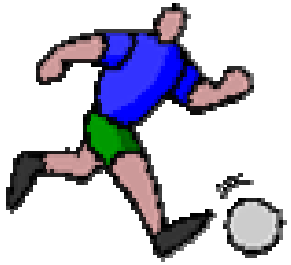
UNIVERSITÀ DEGLI STUDI DI PAVIA

ISSS MEETING

Prof. Lombardi Remo

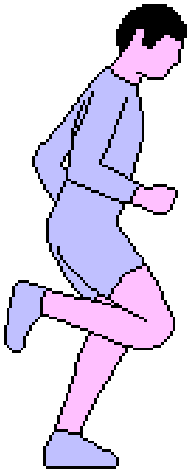
Mauro Testa

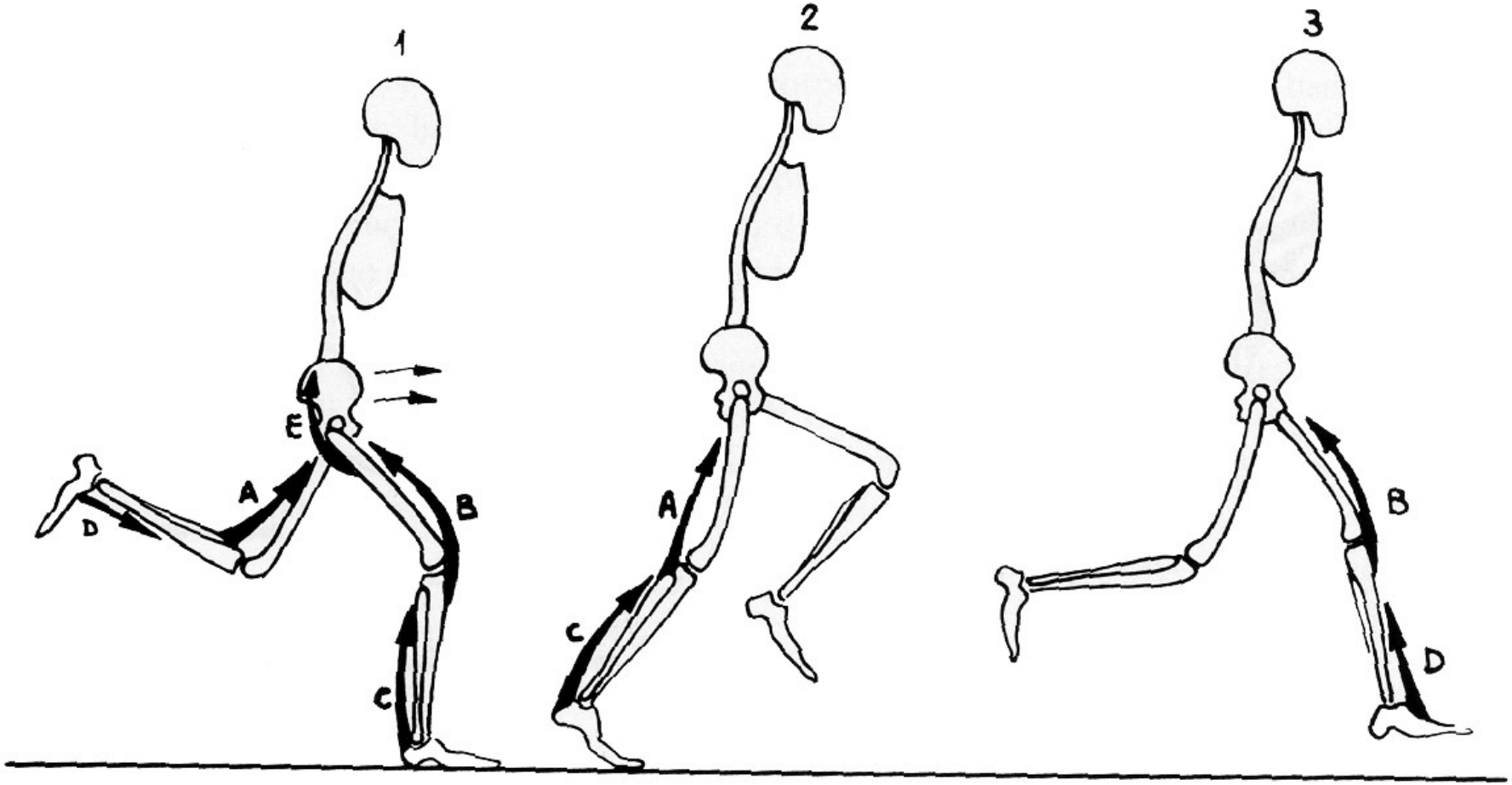


Soccer:

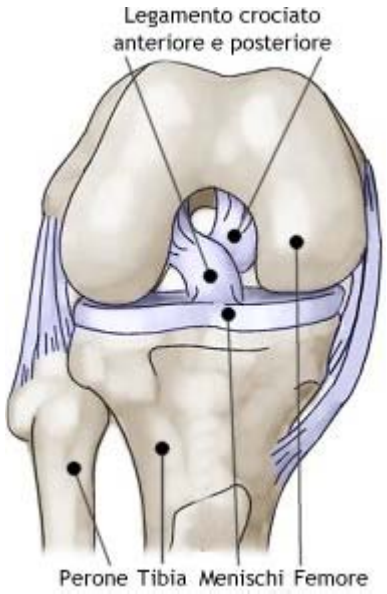
what are we doing?

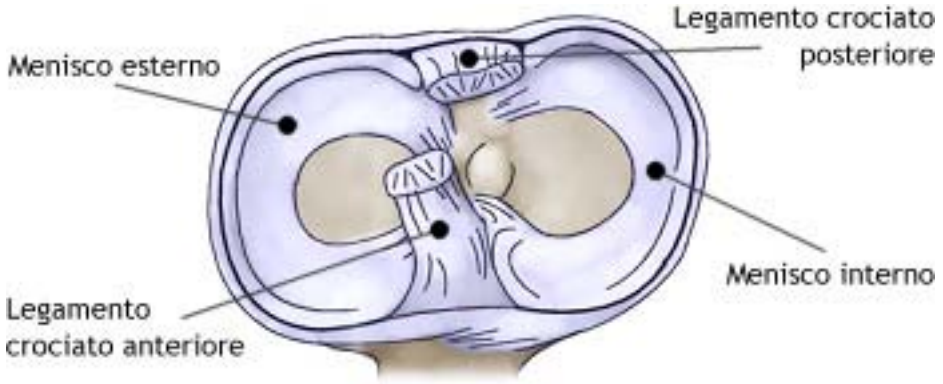
Biomechanical analysis can help us to reduce many traumas



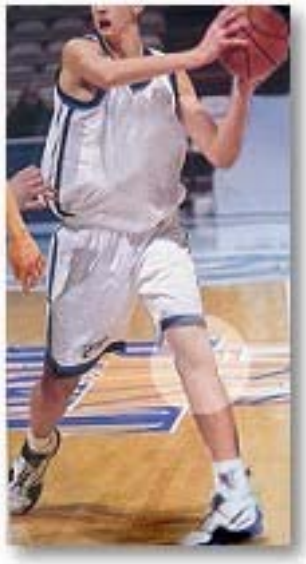


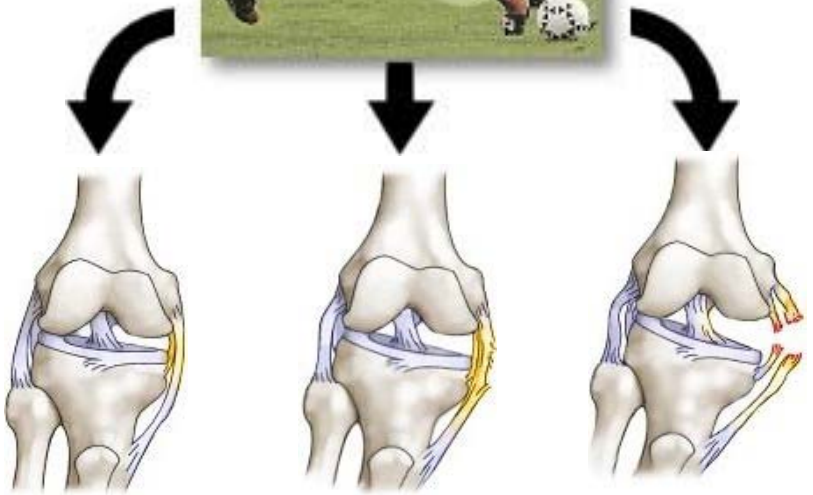
Il ginocchio- the knee





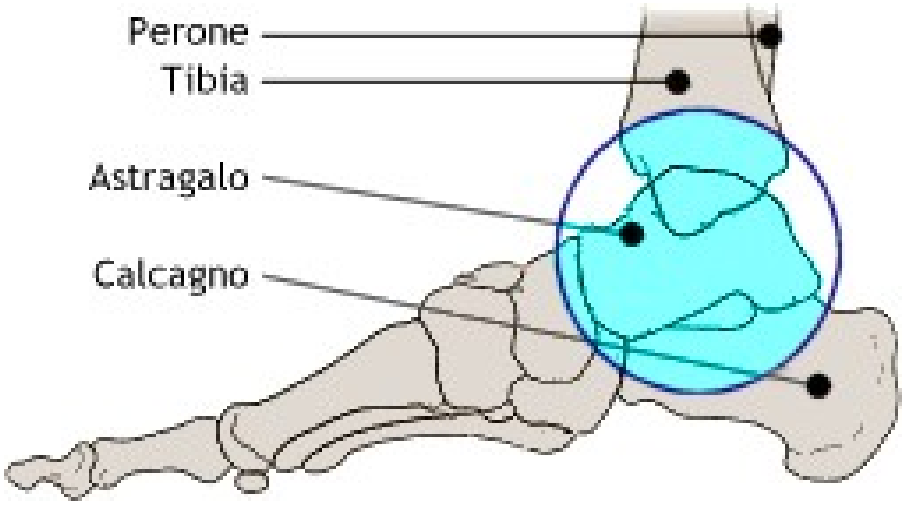
Meniscus and ligaments

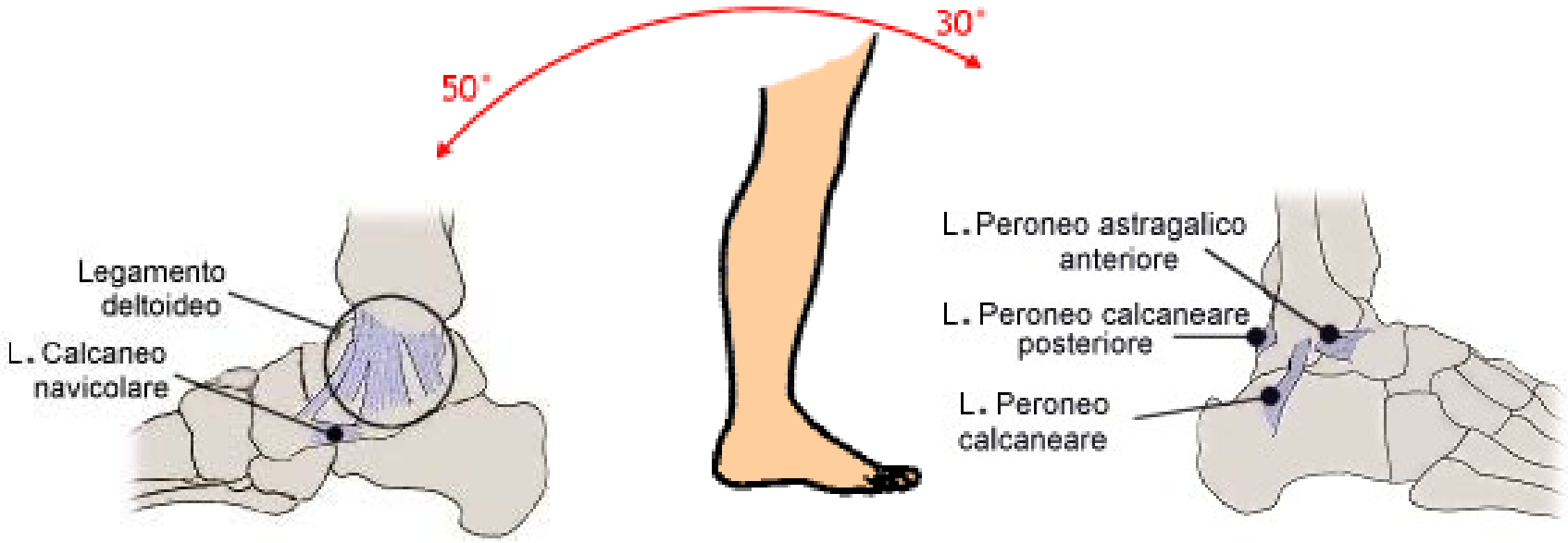




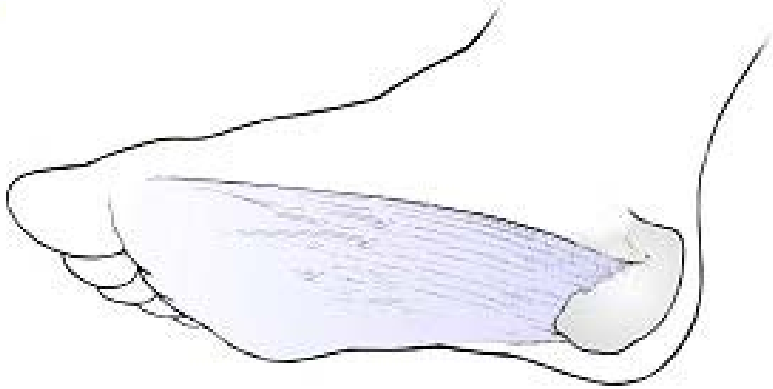
1degree 2 degree 3 degree

La caviglia- the ankle





Tendonitis and plantar fascitis



Problems and trauma

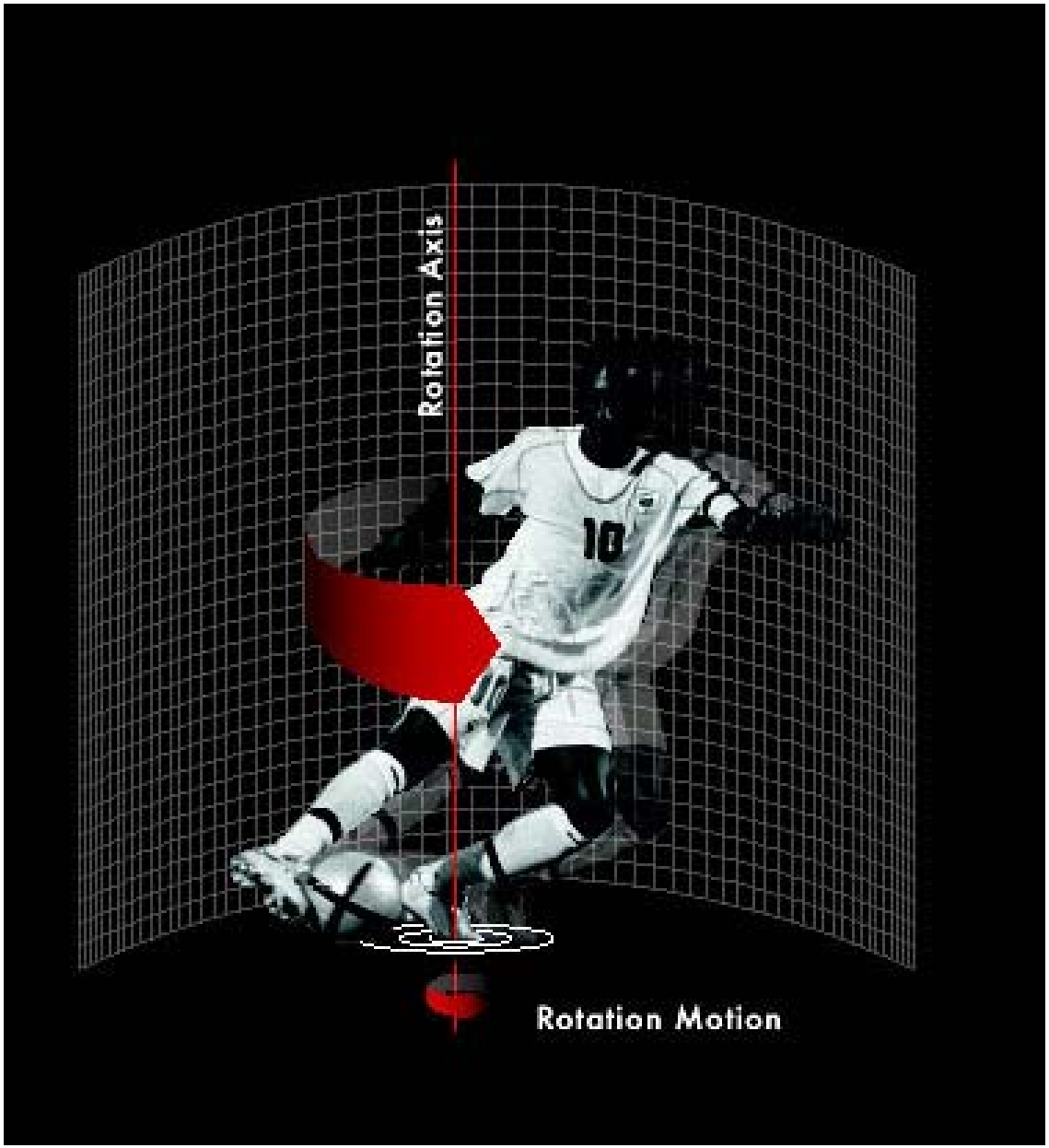
Meazza stadium- Milan

Problems and trauma

Situations near the limit


corsa1
66°
0:00:10.0 (11/145)

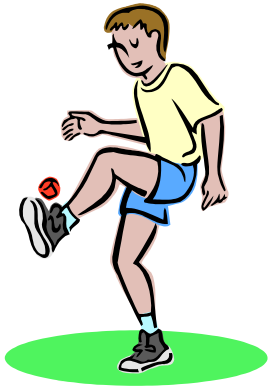
Technical abilities


Rotation Axis
10
Rotation Motion


bwin


3
25


GAUDI



The years of tests for LND

What Bibliography said:

- The covered distances, during a match of kick from a few players (e.g.): (hit the centre them of midfield), generally exceed the 11 km.(Bangsbo 1994).
- (these distances are covers to alternate them of phases of way, of jogging and sprint and at professional level about 6000 contacts of the foot with pitch.(Lafortune can be counted et to, 1997).
- In the same match the football player makes accelerations, decelerations, direction changes and leaps (Sproviero et to, 2002).

Sproviero E., Rosati R.: Rehabilitation programs for “turf toe” injuries in soccer players.
- XIV Congress on Sports Rehabilitation and Traumatology ”The Accelerated Rehabilitation of the Injured Athlete” April 9-10, 2005 - Convention Center - Trade Fair District - Bologna, Italy
Libro degli Atti (Abstract Book) pag. 30
Meyers MC; Barnhill BS: Incidence, causes and severity of high school football injuries on Field turf versus natural grass: a 5-years perspective study: Am J Sports Med 2004 Oct-Nov;32(7): 1626-38
Orchard JW; Powell JW: Risk of knee and ankle sprains under various weather conditions in American football Med Sci Sports Exerc 2003 Jul; 35 (7): 1118-23.
Cawley PW; Heidt RS; Scranton PE; Losse GM; Howard ME: Physiologic axial load, frictional resistance, and the football shoe-surface interface. Foot Ankle Int 2003 Jul; 24(7): 551-6
Orchard J.W.:Is there a relationship between ground and climatic conditions and injuries in football? Sports Med 2002;32(7): 419-32
Sproviero E., De Vito G., Felci U., Macaluso A., Marchettoni P. – Physiological evaluation of elite young soccer players: a longitudinal study
Medicina dello Sport. 55 vol 3 pp 181-187, 2002
Sproviero E., Rosati R., Bevilacqua F - Ruolo delle interazioni tra piede, scarpa e superfici di giuoco nei traumi della I articolazione metatarso falangea nel calciatore
Notiziario settore Tecnico F.I.G.C., N° 1- 2001: 37-40.
Sproviero E - La scarpa da calcio quale fattore di rischio dei traumi da sport e di limitazione del rendimento di prestazione
L’Allenatore. 2001; N° 4 : 25-27
M. A. Lafortune, D. Johnson and E. Morag. Nike Sport Research Laboratory. Performance, Protection and Education of Soccer Players. 1997
Bangsbo J:The physiology of soccer-with special reference to intense intermittent exercise. Acta Physiologica Scandinavica Supplemento 1994; 619: 1-155.

J Sci Med Sport. 1999 Oct;2(3):211-26.
Biological reaction to vibration--implications for sport.

Mester J, Spitzenfeil P, Schwarzer J, Seifriz F.

Institute for Theory and Practice of Training and Movement, German Sport University, Cologne.

In many situations of everyday life, vibration load occurs. Here whole body vibration in vehicles, such as boats, cars, helicopters and others as well as hand-transmitted vibration (motor saws etc.) can be named. As vibration is assumed liable to cause various threats to human health, a great number of studies in work science focussed on dose-effect relations and concepts for prevention. Although in many sports remarkable vibration load also occurs, there is very little research on the potential dangers and benefits of vibration stimuli, e.g. on whole body vibration and the implications for muscular activity and neuromuscular control in sport.

Vibration effects according literature.

-The force transfer from the ground to the tissues was compared with changes in the muscle activity.

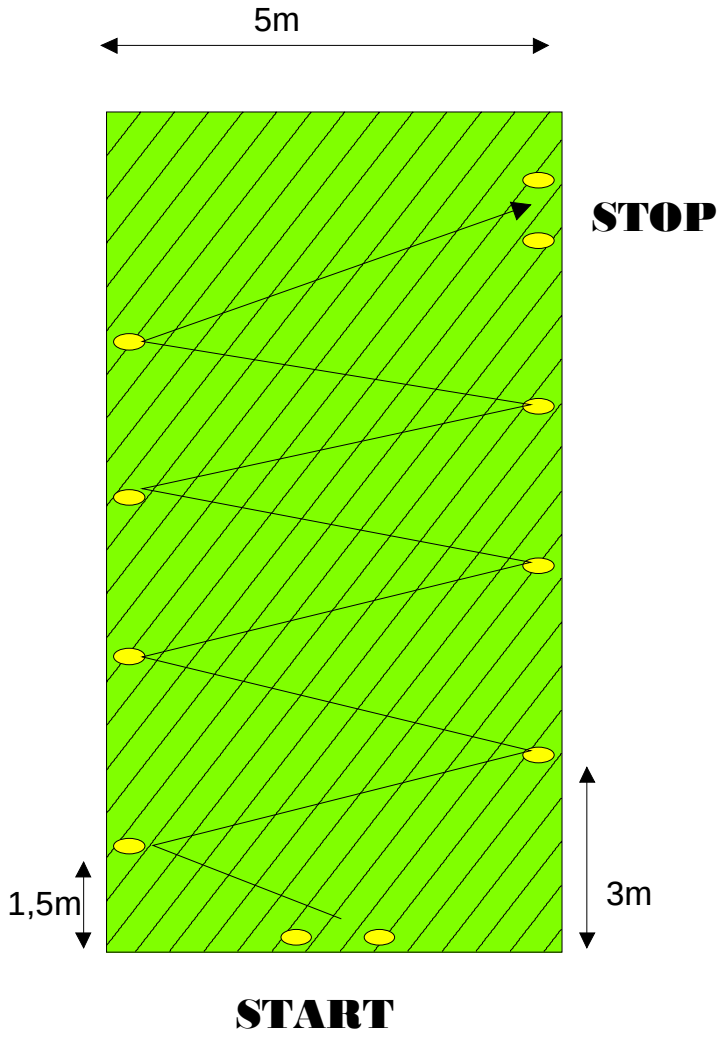
- This increase concurred with increases in the muscle activity for the biceps femoris and lateral gastrocnemius. The evidence supports the proposal that muscle activity damps soft-tissue resonance at heel-strike.

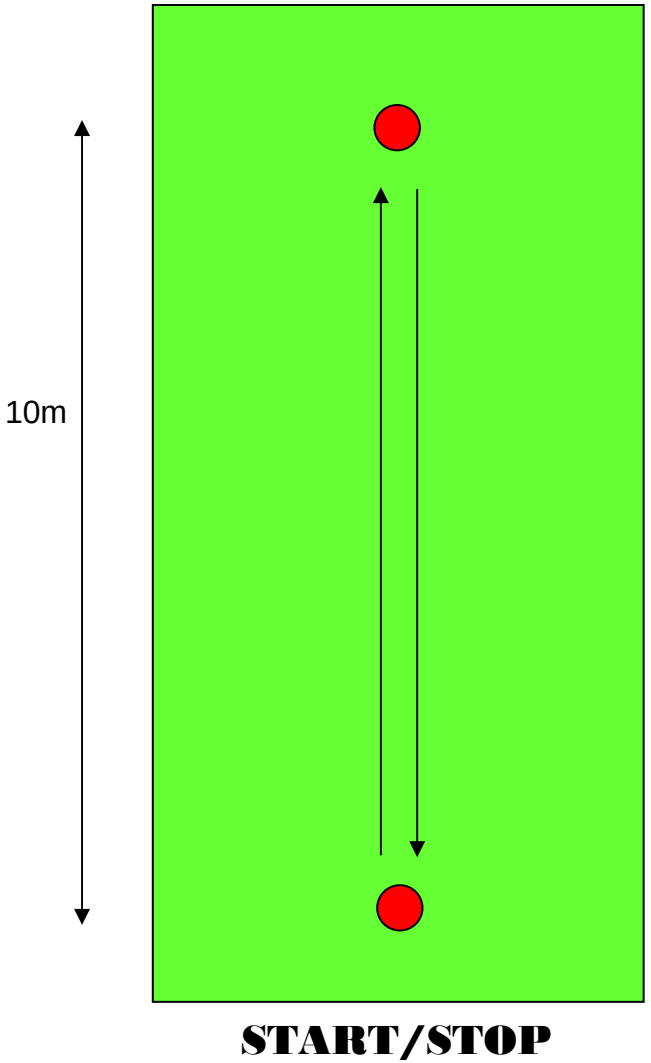
-Vibrations encountered during inline skating resulted in modifications of neuromotor functions related to the muscle spindles' primary afferent. These changes may partially be explained by presynaptic inhibition; however, a more plausible mechanism may be a decrease in the Ia afferent transmission induced by the vibration.

- Both continuous vibrations and pulsed bursts of vibrations were presented, across the frequency range of 10-65 Hz. Elevated muscle activity and increased damping of vibration power occurred when the frequency of the input was close to the natural frequency of each soft tissue.
It is suggested that soft tissue damping may be the mechanism by which resonance is minimized at heel strike during running.

- Increases in muscle activity in the lower extremities result in increased damping to reduce this vibration.
These increases in myoelectric frequency match the spectral patterns which indicate increases in recruitment of faster motor units.

Protocol



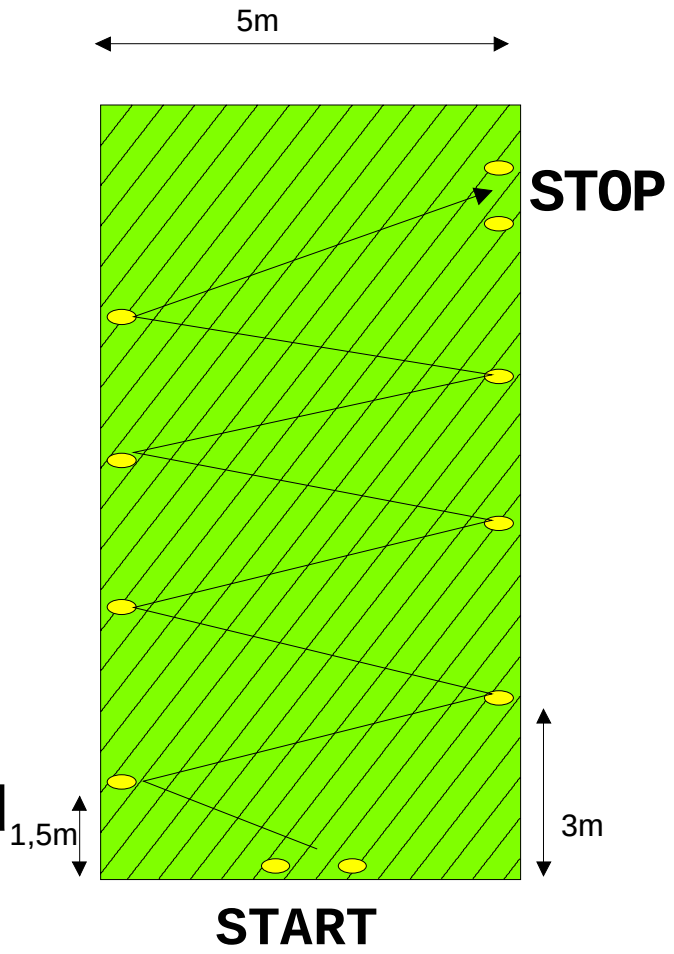


Protocol

Tested subjects:

- 17 young men
  - ages: 16-18
  - heights: 180 ± 10 cm
  - weights: 70 ± 5 kg

  shoes of their property with fixed not plugged tappings of heels.
- shoes with conic studs



Protocol

Tested 2 natural 6 synthetic

Tests performed in:

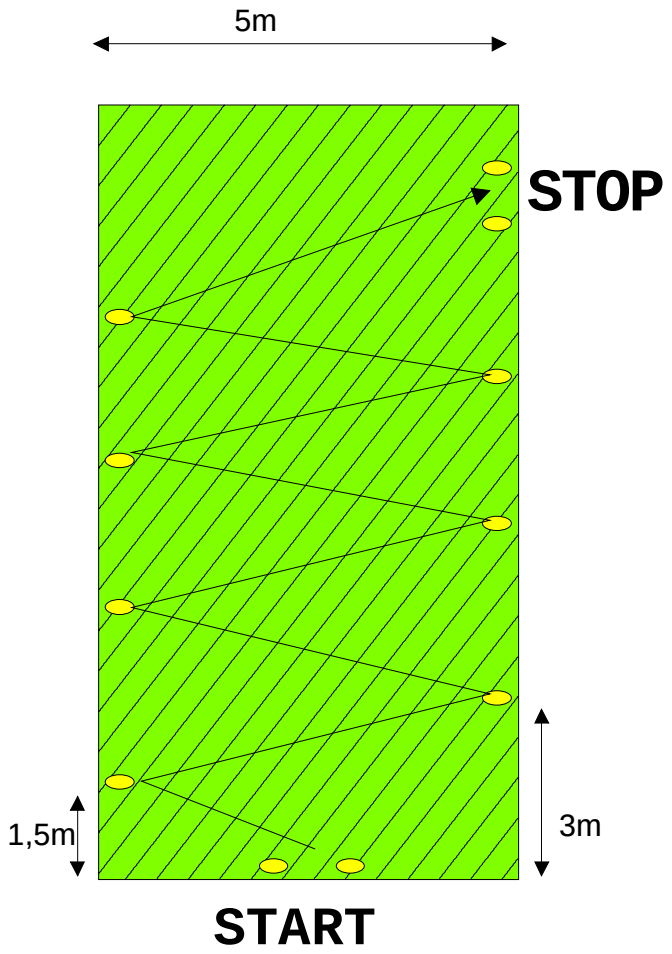
- Winter
- Spring
- Summer

Tests performed in:

- North of Italy
- Center of Italy
- South of Italy

Trials inside every single test:

- with the insoles (Novel)
- with the accelerometers



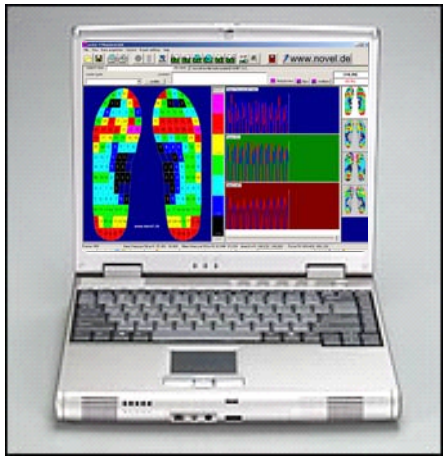
Study of the distribution of the plantar pressures
Used instrumentation

- **Pedar-X System** (Novel$_{gmbh}$, Munich, Germany).

Sensori

Unità di acquisizione

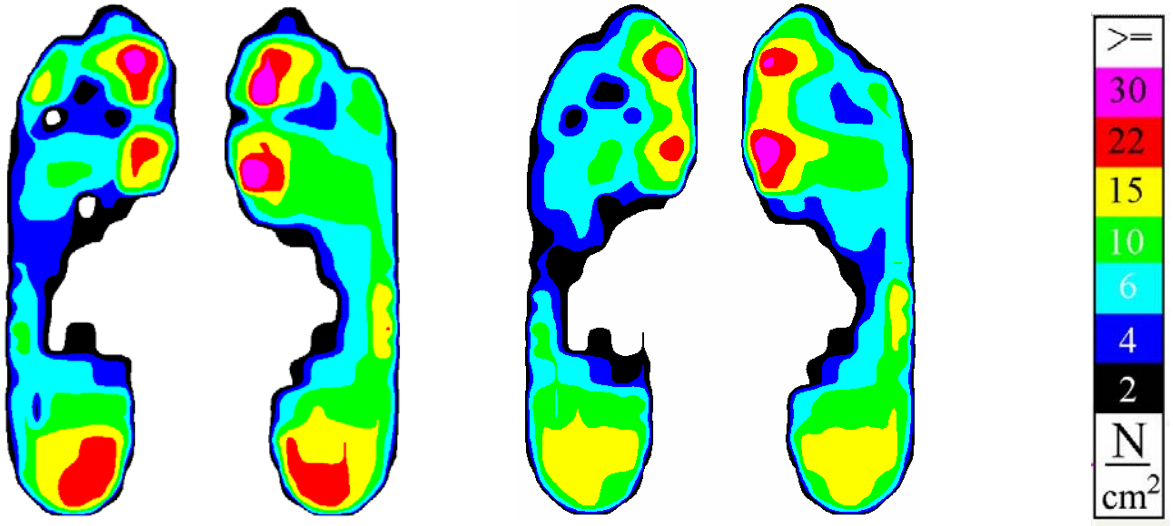
Bluetooth



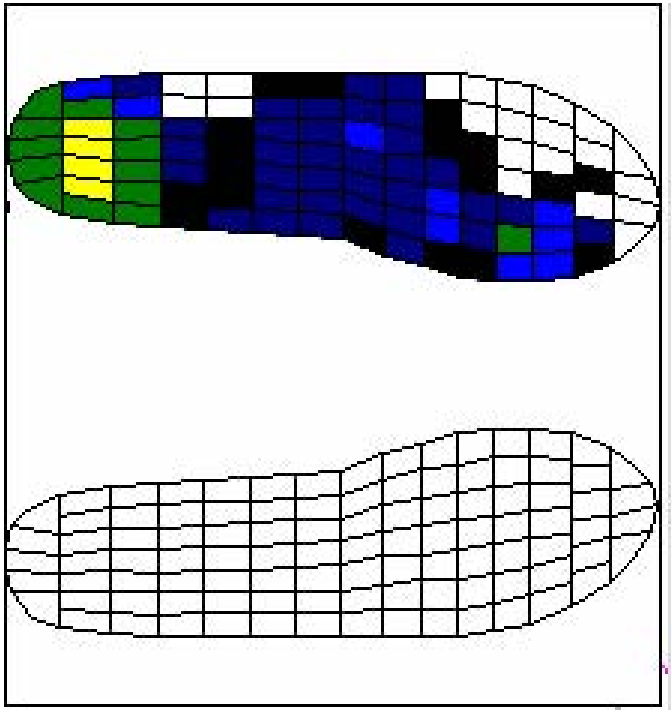
Software Pedar (Pc dotato di modulo BT)

Map of the plantar pressures

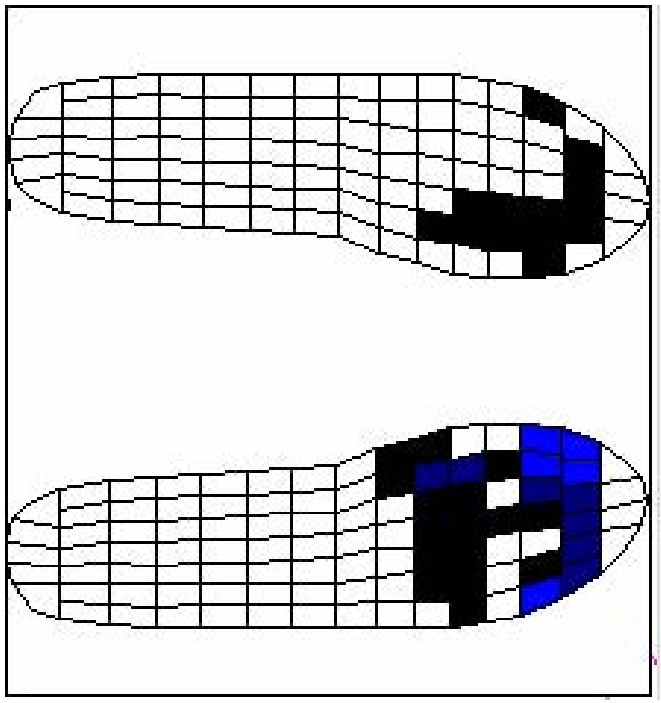
- It allows to know the areas of loaded major during a perambulation/run. To codify the various pressure levels a colour stair is used.

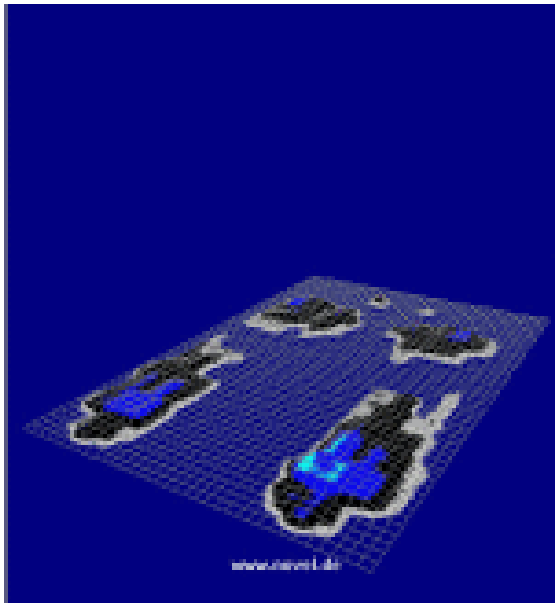


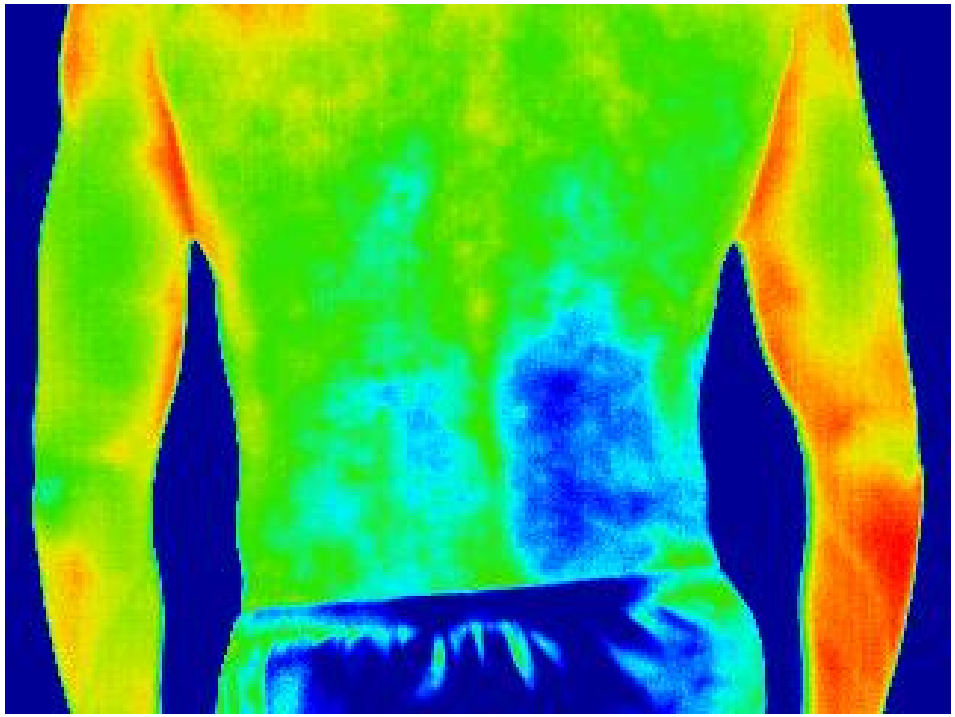
Novel’s tools

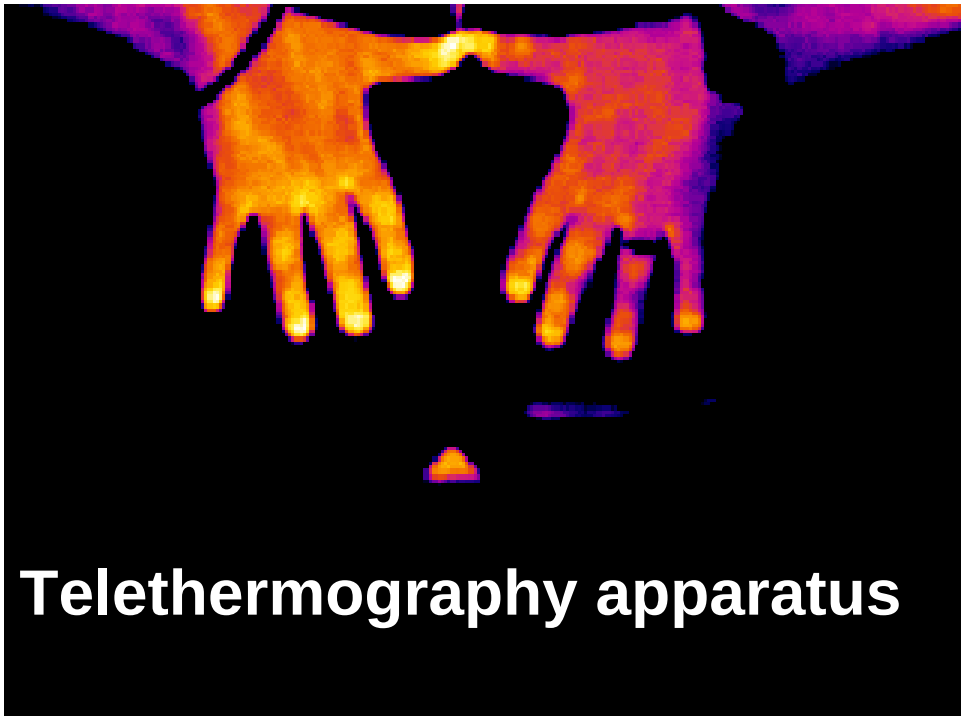


Novel’s tools

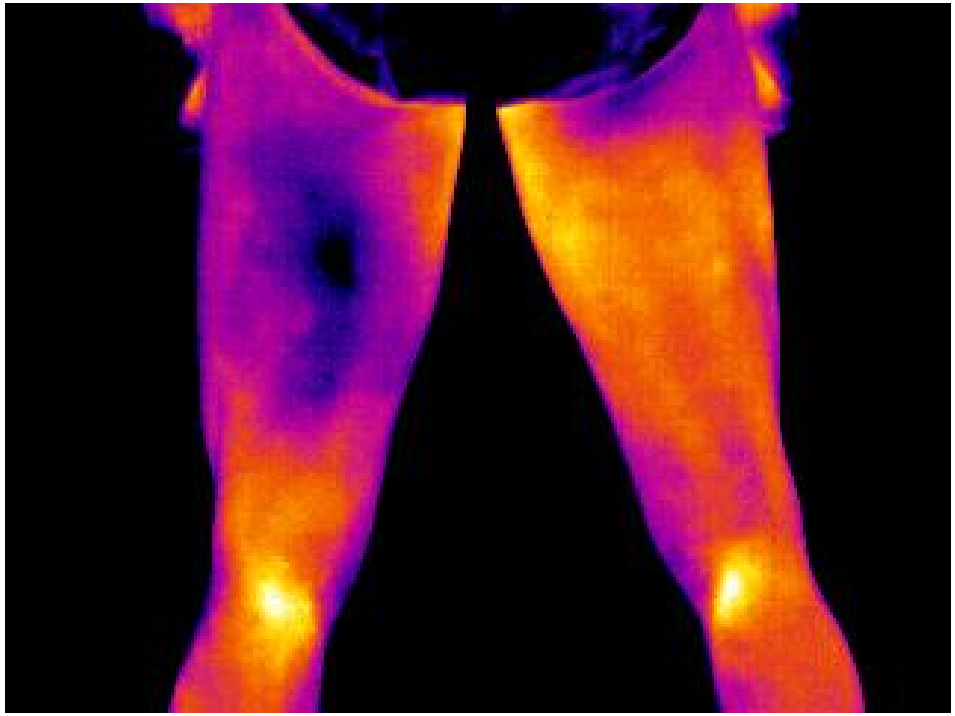


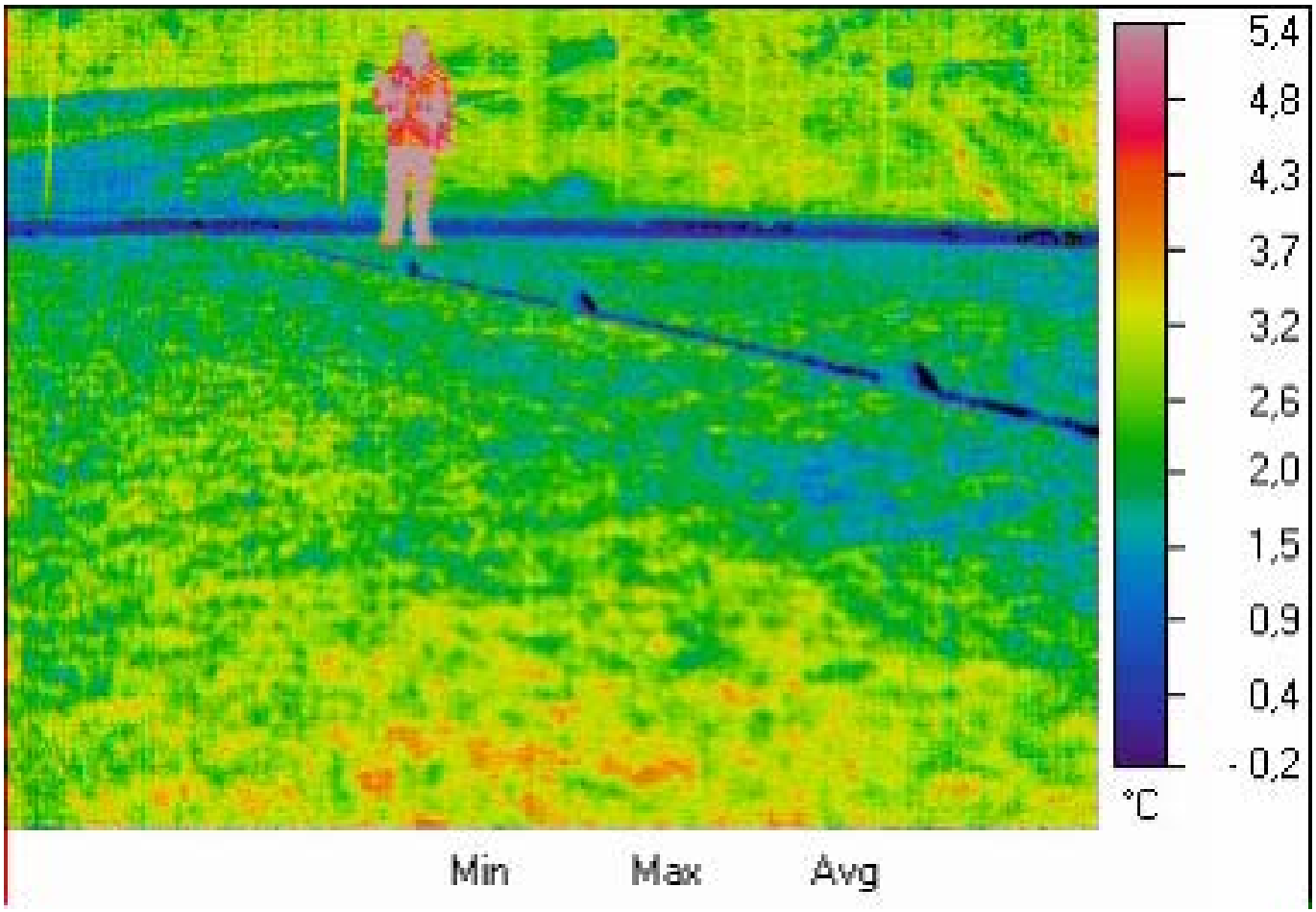






Telethermography apparatus




5,4
4,8
4,3
3,7
3,2
2,6
2,0
1,5
0,9
0,4
- 0,2
°C
Min
Max
Avg

Accelerometers

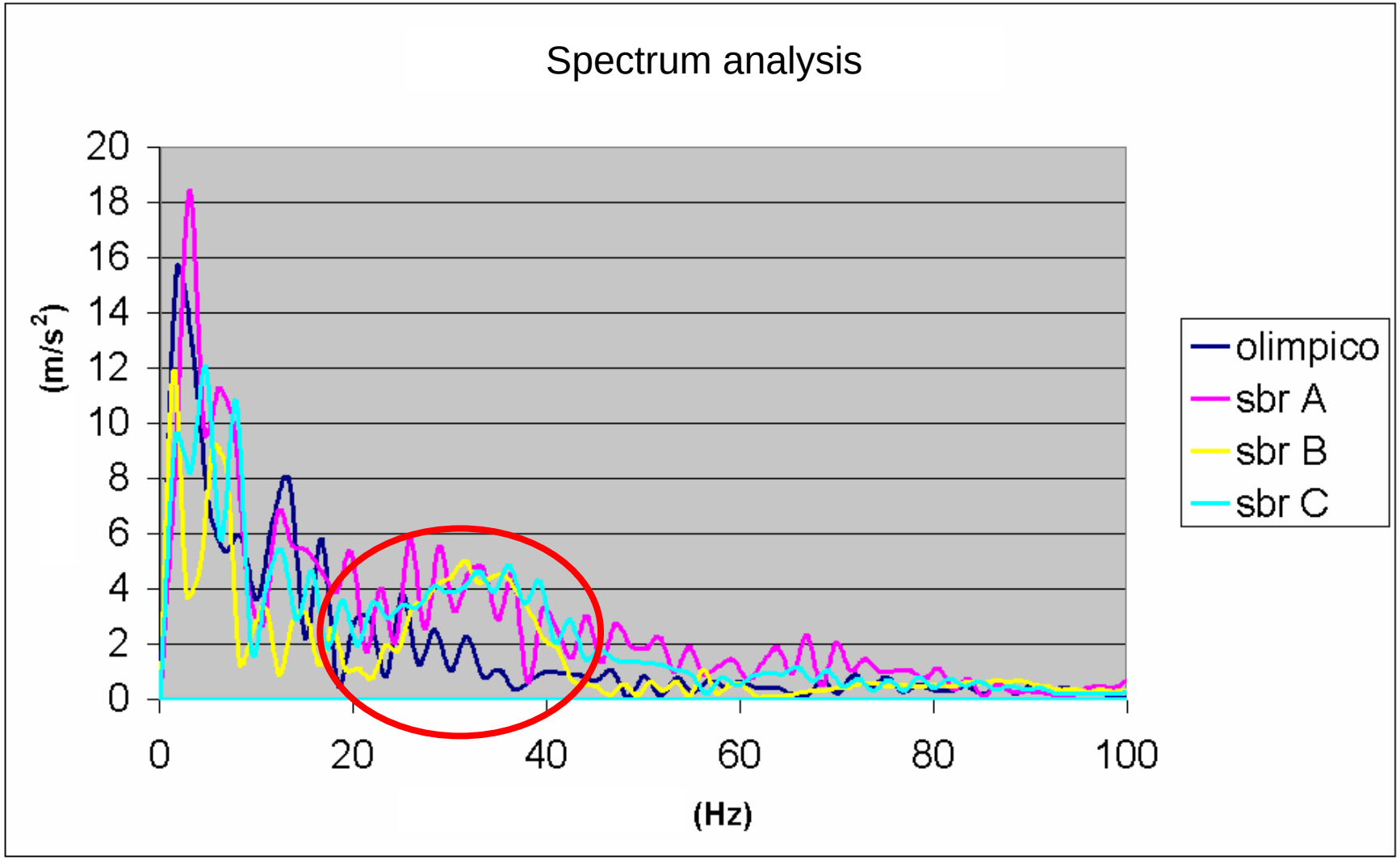
An insole as trigger

And two accelerometers positioning on the ankles

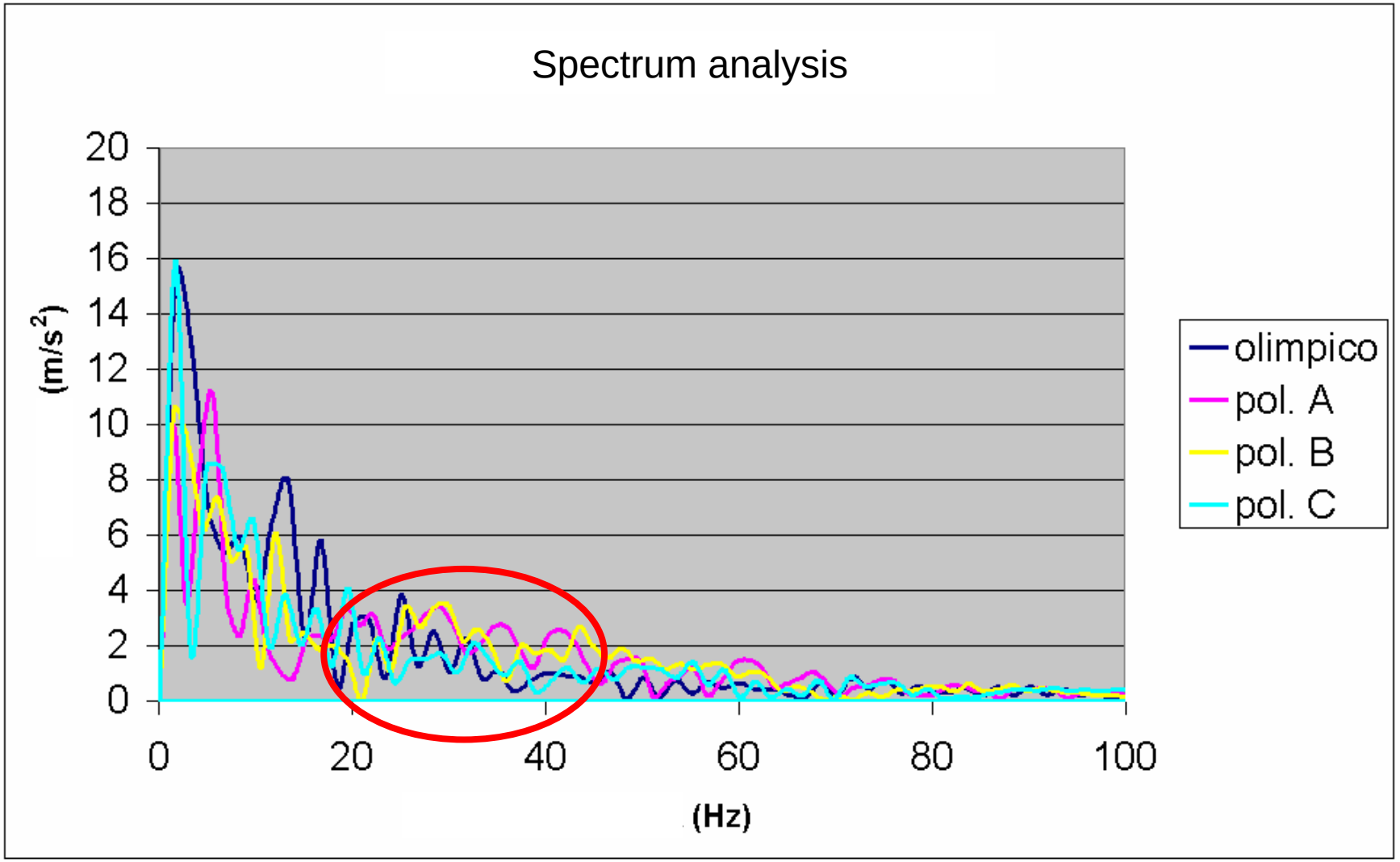
Winter Test

- The next two slides show the comparison between 1 natural turf (Olimpico, Roma) and 3 artificial turfs filled with SBR and respective energy dispersion graphs
- The following two slides show the comparison between 1 natural turf (Olimpico, Roma) and 3 artificial turfs filled with polymeric fillers and respective energy dispersion graphs

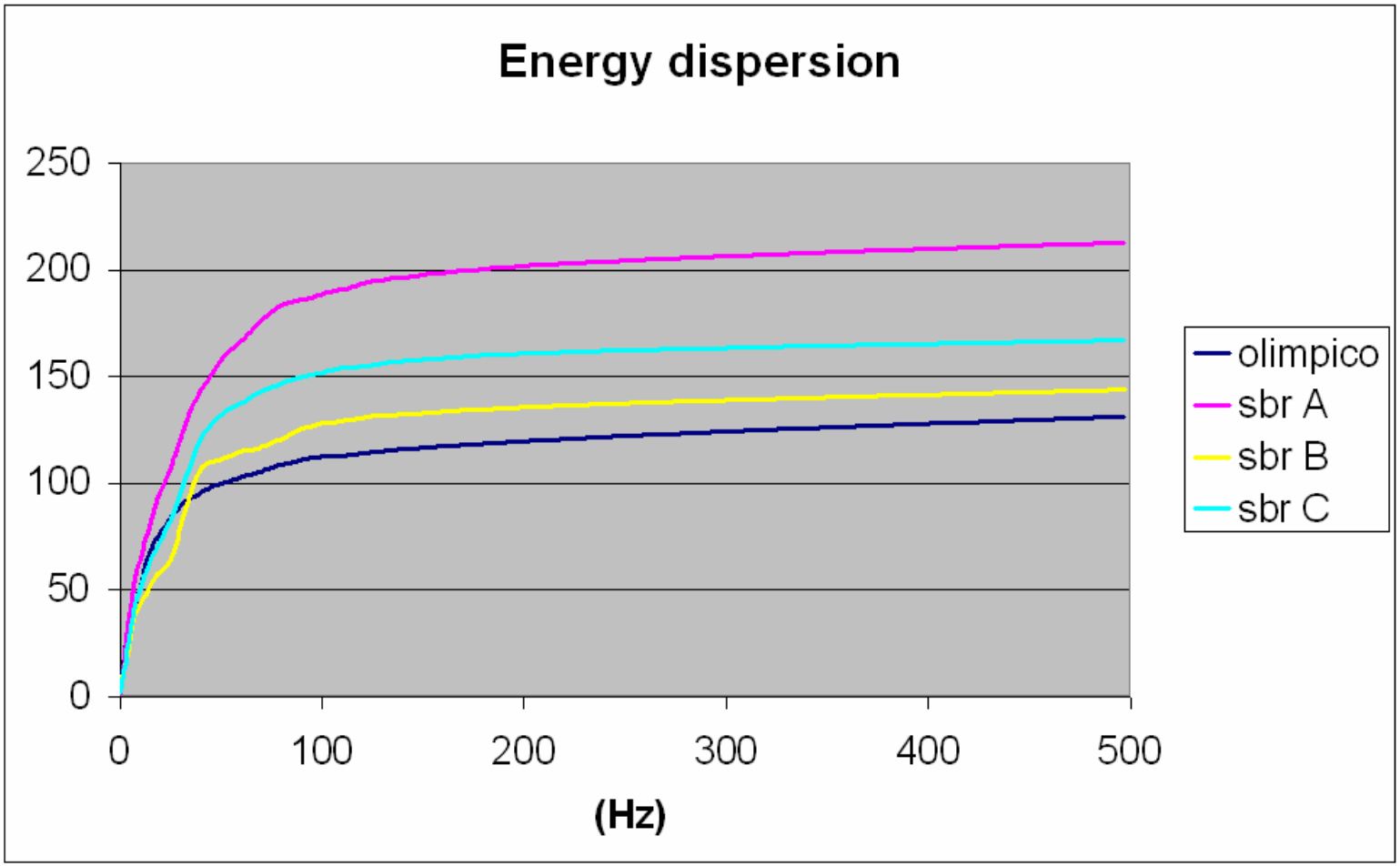
Winter Test


Spectrum analysis
20
18
16
14
12
10
8
6
4
2
0
(m/s²)
0
20
40
60
80
100
(Hz)
olimpico
sbr A
sbr B
sbr C

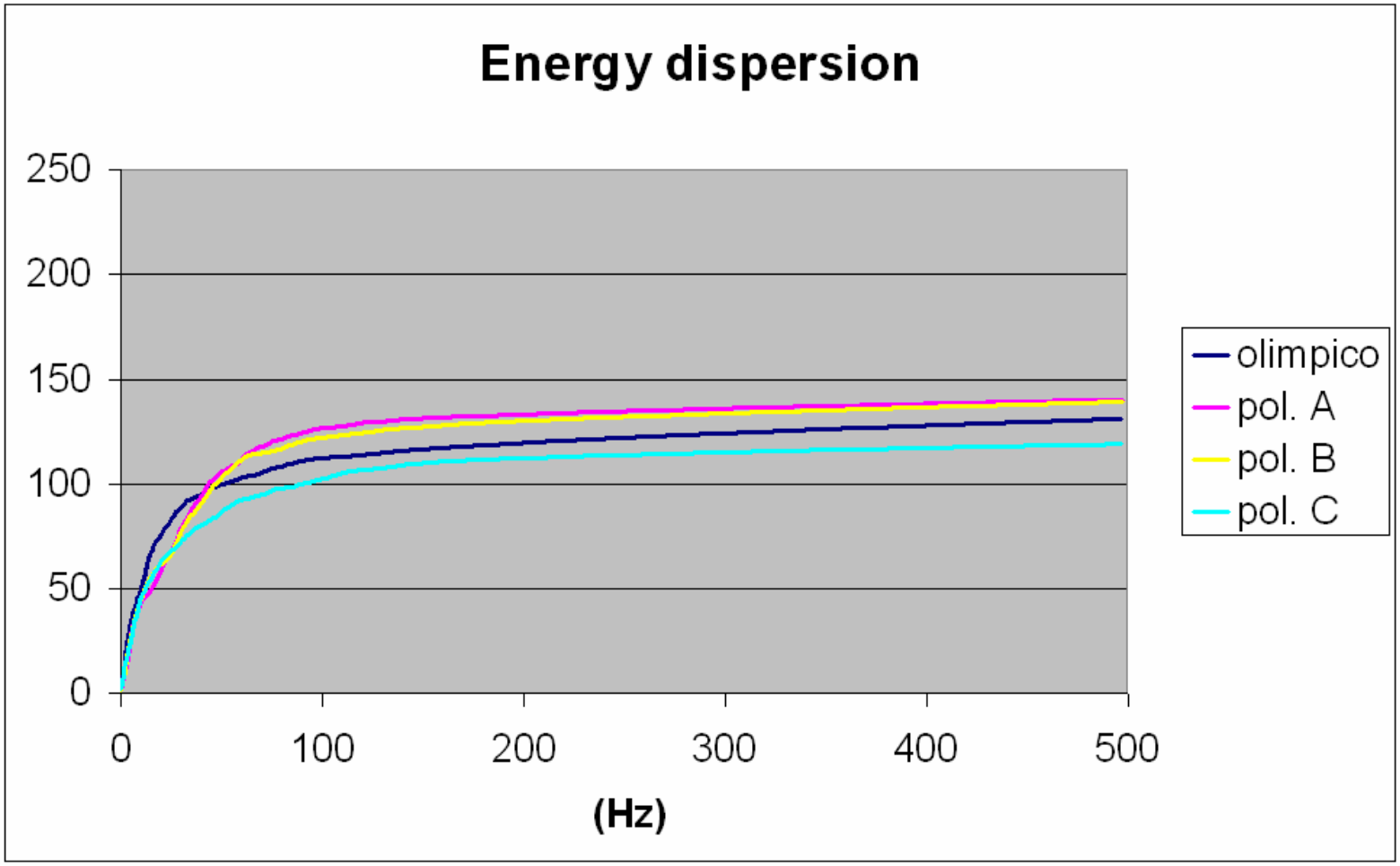
Winter Test


Spectrum analysis
20
18
16
14
12
10
8
6
4
2
0
(m/s²)
0
20
40
60
80
100
(Hz)
olimpico
pol. A
pol. B
pol. C

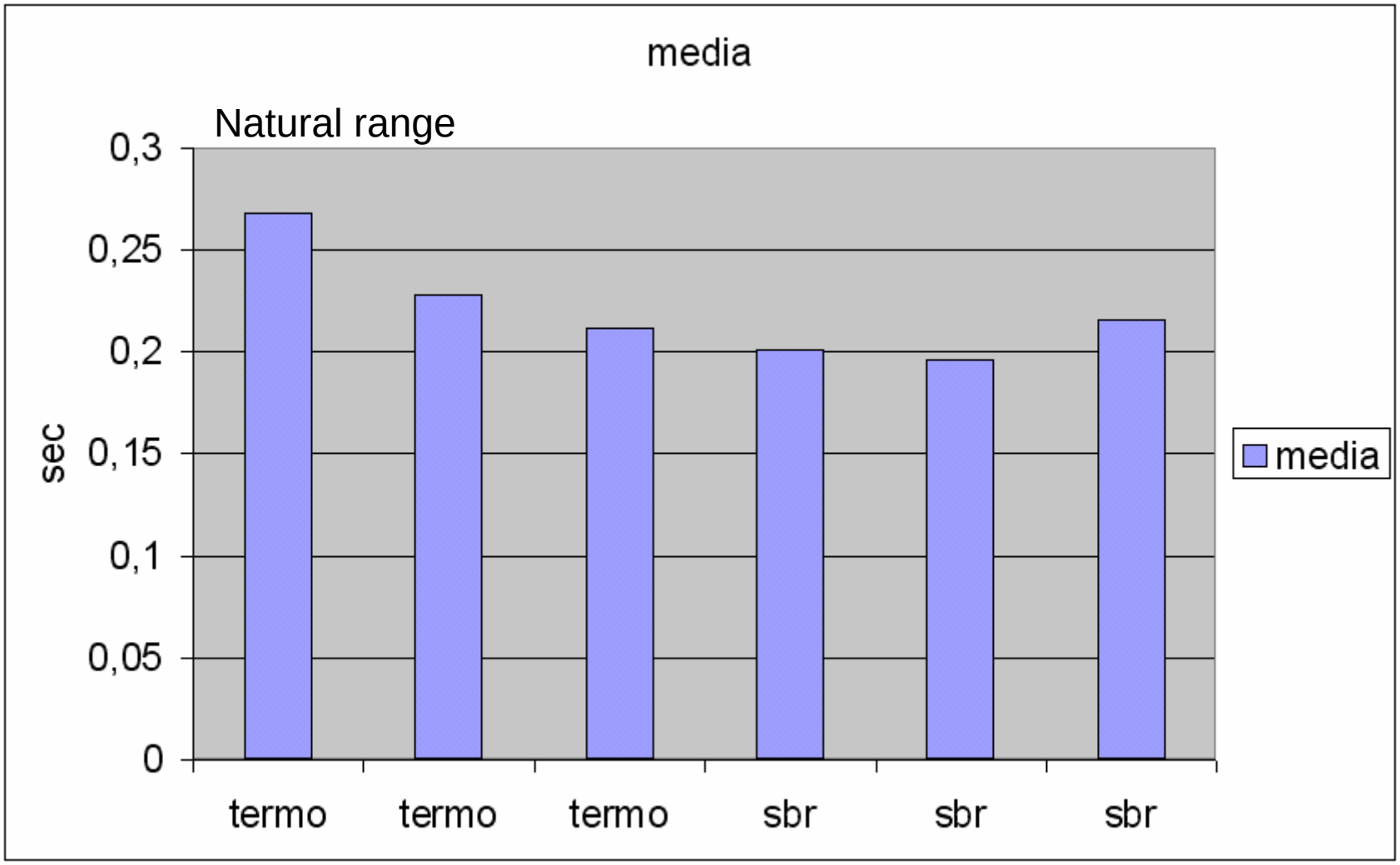
Winter Test


Energy dispersion
250
200
150
100
50
0
0
100
200
300
400
500
(Hz)
olimpico
sbr A
sbr B
sbr C

Winter Test


Energy dispersion
250
200
150
100
50
0
0
100
200
300
400
500
(Hz)
olimpico
pol. A
pol. B
pol. C

time of contacts



Bibliography comments

- The levels of muscle activity in the lower extremities are adjusted in response to the loading rate of the impact forces.

-J Appl Physiol. 2001 Sep;91(3):1307-17.
- **Muscle activity in the leg is tuned in response to ground reaction forces.**

Wakeling JM, **Von Tscharner V**, **Nigg BM**, **Stergiou P**.
Human Performance Laboratory, Faculty of Kinesiology, University of Calgary, Calgary.

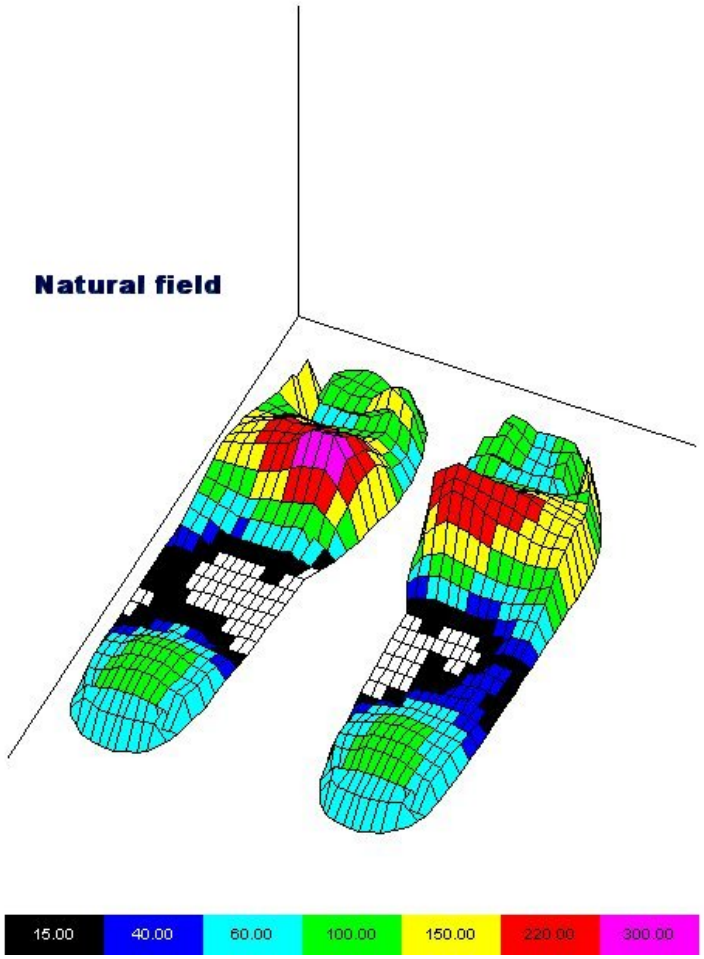
-J Biomech. 1992 Mar;25(3):223-34
Mechanical analysis of the landing phase in heel-toe running.

Bobbert MF, **Yeadon MR**, **Nigg BM**.

-J Biomech. 1995 Jun;28(6):661-8.
- **Direct dynamics simulation of the impact phase in heel-toe running.**

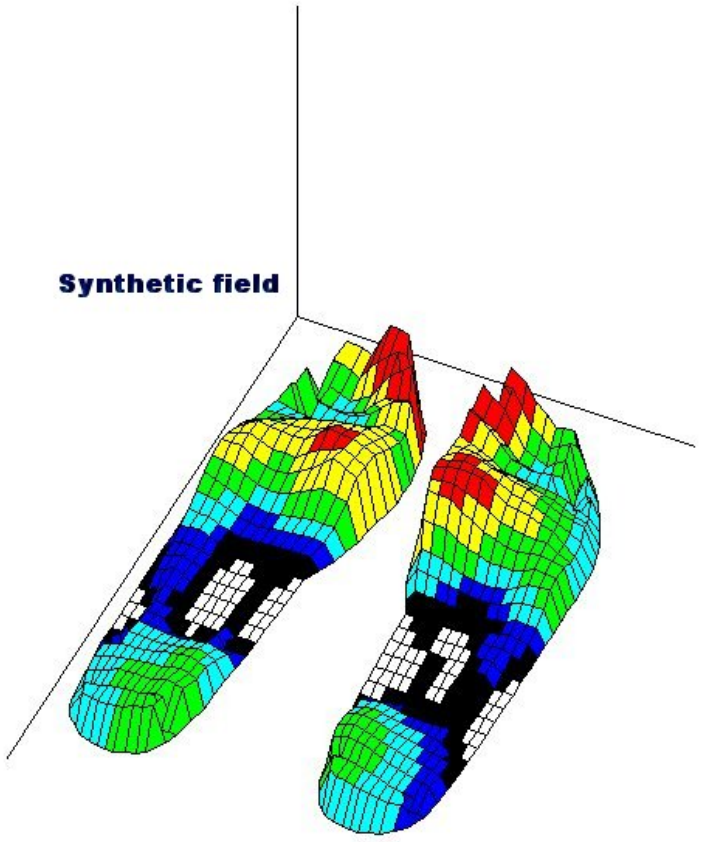
Gerritsen KG, **van den Bogert AJ**, **Nigg BM**.

Natural field

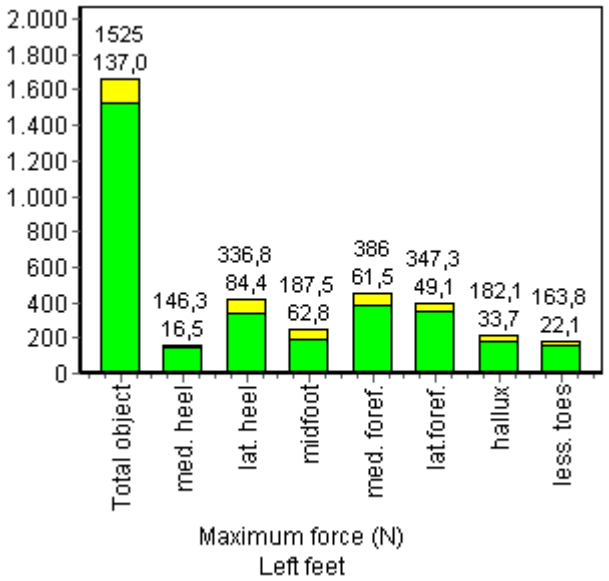


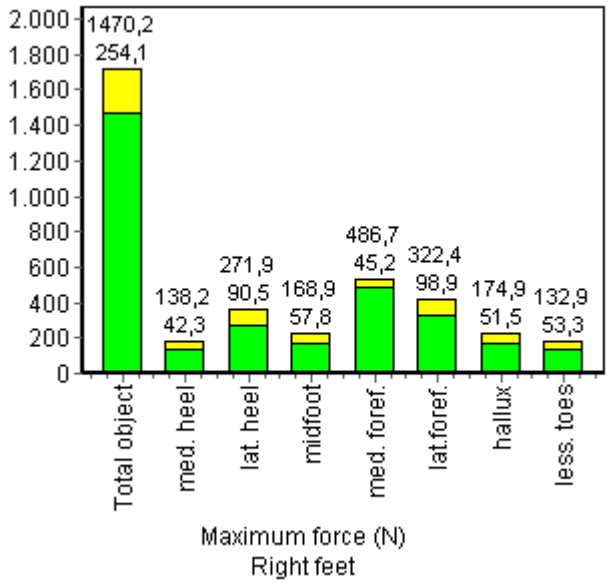
15.00 | 15.00 | 40.00 | 60.00 | 100.00 | 150.00 | 220.00 | 300.00 | kPa

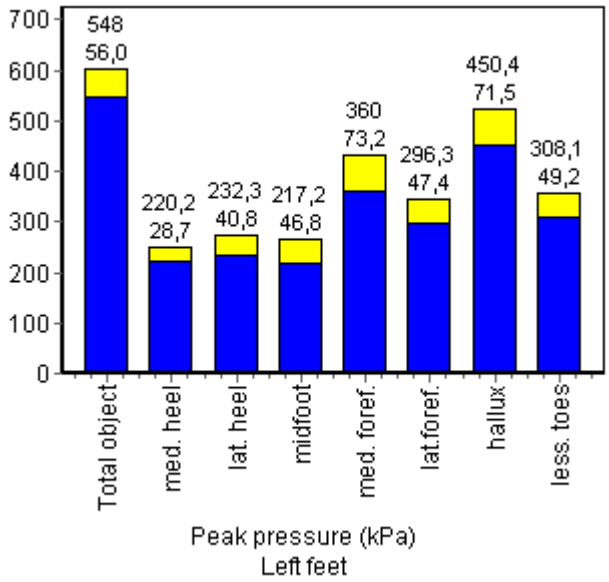
Synthetic field

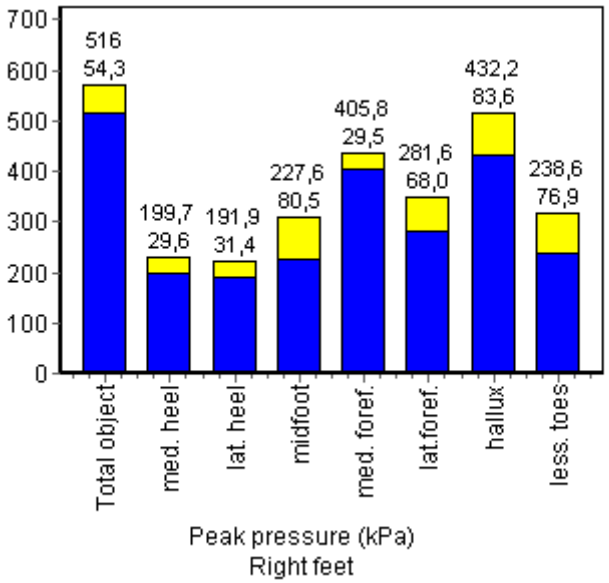


20.0 | 20.0 | 40.0 | 60.0 | 100.0 | 150.0 | 220.0 | 300.0 | kPa



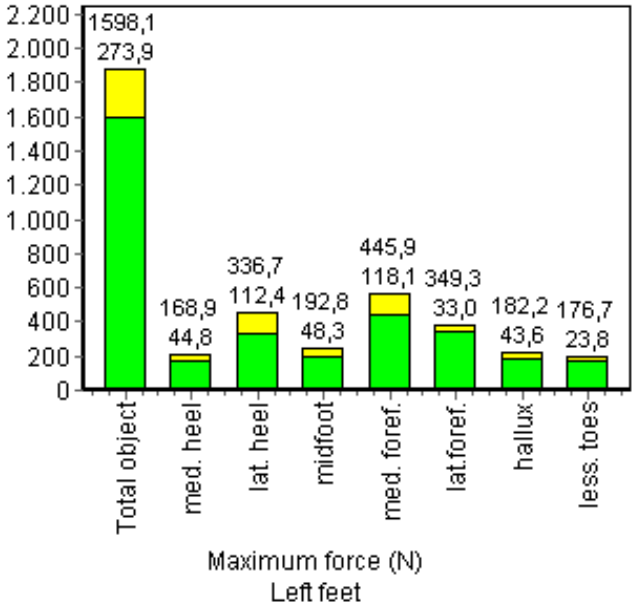


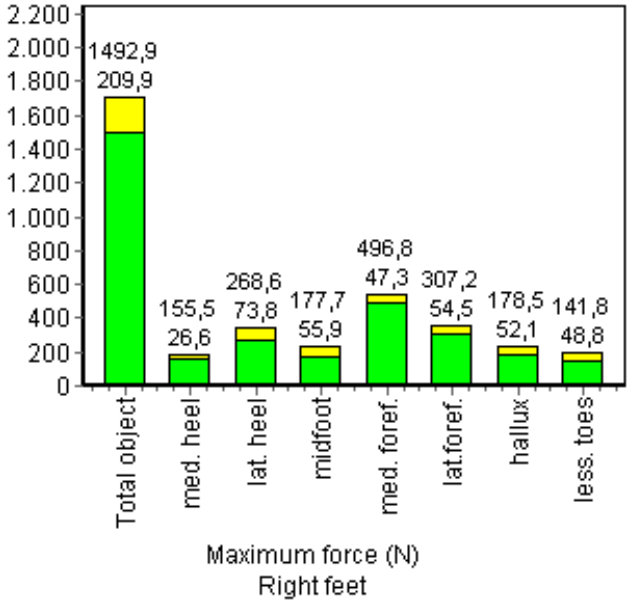


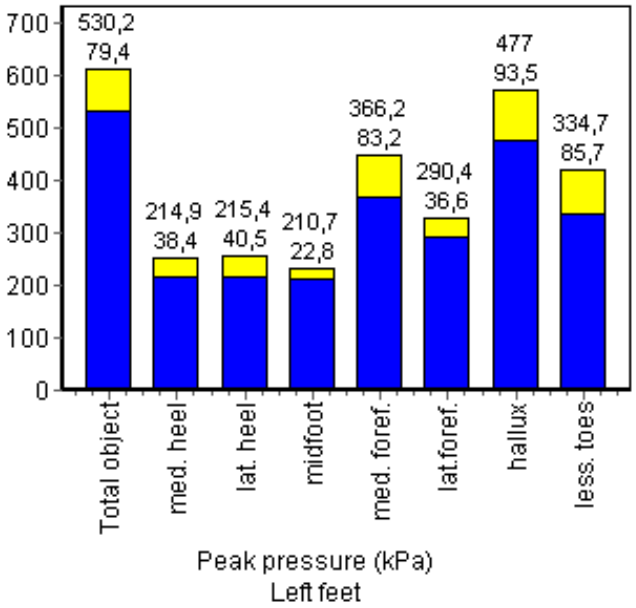


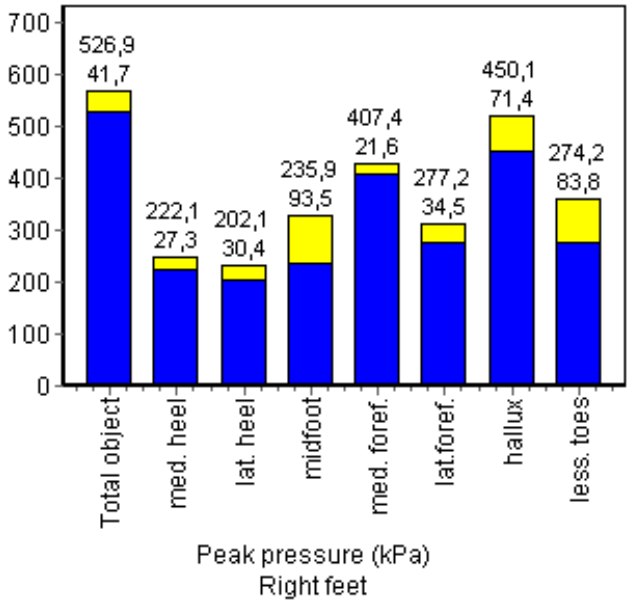
Natural

NATURAL
1497.5 N
532 kPa







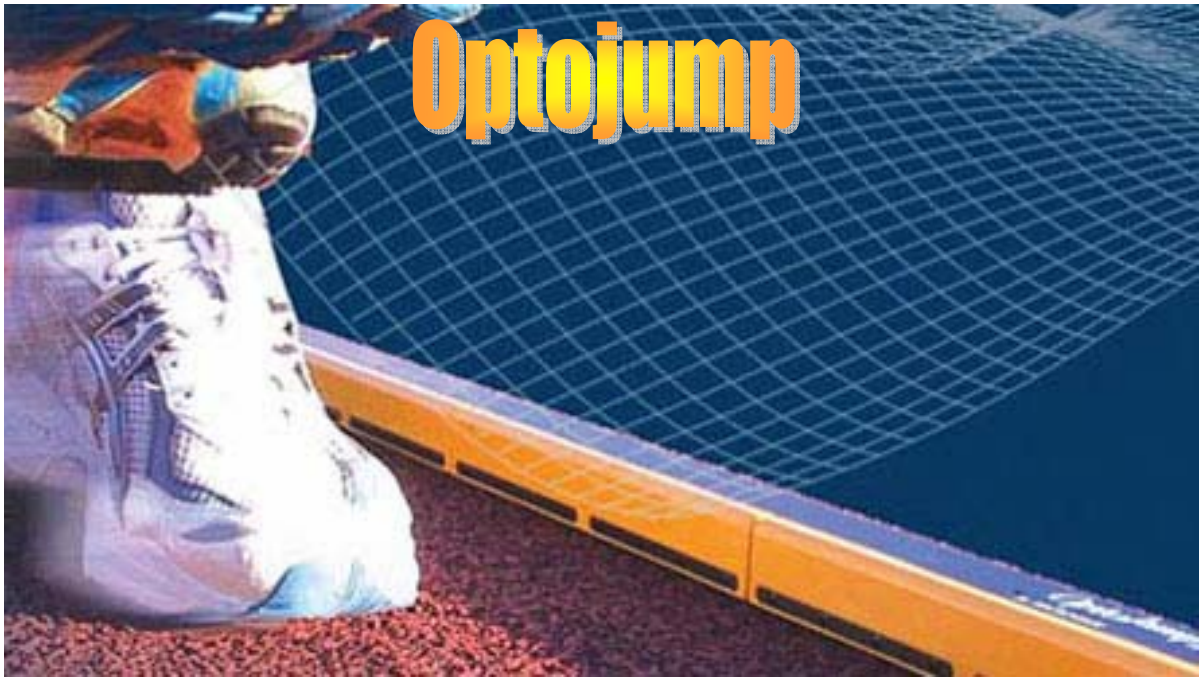


Artificial

SINTETIC
1545.5 N
528.55 kPa

Conclusions

- **Accelerometers research**: from the graphs it turns out that there is an increase in the vibrations in turfs filled with recycled rubber.
  The scientific literature claims that the organism responds to these vibrations with muscle contractions in which fast motor fibers are interested. Probably, there is an increase of muscle fatigue and consequently the performances are reduced.
- **Pressure sensors research:** From the pressure data it turns out that there are not significant relevance between the fields tested.
- **Future works:**
  - It is necessary to open a dedicated piece of research to adolescents and subjects in growth.
  - It is necessary to compare the amateurs' world to that of the professionals.
  - It is necessary to open a dedicated research on boots soccer shoes for different surfaces

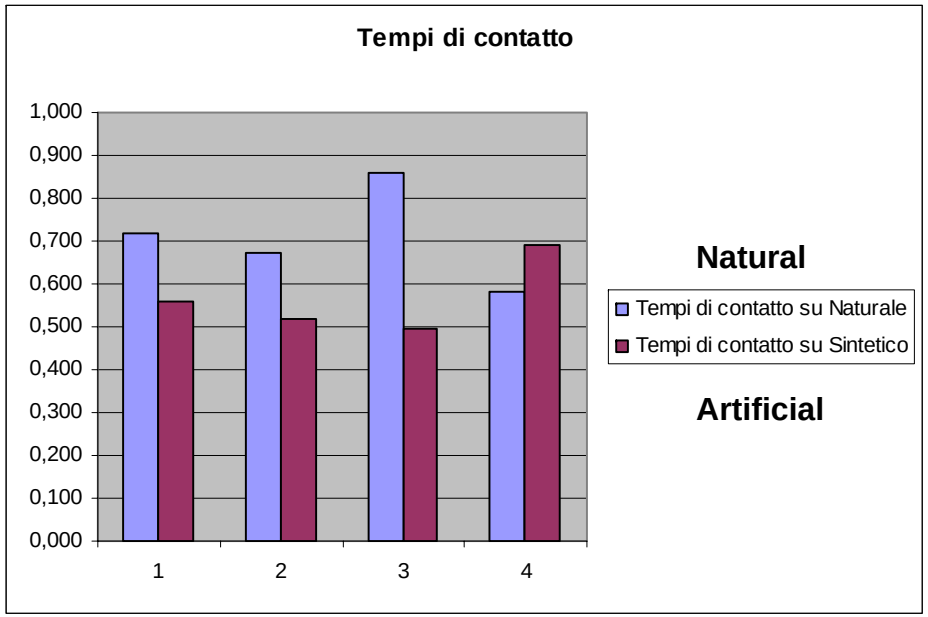


What is OptoJump?

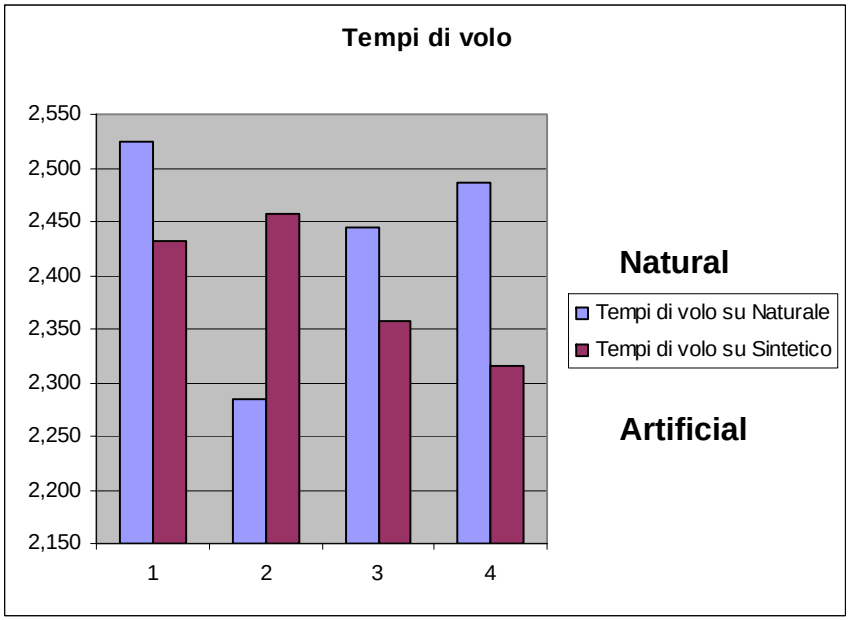
OptoJump is an instrument for work and analysis which makes it possible to measure the athlete's performance. Its optical acquisition system allows the measurement of contact and flight times during a series of jumps to a precision of 1/1000s. It consists of two bars with embedded instruments (size 100x4x3 cm), one containing the control and reception unit, the other the transmission unit. Two or more bars can be connected together to increase the length of the track used for measurement as desired.

Optojump test

Time of contact

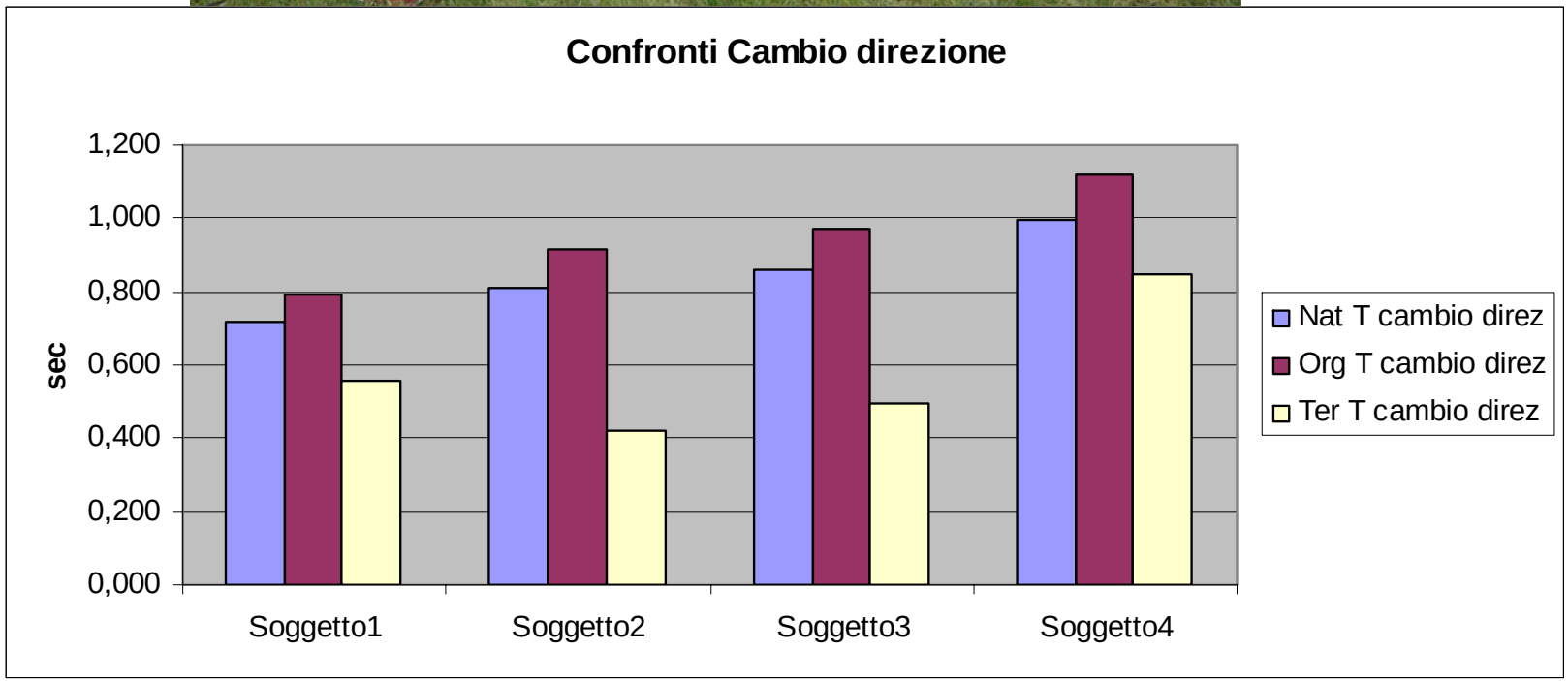


Time of fly



rotational movement

inside of the bars



First impressions

- Natural seems a right compromise from prevention to performance
- The new infill seems to imitate better natural fields

The producers' research has to be addressed to imitate natural field!

Soccer boots importance

CON QUESTA DRIBBLO ANCHE IL DIVANO!

With this shoe i can make a dribbling even to a divan!

TWISTN’GO

TWISTN'GO

The "Twist'n Go" Technology As A Result Of The Joint-Venture Between Lotto and University of Pavia

In Soccer, Most Movements Are Very Rapid And Over Short Distances.

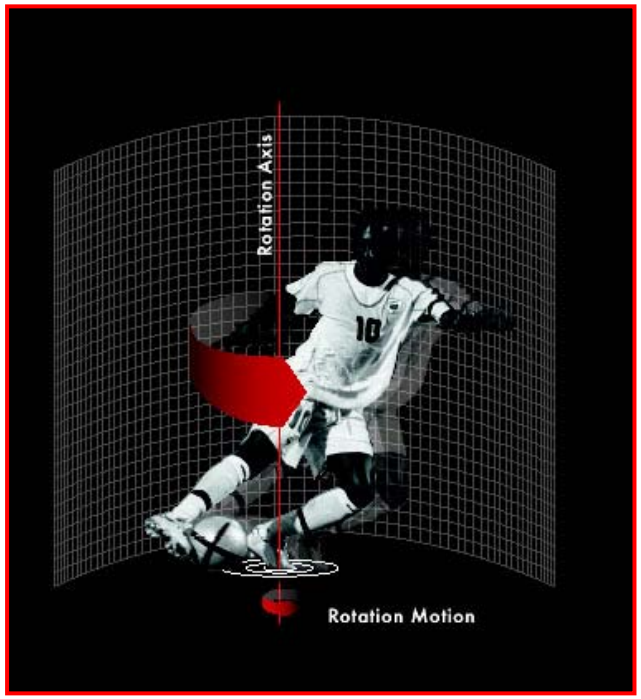
This Requires An Intense Effort due to:

- **Foot/Ground Friction**
- **The Inertial Forces in Quick Accelerations And Quick Stops**

TWISTN'GO

Lotto Decided To Study The Athletes Behavior In The Change Of Direction :

- **It Is A Movement That Needs A Harder Effort**



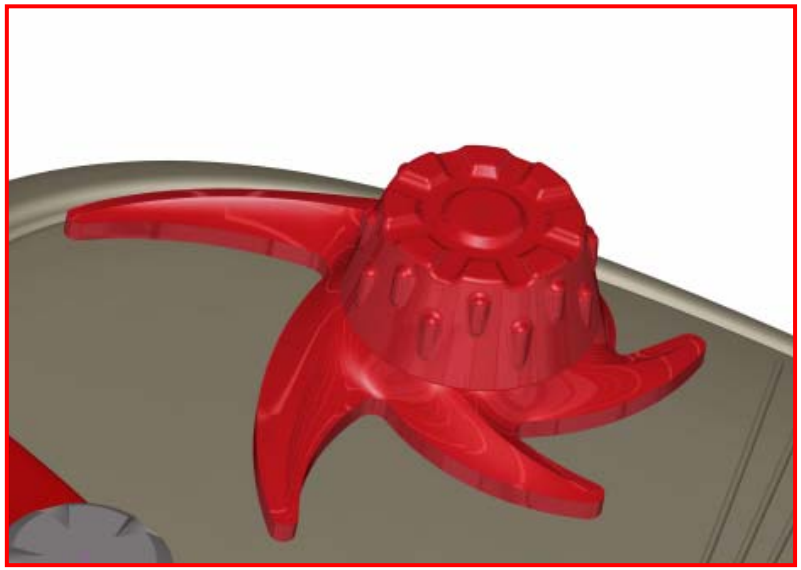
If Not Performed In The Correct Way May Occur Injuries

TWISTN'GO

The Change Of Direction Occurs Under The Base Of The First Metatarsal

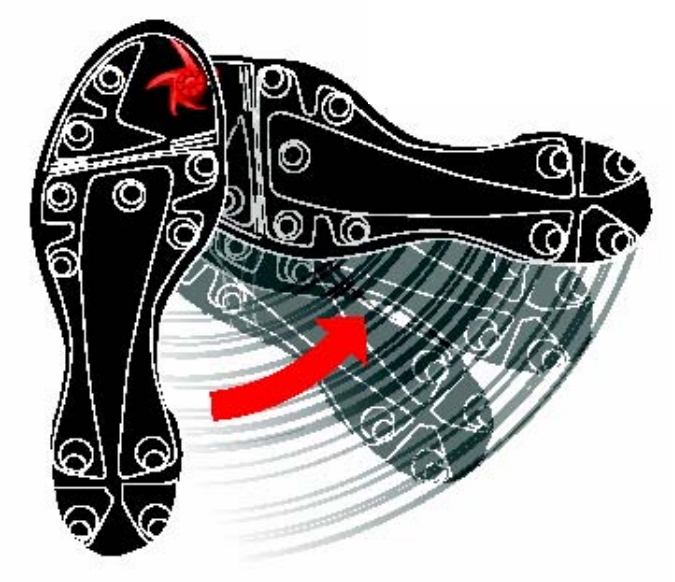
TWISTN'GO

Twist'n Go Is The First Rotating Stud That Improves Performance And Simultaneously Reduces The Risks Of Injury



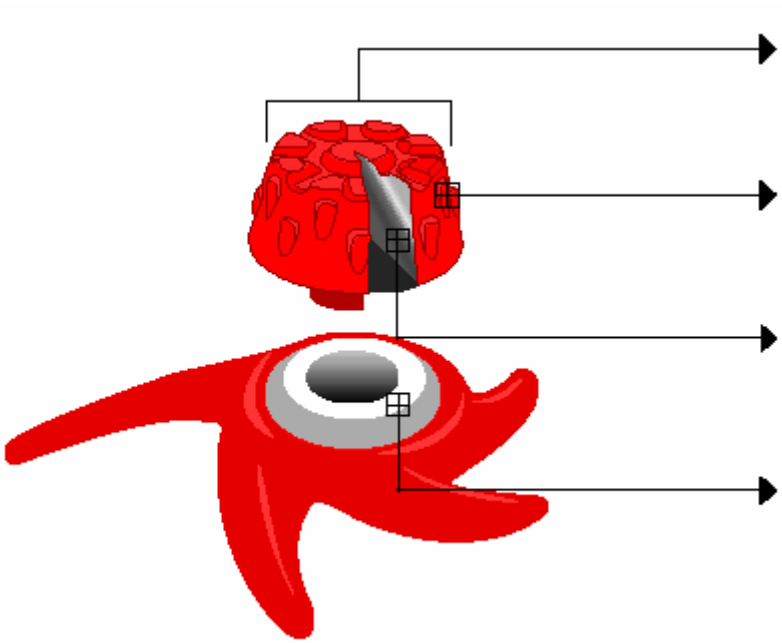
TWISTN'GO

All Studs are Conical And Fixed With The Exception Of One Located in Correspondence of the Rotating Point. This Stud Is Fixed To The Outsole Too, but It Rotates



The Stud Penetrates the Ground Allowing The Shoe To Rotate

TWISTN'GO



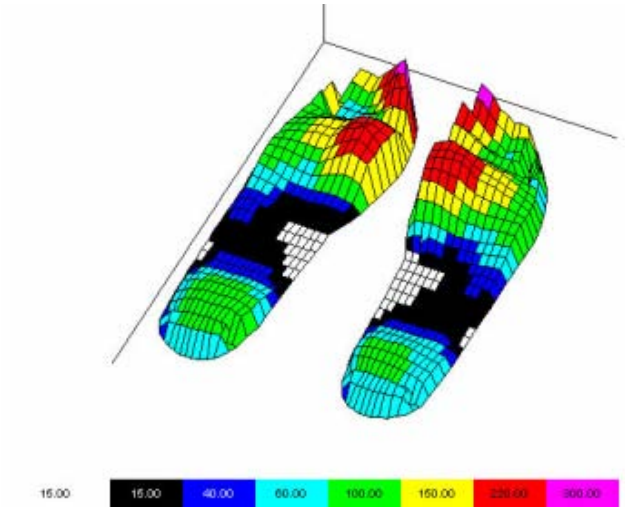
The Bigger Diameter Improves Stability During the Rotation

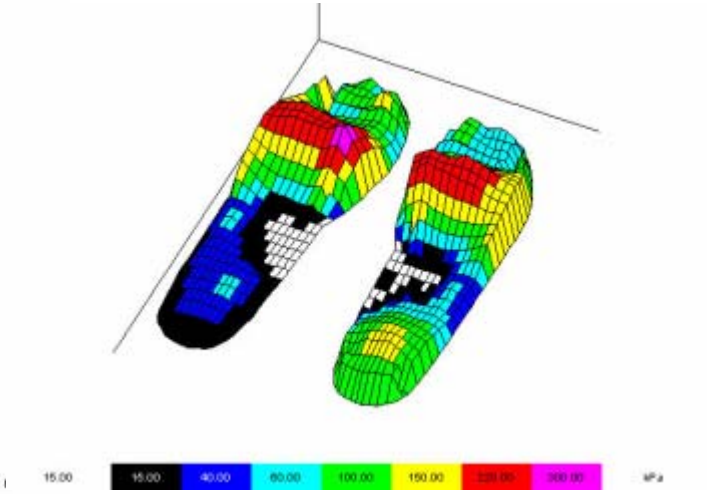
The Extra-grip Profile Gives a Better Traction

Created in Aluminum, Provides Higher Resistance And Longevity

Self-lubricating Ring Nut Material, Facilitates Rotation and Is Water Resistant

TWISTN'GO





Traditional boot

Boot w/ TWIST 'NGO technology

By using the TWIST'NGO technology the pressure on the sole is reduced underneath the toe and better distributed over the forefoot

TWISTN'GO

Each player in 90 minutes run from 8 to 12km

In 90 minutes he make from 1.500 to 2.000 rotational movement

TWISTN'GO RESULTS:

- Reduces foot/ground friction about 2/3%
- Increase speed of 0,16m/sec
- Reduces of about 0.16sec the time needed for a 180 degrees turn

TWISTN'GO

Speed

Provides Faster Rotation Compared To Traditional Studs; Foot/Ground Friction Is Reduced And Improves Performance

Prevention

The Foot Maintains Its Axis When Rotating; The Movement Quality Improves And Reduces The Risk of Injury

Stability

During Rotation, Balance Is Not Only Maintained but Improved; The Stud Works As a Pivot Point and Provides Higher Stability At The Point of Contact