# Biomechanical assessment of sport movements

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In order to compare sports performance of athletes using different sports equipment, the laboratory provides biomechanical, bioenergetic and physiological assessment during sports movements such as running and walking. Available instrumentation includes metabolimeter, bipolar surface electromyography, wearable inertial sensors, stereophotogrammetry, force platforms, pressure insoles, and lactacidometer. Assessment can be done both indoors, thanks to the use of treadmills, and outdoors thanks to the portability/wearability of the instruments. Collaboration between bioengineers and kinesiologists allows a fit-for-purpose assessment protocol definition and comprehensive data analysis including psychological aspects such as perceived exertion.

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| **Laboratory** | CIRI SCIENZE DELLA VITA |
| **Specialization Area** | Health and Wellness |
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| **Keyword** | biomechanics, sport, footwear, bioenergetics |

***"360-degree analysis of a sports shoe (motor work and perception of effort)"***




*Fig. 1: Sports footwear performance evaluation*

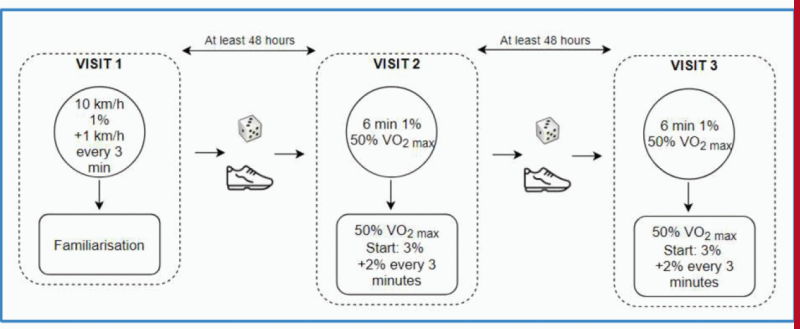



*Fig. 2: Protocol for performance evaluation with trail-running shoes*

## Description

The service offered consists of gait performance evaluation. The service is aimed at companies interested in comparing the performance of sports equipment such as footwear and/or insoles under controlled conditions such as the laboratory or in a real-world environment closer to real use.
The items that are evaluated are multifaceted and from different perspectives::

- energy consumption by metabolimeter
- blood parameters using lactacidometer
- cardiac variability using heart rate monitor
- muscle activation using surface electromyography
- plantar pressures using pressure insoles
- shock-attenuation and spatiotemporal parameters using inertial sensors
- perceived exertion using RPE

## Innovative aspects

The instrumentation available to the laboratory is normally used for research activities, ensuring that it is constantly updated on the latest developments in the field.
The multidisciplinary group composed of bioengineers and kinesiologists ensures a holistic view as it includes different skills: technological and sports.
In addition, the multidisciplinary approach is essential for the definition of appropriate and innovative assessment protocols.
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## Potential applications

In order to compare performance and biomechanical variables during the use of a sports equipment such as sports footwear (running, trail-running, mountaineering boot, etc.), it is possible to evaluate athletes while walking/running at different speeds and at different inclinations on treadmills under controlled conditions, or to conduct an evaluation on a defined outdoor route to get closer to the actual conditions of use.

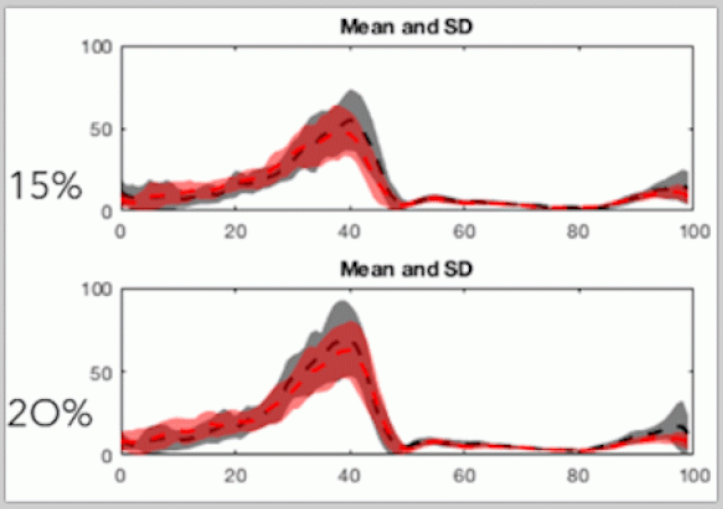



*Fig. 3: Soleo activities in two different treadmill inclinations, with two boots*

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| **Involved partners** | Absent |
| **Implementation Time** | (3/6M) according to type of assessment required |
| **Technology Readiness Level** | TRL9 - Actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space) |
| **Exploitation** | Performed this service on two occasions for a company |

# Application example

**Pilot study comparing two models of mountaineering boots with different drop (6mm and 12mm).**
**Evaluation of electromyographic activity, metabolic consumption, vertical reaction force and perceived exertion while walking at different inclinations.**

From the comparison, it was possible to assess different muscle recruitment depending on the footwear and treadmill inclination.

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