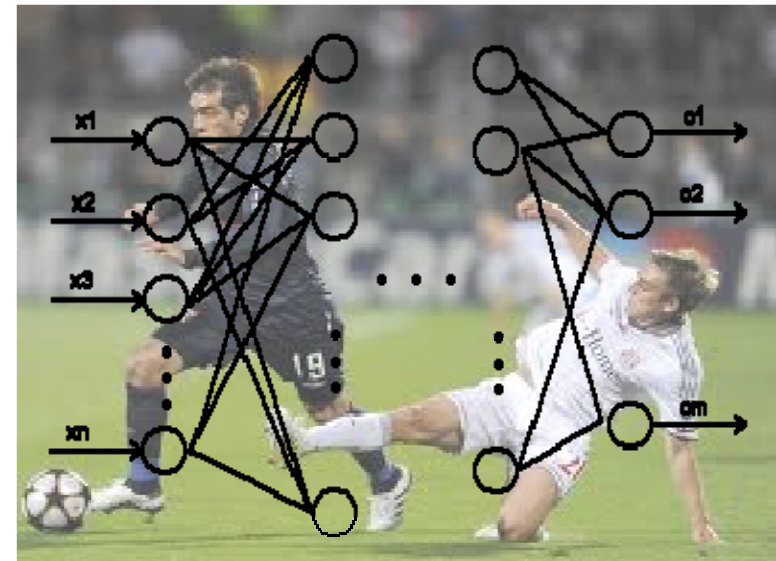


Tasks for Sports Science

- Control tasks
 - Controlling the quality of measurements
 - Controlling the acceptability of workflow
 - Compare different offers on scientific criteria
 - Test for reliability and validity of measurements
- Enhancement tasks
 - Assess validity of standard reports
 - Create new insights from data
 - Generate information of practical interest from data

Program

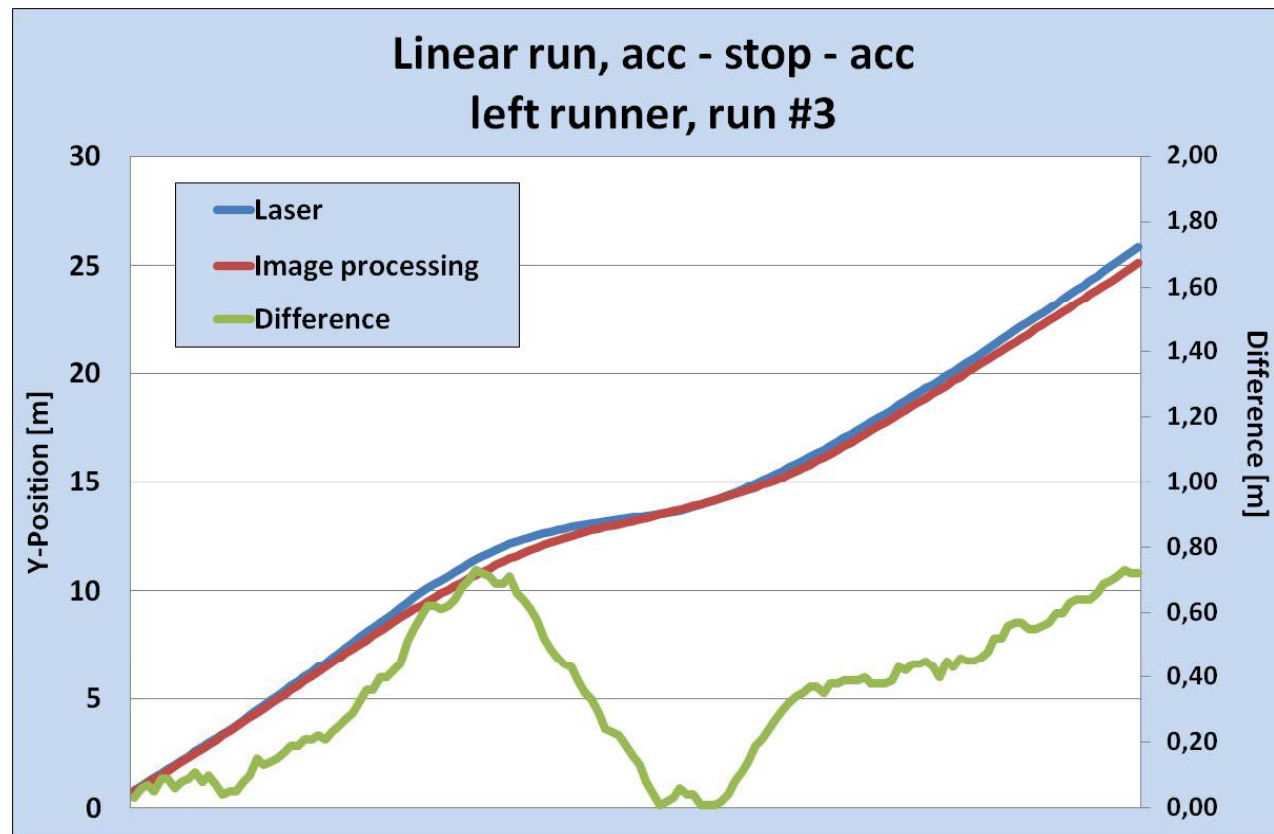
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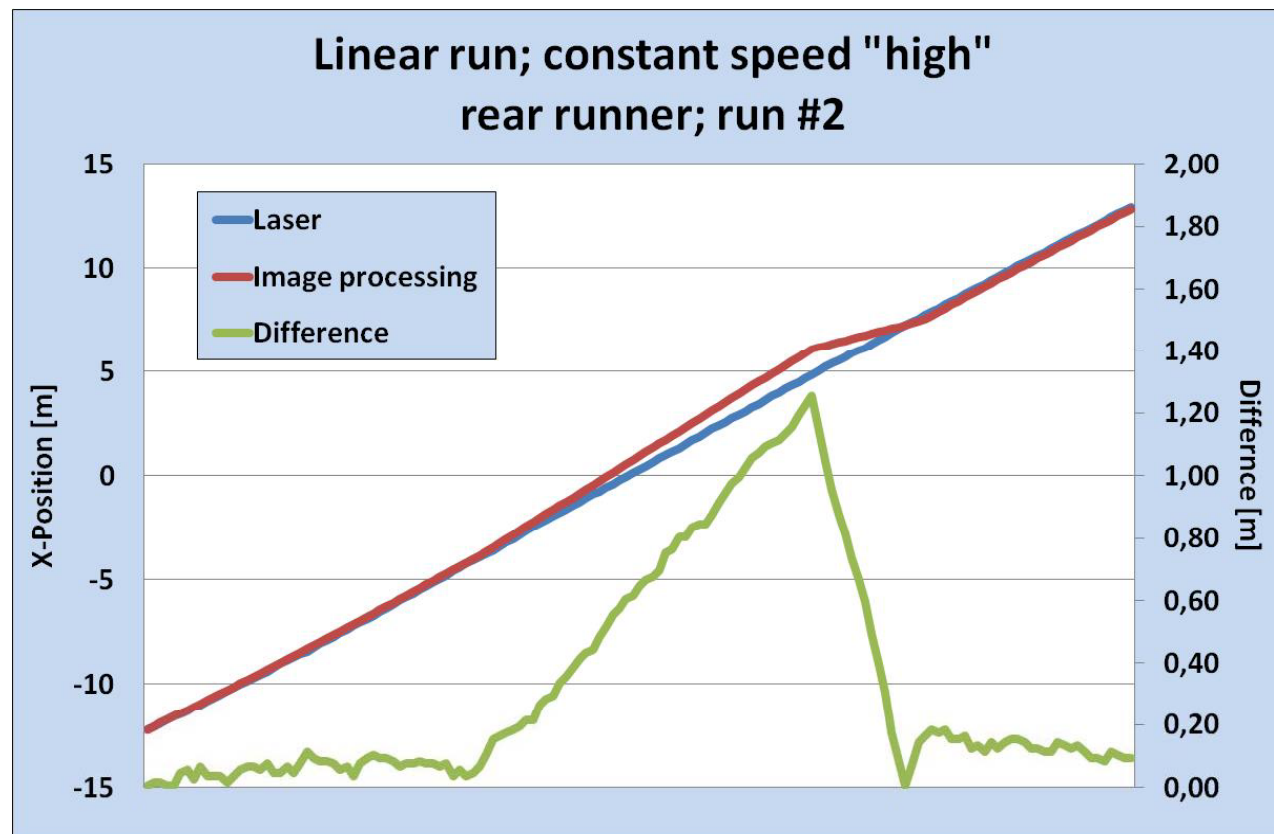
Reliability

- Different systems come to different results
 - Different filtering techniques
 - Number of cameras used ranges from 2 on the press desk to 20 mounted all over the stadium
- Some reliability studies with poor quality
- Lack of know how and knowledge!

Problems of image detection 1



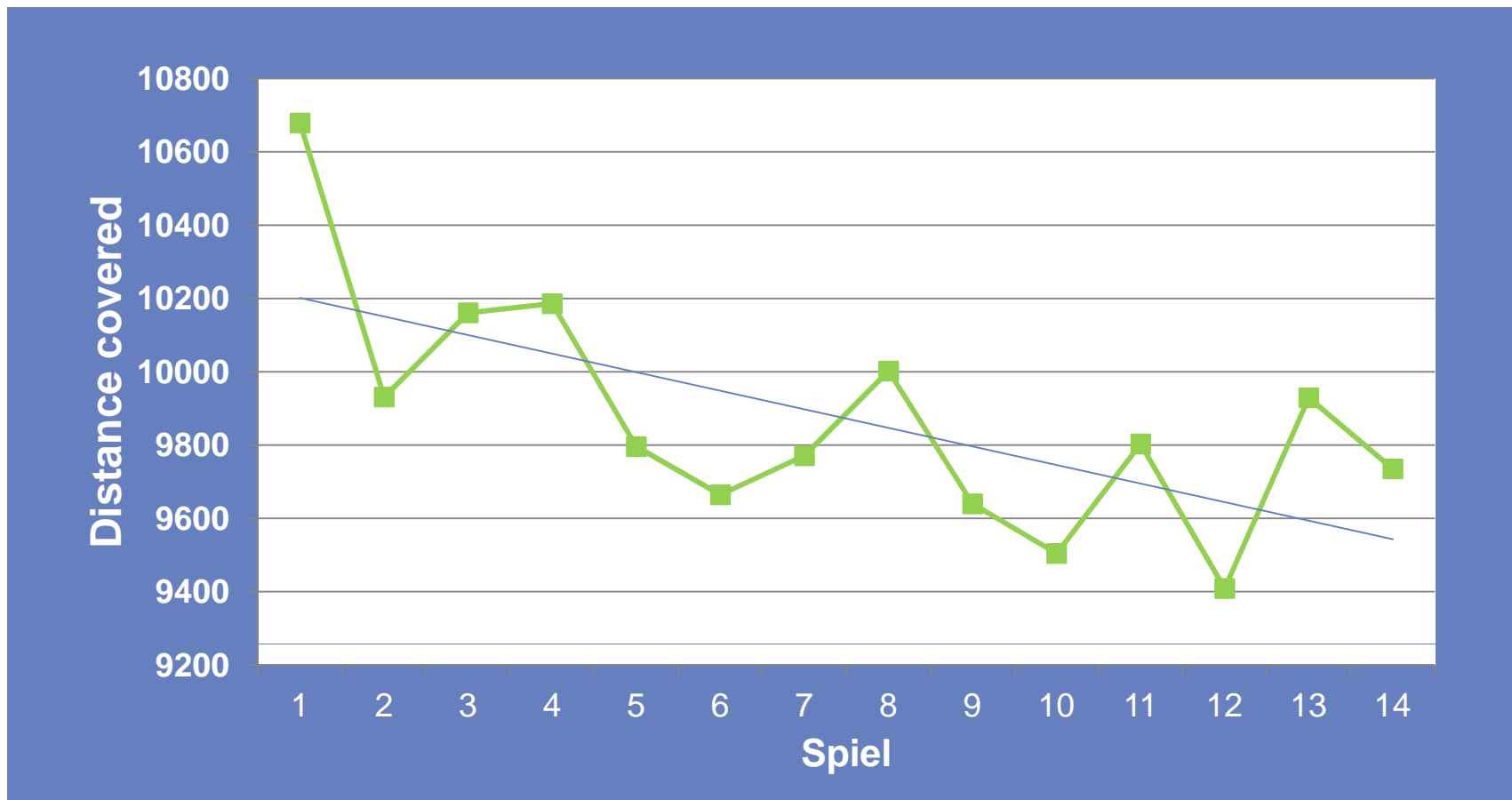
Problems of image detection 2



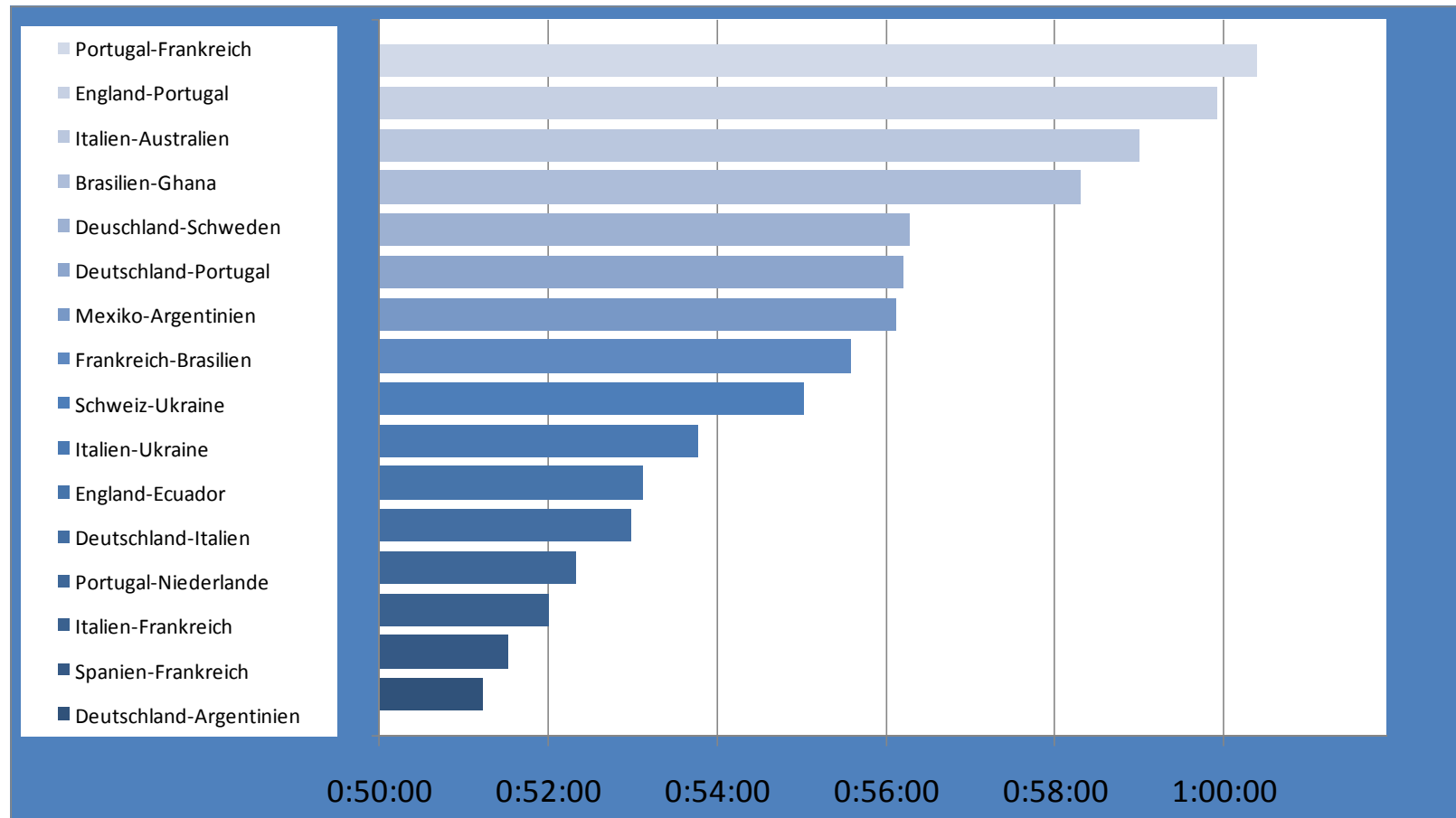
Validity

- Frequently, distance covered and distance covered in high intensity running is taken as a measure for endurance capacity
- Frequently, the reduction of distance covered in the second half is taken as a sign of fatigue

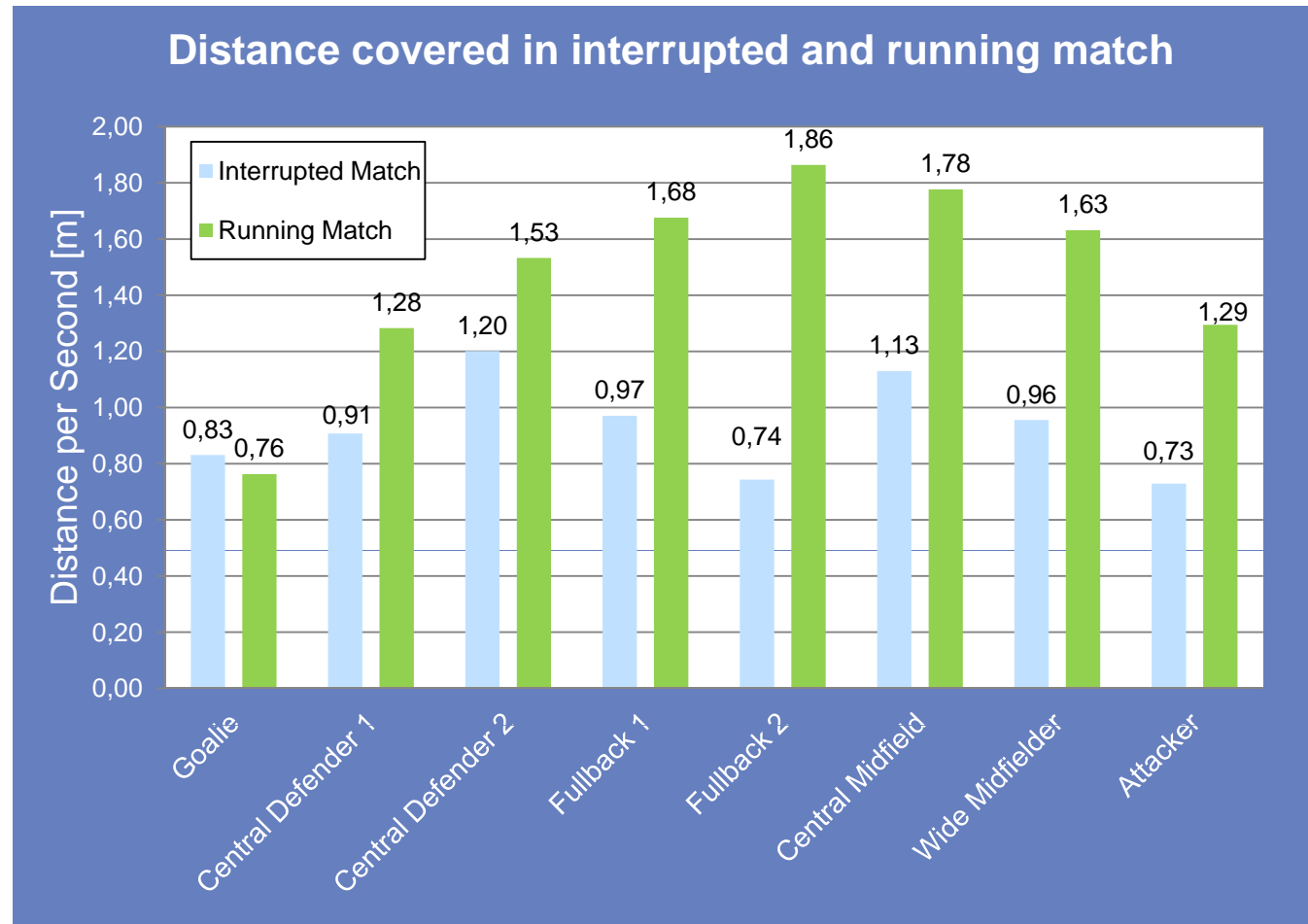
Distance covered per match



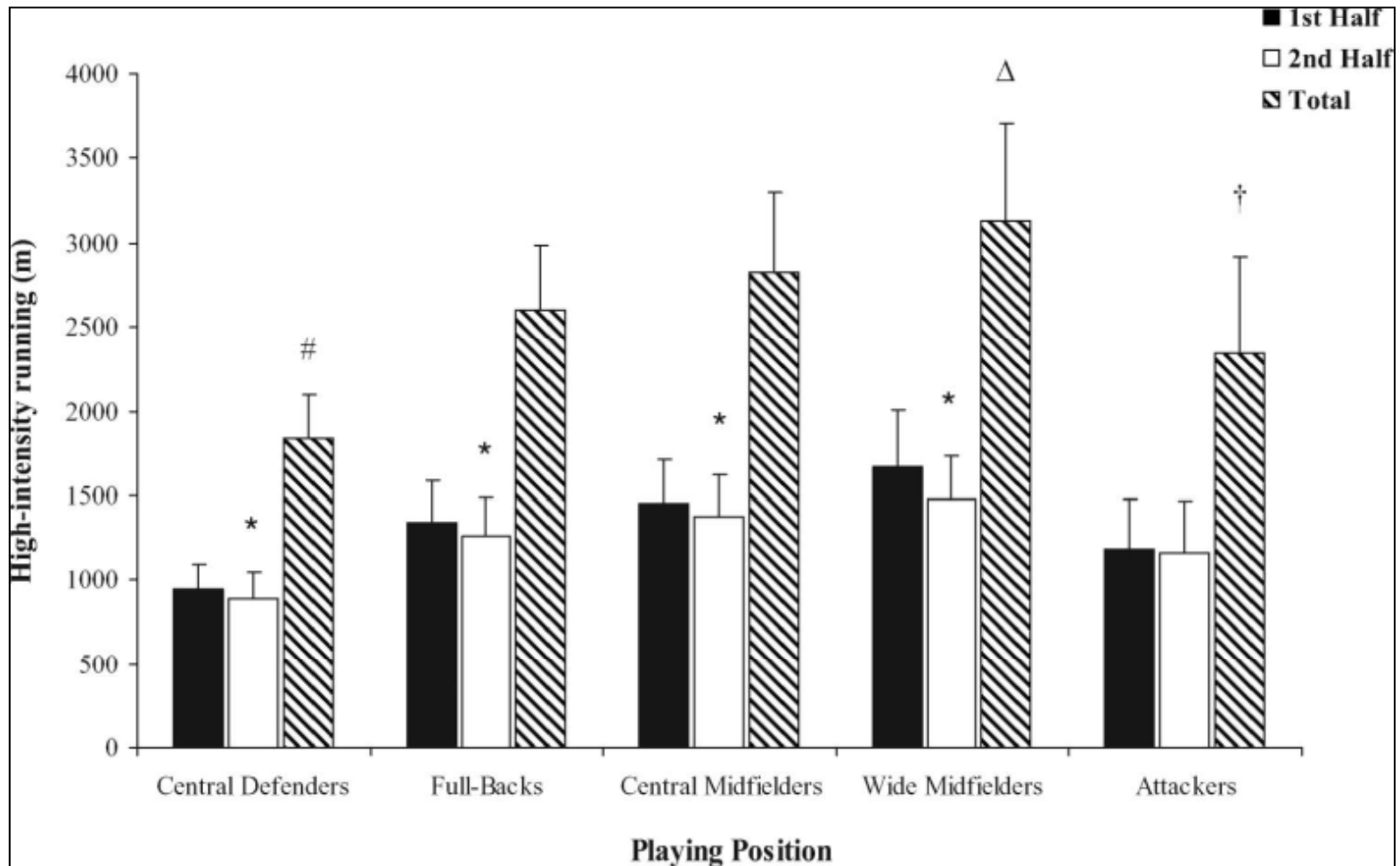
Variation of time played



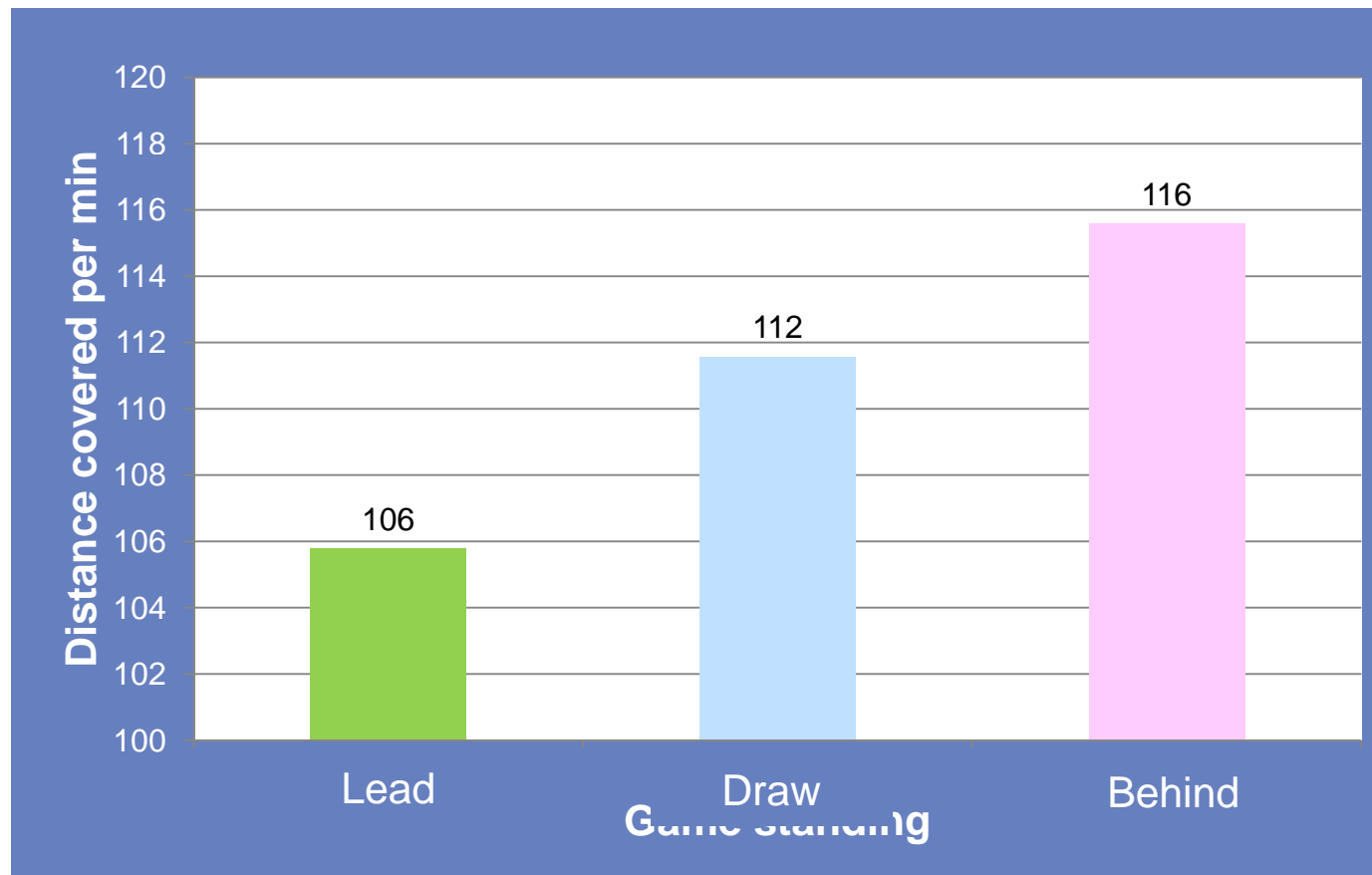
Validity of distance covered



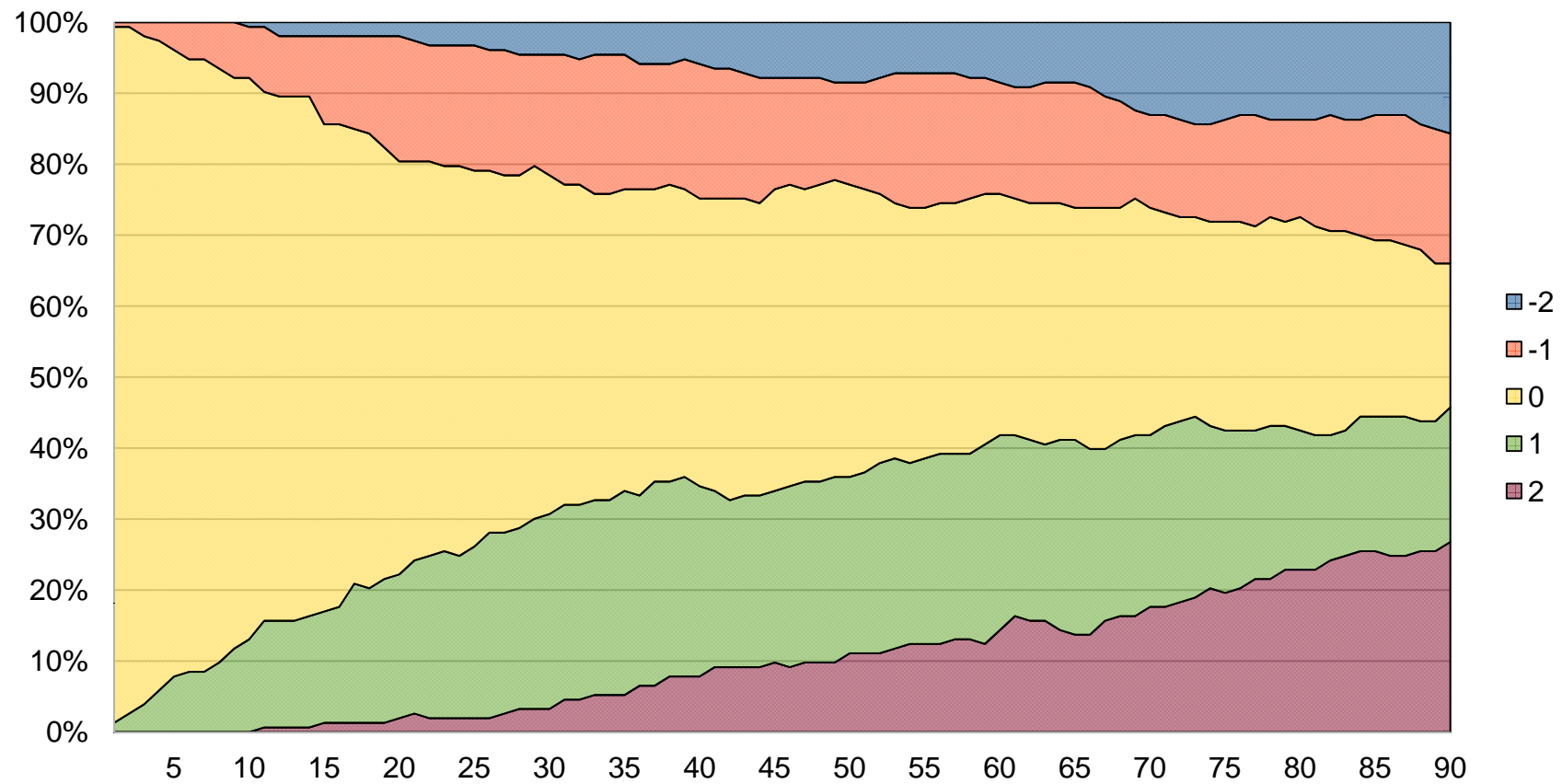
Fatigue



Distance covered and standings



Game standings over 90 minutes (n=306 games)



Further pitfalls

- Ball possession
 - Varies between 33% and 66%
 - Ball possession is not a good indicator of success
 - Teams in ball possession run more
- Playing position
- Quality of tactics

Resumée position detection

Achievements

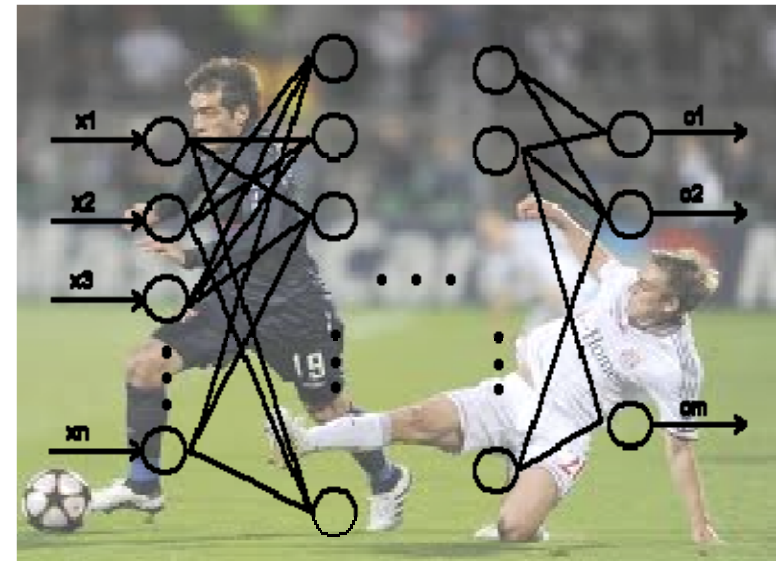
- Technological innovations have made positional data available
- A wealth of information is available routinely per match

Still to solve

- Standards for data processing (filtering techniques)
- Standards for accuracy testing
- Interpretation of position and speed data
- Key aspect: capability to select different situations
 - Running game / interrupted game
 - Offence / Defense
 - Set game / fast break / position game
 - Playing position

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A glance in the future

- Technological development is a continuous process
- Many areas will be affected
 - Physiological sensors in/on athletes
 - Mechanical sensors in athletes and environment
 - Detailed video coverage and instantaneous 3D-Simulations
 - Information exchange via „Evernet“ / „Seamless network“
 - Artificial Intelligence for data analysis
- Comprehensive data on athletes' performance will be available in near future

Role of national institutes

Innovation cycle

- Identify promising developments
- Run pilot studies
- Organize routine implementation

Innovation projects

- Collaboration with external partners (universities, companies)
- Financing, funding
- Bridge the gap to practice

That's what it is all about!

