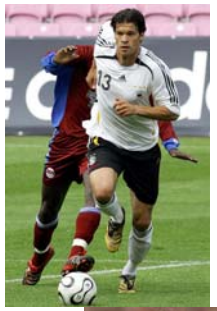
New methods to evaluate traction on fields





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INSTITUTO DE BIOMECÁNICA DE VALENCIA

Mercedes Sanchis Almenara

03/04/07

Player Surface Interaction

- Shoe-surface interaction is important for both the performance and the safety of athletes
- This interaction is related to:

-Performance: improvement of performance during displacements, sprints, changes of direction, …

-Injuries: excessive or insufficient traction can lead to injury

Shoe-Surfaces Interaction & Injuries

- **In American Football, the severity and incidence of knee and ankle injuries were reported to be significantly lower when using shoes with friction properties** (Ekstrand & Nigg, 1989)

- **An athlete's skills are limited by the quality of the fixation of that player to his present playing surface… but there is a trade off. Any increase in fixation increases the risk of injury** (Levy et al., 1990)

- **Friction is necessary for rapid starting, stopping, cutting and pivoting; however, increased frictional force may contribute to the increased incidence of injury** (Inklaar, 1994)

- **Increase in turf temperature, in combination with cleat characteristics, affects shoe-surface interface friction and potentially places the athlete's knee and ankle at risk of injury** (Torg et al., 1996)

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Shoe-Surfaces Interaction & Injuries

- **It is possible that measures to reduce shoe-surface traction, such as ground watering and softening (…) and player use of boots with shorter cleats, would all reduce the risk of football injuries** (Orchand, 2002)

- **Cold weather is associated with knee and ankle injury risk in outdoor stadiums, probably because of reduced shoe-surface traction** (Orchand & Powell, 2003)

- **While traction is frequently necessary for athletic performance, excessive traction increase the risk of 'foot fixation', an etiological factor in some types of injury** (Shorten et al., 2003)

- **…**

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Standard methods to evaluate traction

- TRRL pendulum

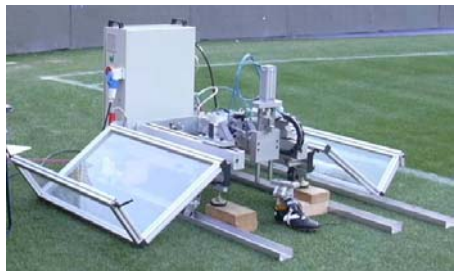
Is there a relation between these tests results and players' perception and performance?

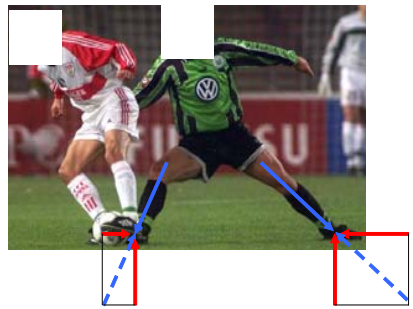
-The result is maximum traction value (nothing about time to obtain the maximum or rotated angle)

New methods to evaluate traction

- **IBV has developed two methods to evaluate traction:**

-Mechanical test: **it consists of a machine capable of reproducing the lateral displacements that sportsmen make in their natural movements during matches**



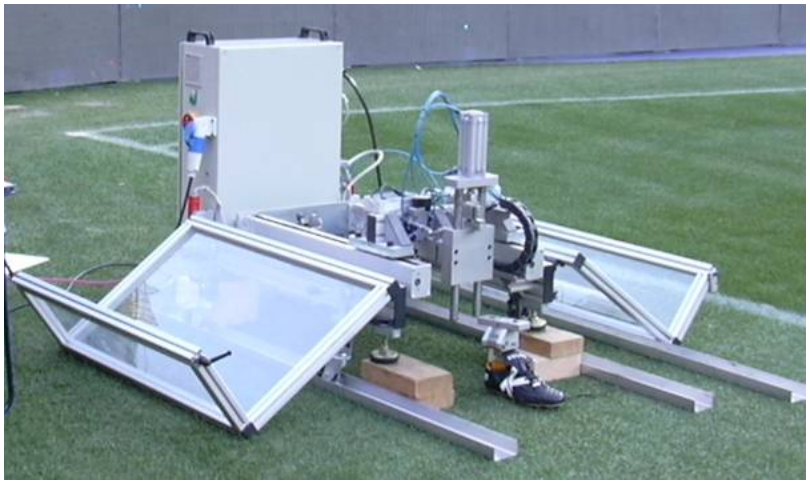


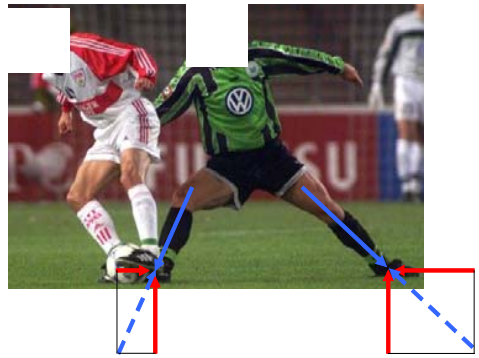
-Biomechanical test: **it consists of a soccer boot with instrumented studs**

New methods to evaluate traction

- **Mechanical test device:**

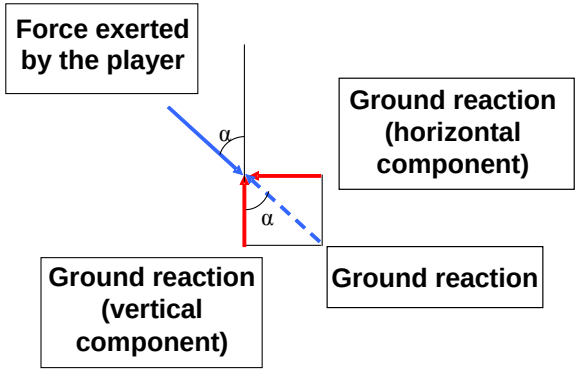
  -The movement of this machine consist of a horizontal displacement at controlled velocity, recording the horizontal force necessary to produce the displacement
  -Vertical force = 150 N; constant velocity = 0.4 m/s





New methods to evaluate traction

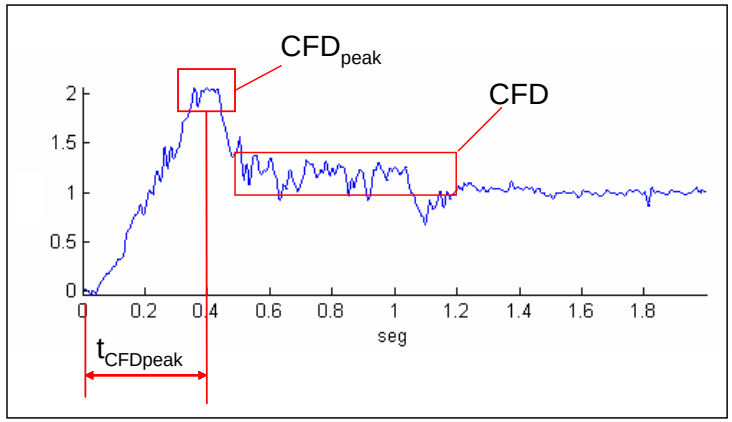
Mechanical test device:

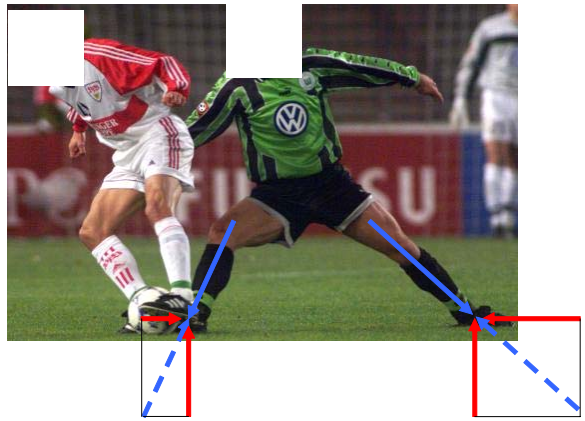


$$CFD = \frac{Fh}{Fv},$$

$$tg\alpha = \frac{Fh}{Fv},$$

$$\longrightarrow \quad CFD = tg\alpha; \quad \alpha = actgCFD$$

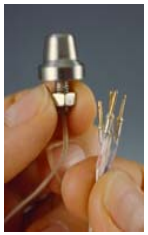


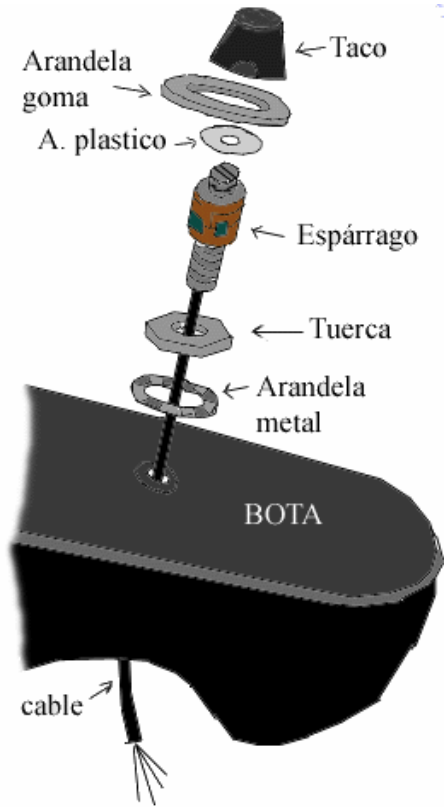


New methods to evaluate traction

- **Biomechanical test device:**

  -It consists of a soccer boot with thirteen instrumented studs by means of strain gauges for measuring forces in each stud

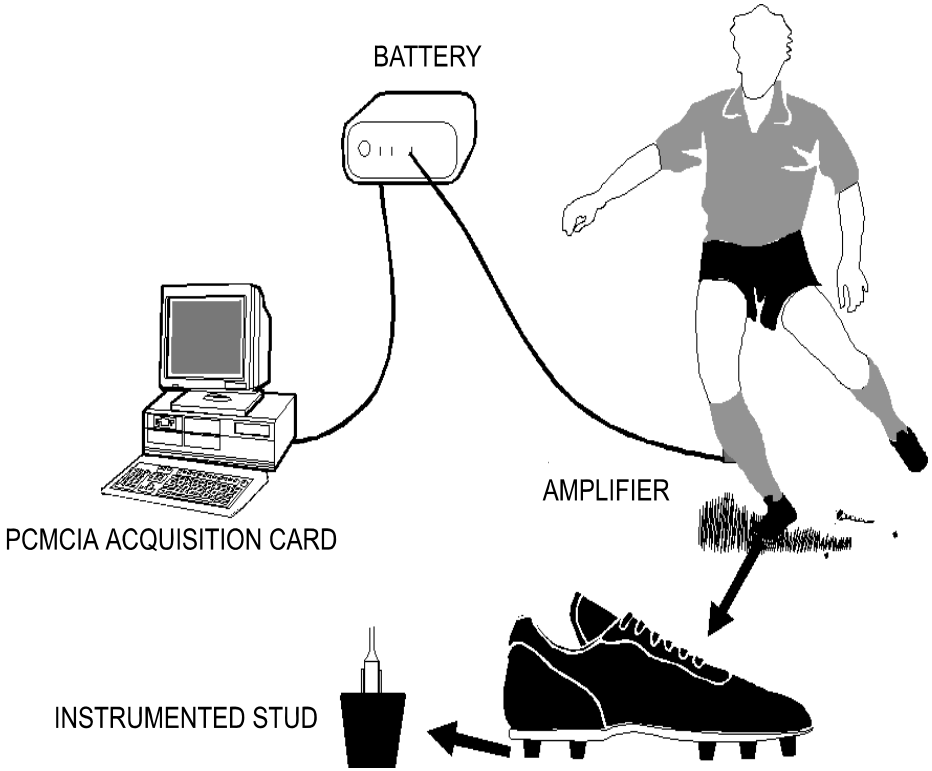




Taco: stud
Arandela goma: rubber washer
A. plástico: plastic washer
Espárrago: bolt
Tuerca: nut
Arandela metal: metal washer
Bota: boot
Cable: cable

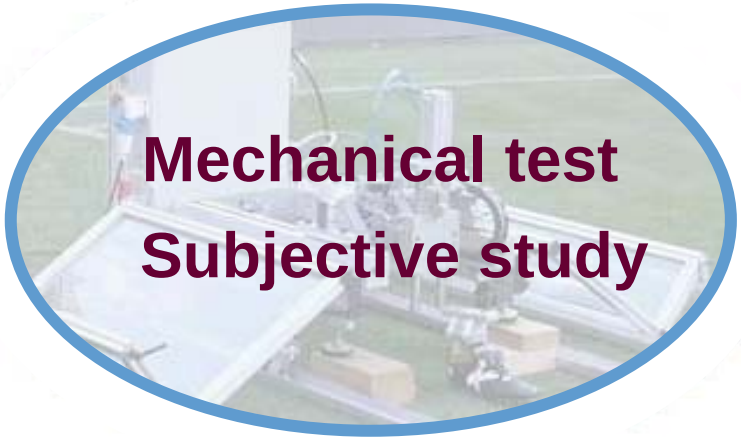
New methods to evaluate traction

- **Biomechanical test device:**



New methods to evaluate traction

- Two studies were carried out:



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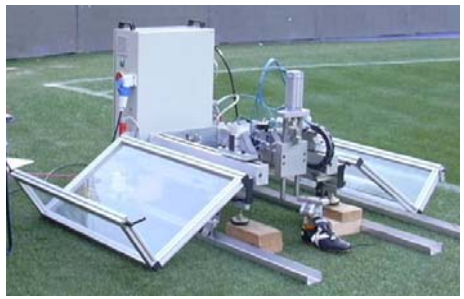
New methods to evaluate traction

Mechanical test & Subjective study:

- **Five natural grass and five artificial turf fields**
- **Five points were tested by means of IBV test device and three repetition for each one**
- **Five experienced soccer players without injuries performed the test**



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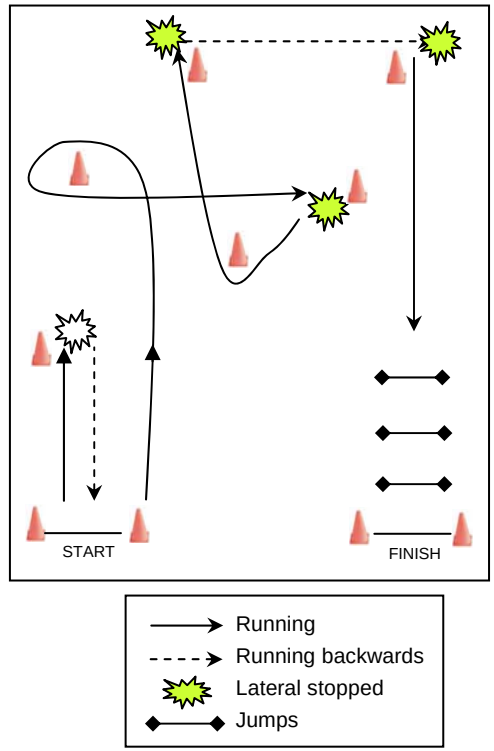

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New methods to evaluate traction

- Mechanical test & Subjective study:

Mechanical test:

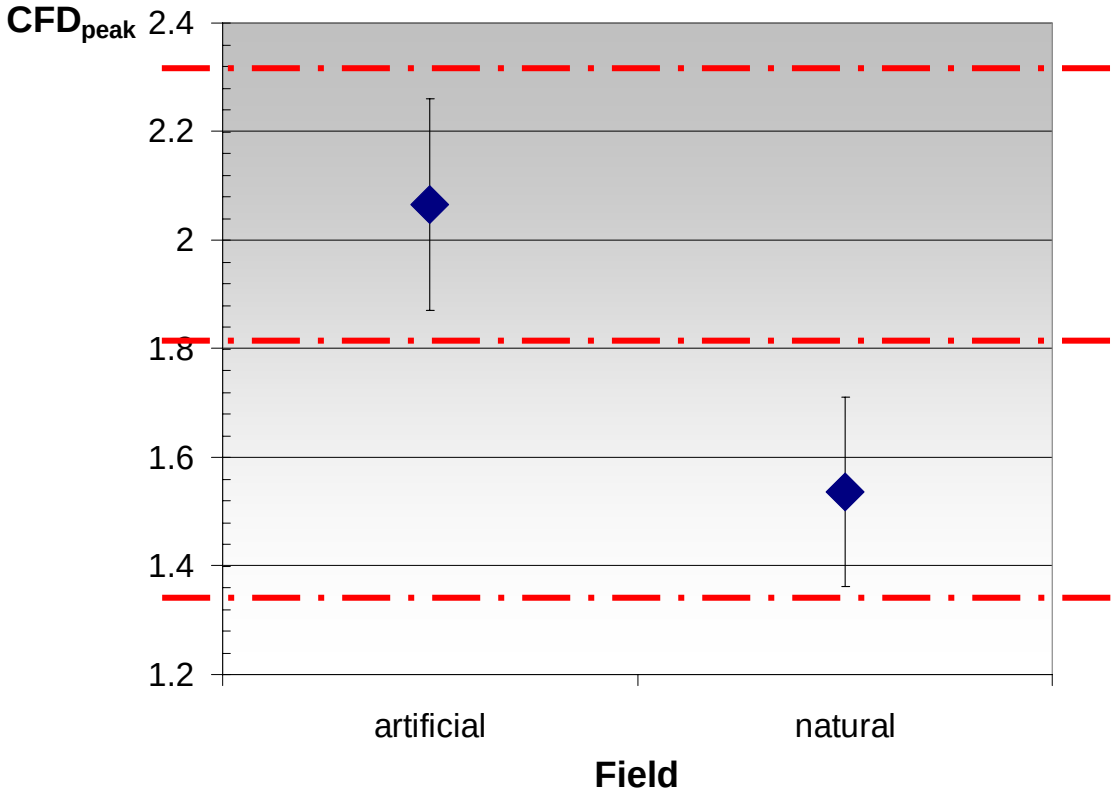
- CFD_{peak}
- t_{peak}

Subjective study:

- easiness to stop
- easiness to begin to run
- slips
- risk of injury perception
- performance
- traction in general

Results

- Mechanical test results:



Results

- Differences between surfaces were found in easiness to stop (players perceived easier to stop in artificial turf than in natural grass); there is a correlation between these results and mechanical test results

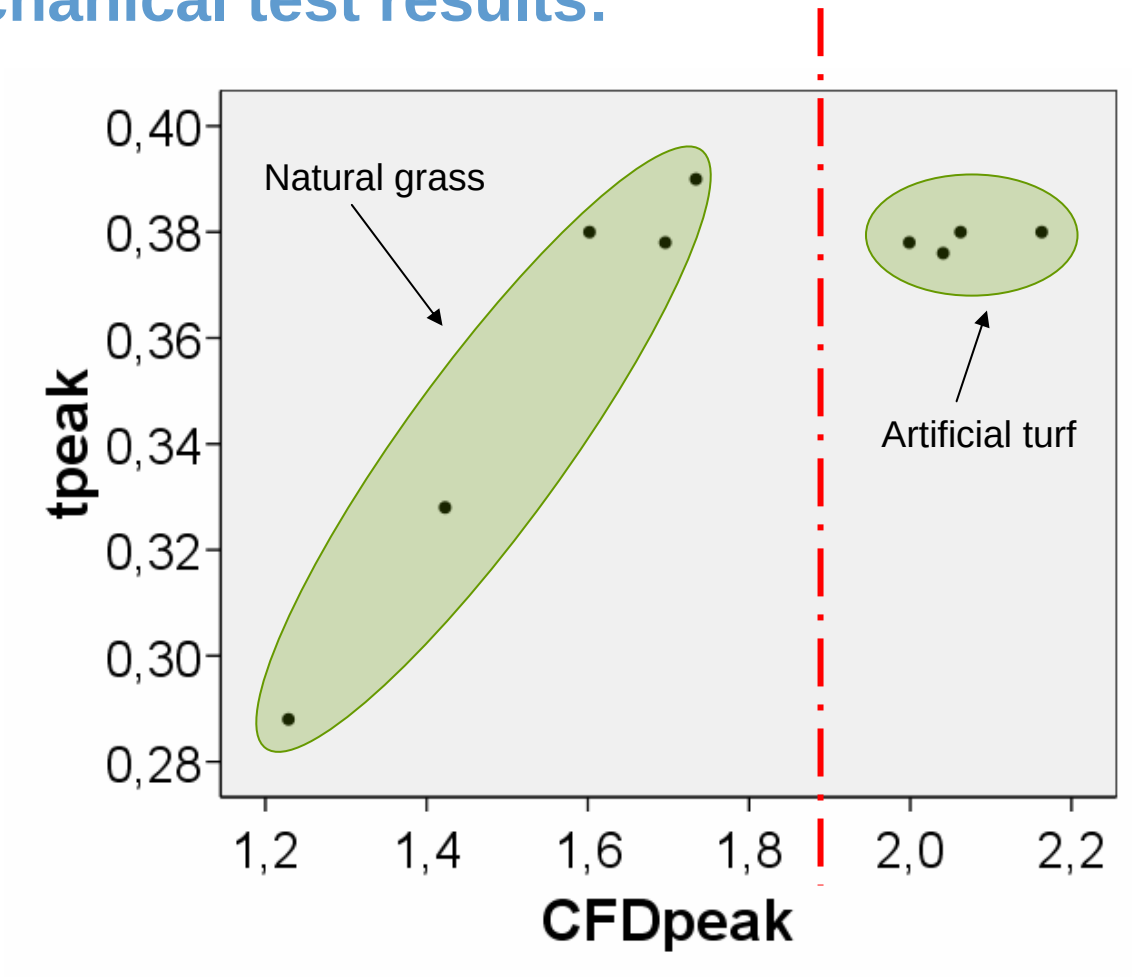
- Differences were not found about easiness to run and slips between surfaces

- Players perceived a better performance in artificial turf, related to larger CFDpeak

- Traction in general was perceived as larger in artificial turf than in natural grass

Results

- **Mechanical test results:**



Results

Mechanical test results:

- Players perceived more risk of injury in artificial turf than in natural grass

Conclussions

About mechanical test:

- A good correlation exists between mechanical test results and players perception about:
  - easiness to stop
  - performance
  - traction in general

- It is possible that the relation CFD_{peak}-t_{peak} is an indicator of the severity of the stopped, related to risk of injury

New methods to evaluate traction

Biomechanical test:

- **Five males semi-professional soccer players participated in the experiment**

- **They performed five repetitions of three common movements in soccer over a natural turf ground:**
  - start running
  - outer turning
  - inner zigzag

- **These movements were selected because :**
  - they are very common movements on soccer matches
  - they are related to typical injuries suffered by soccer players
  - the influence of the studs could be important for the performance of the action

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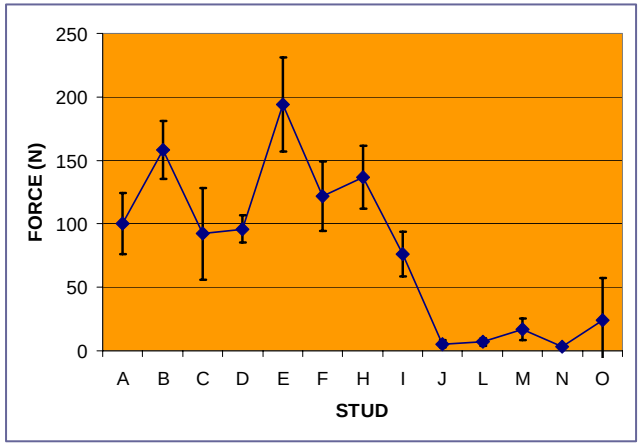
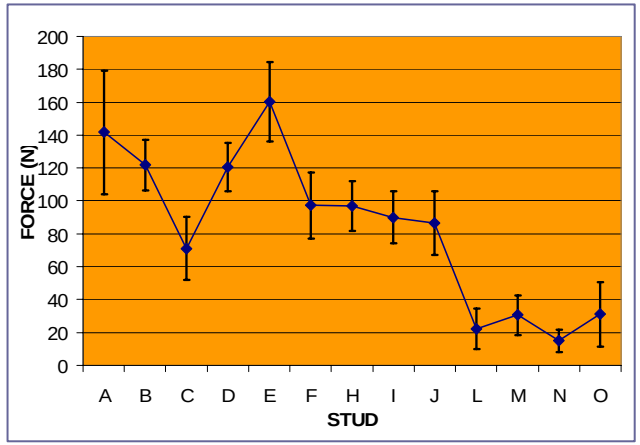
Results

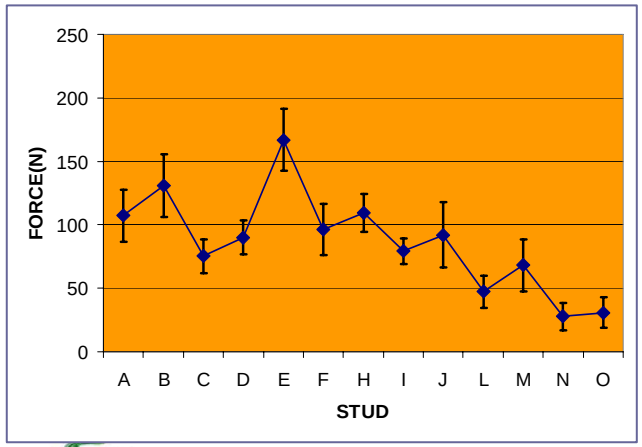
Biomechanical test results:



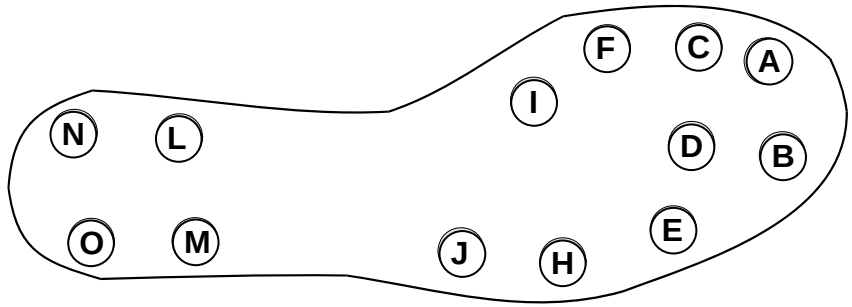
Outer turn



Start running

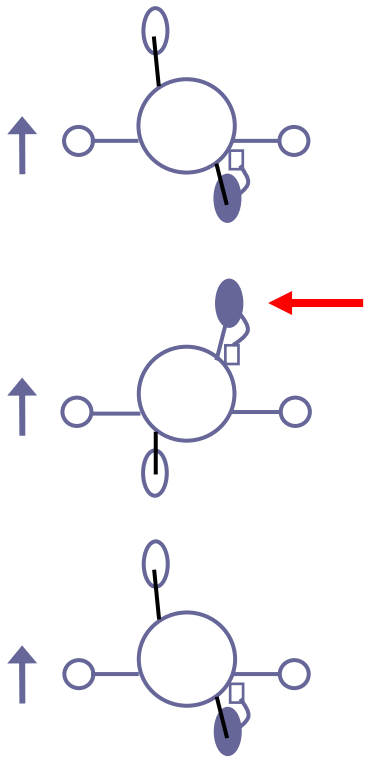


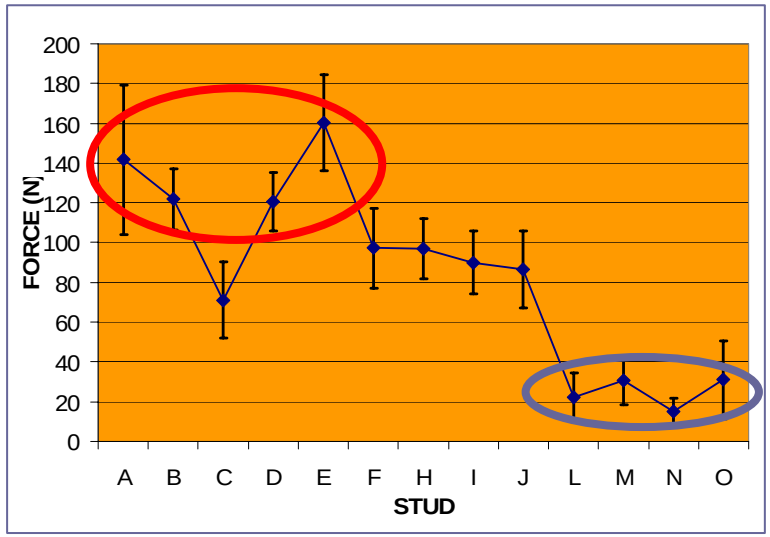
Inner turn



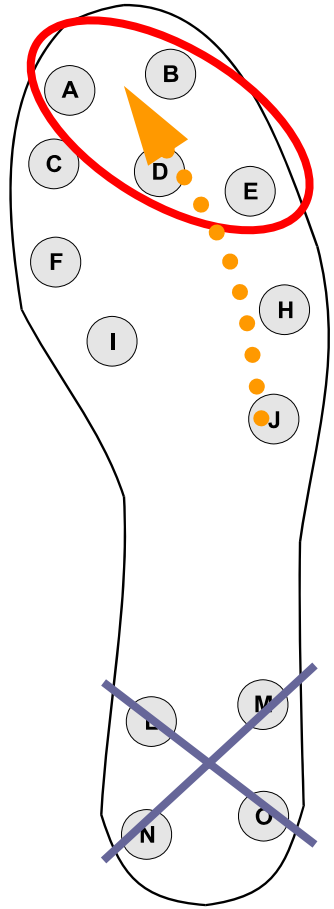
Results

- **Biomechanical test results:**



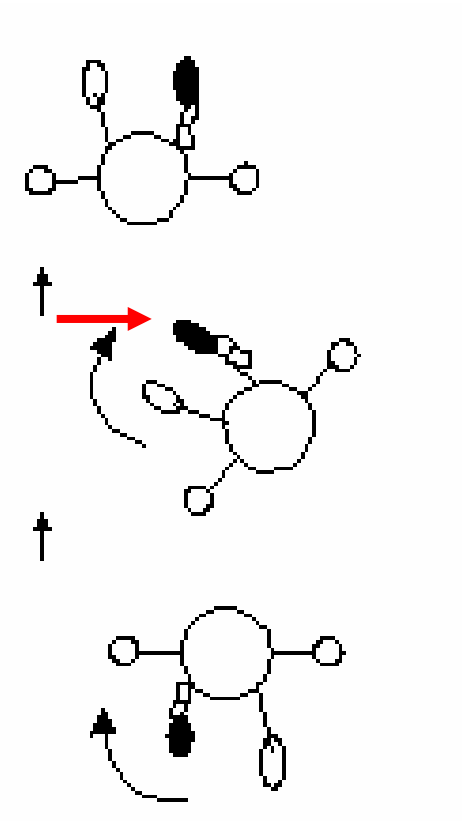


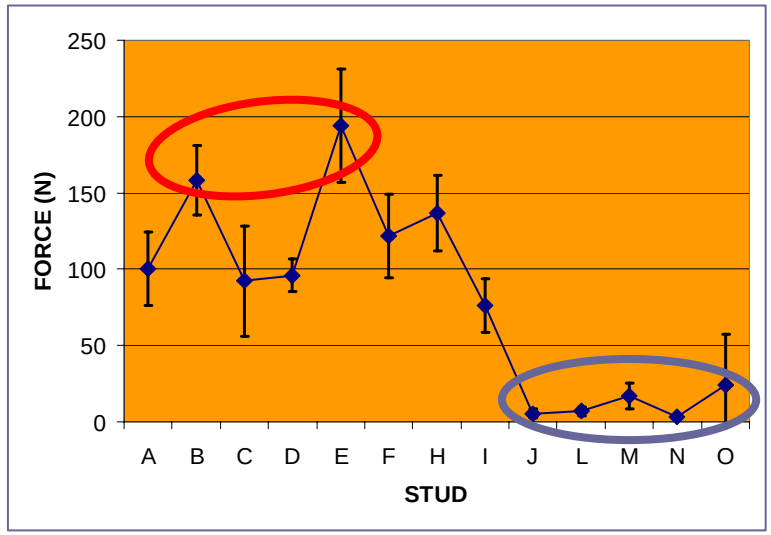
Start running



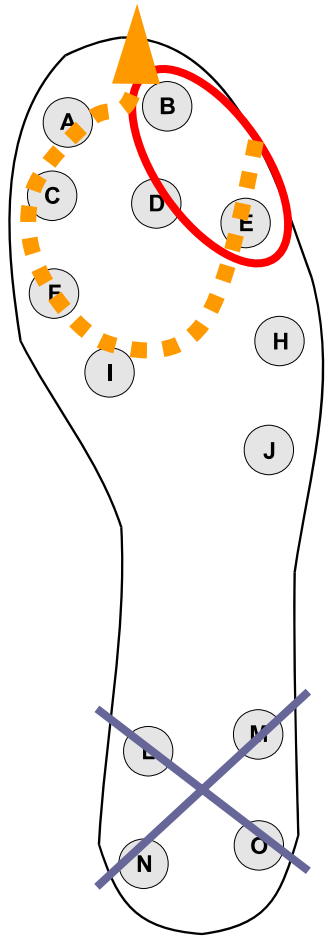
Results

- **Biomechanical test results:**



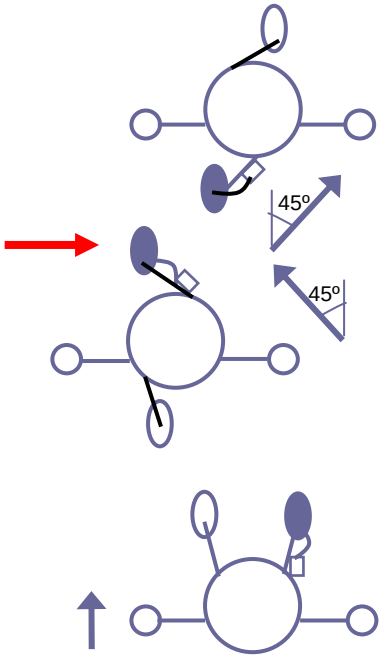


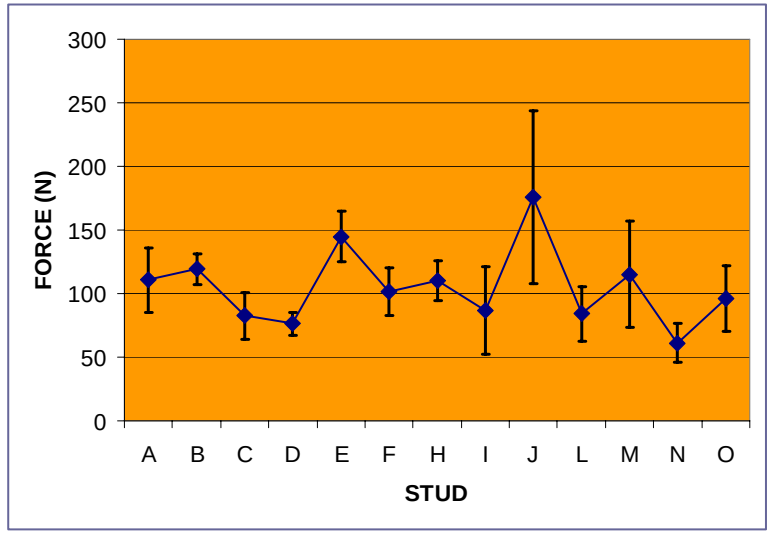
Outer turn



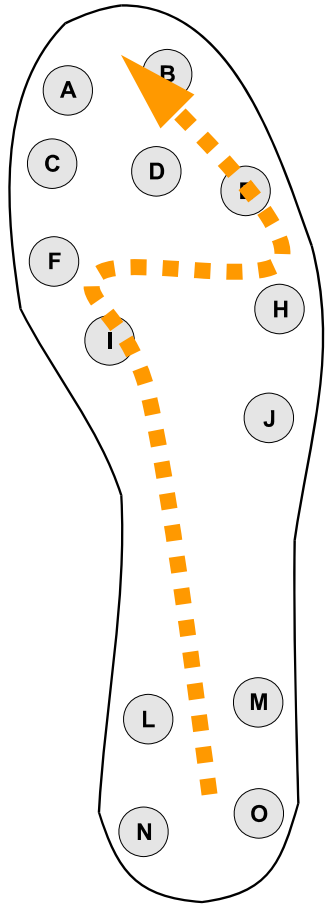
Results

- **Biomechanical test results:**





Inner zigzag



Conclussions

About biomechanical test:

- The front-outer studs presented the highest forces and time of actuation during the studied movements

- The forces in the rear studs were very low in the majority of movements

- These results suggest that different areas of actuation exist and they require different design parameters for studs

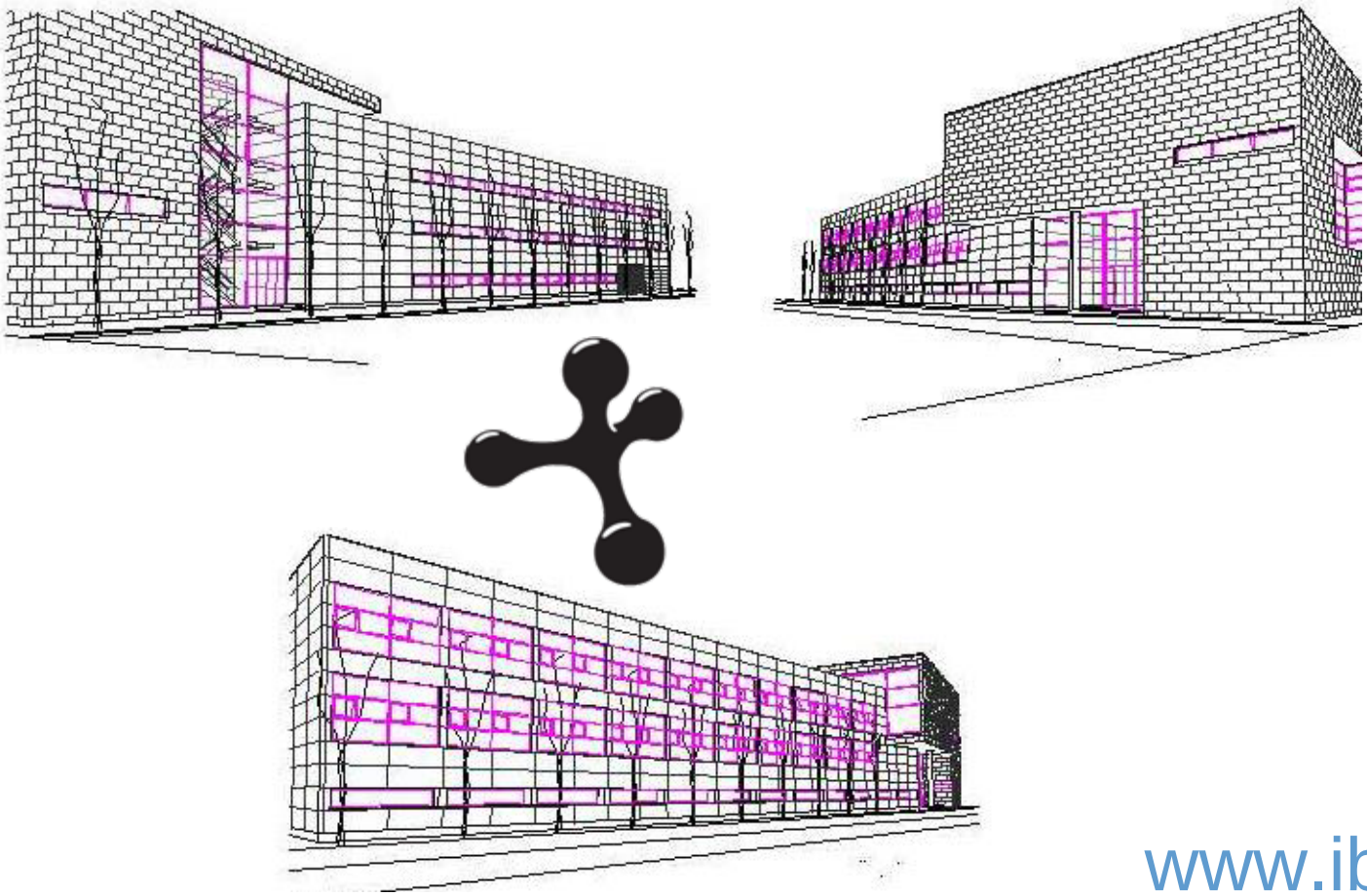
Conclussions

- Traction in artificial turf is different than in natural grass. It is necessary to continue working in this term

- Traction is different depending on shape and size of studs. It is necessary to know the influence of these in traction (standard methods simplify to a one type of stud)

- Future works: try to develop models to predict risk of injury starting from traction values

Thanks for your attention



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