DIGITSOLE® PRO

Running analysis interpretation manual

English

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Parameters definition

- **Recording time (min):** Duration of the recording.
- **Running speed (km/h):** Average running speed during the recording.
- **Pace (steps/min):** Average number of cumulative steps (right + left) per minute during the recording.
- **Stride duration (ms):** Period between two consecutive touchdowns of the same foot on the ground.
- **Contact time (ms and %):** Average time the foot is in contact with the ground, can be expressed as a percentage of the stride time.
- **Airborne time (ms and %):** Time during which the foot is not in contact with the ground, can be expressed as a percentage of the stride duration.
- **Stride length (m):** The distance covered in a stride between two consecutive touchdowns of the same foot.
- **Approach type:** Expresses the predominance of heel or forefoot approaches on the ground during recording.
- **Symmetry:** Expresses the congruence of the contact times of the two lower limbs

Overview

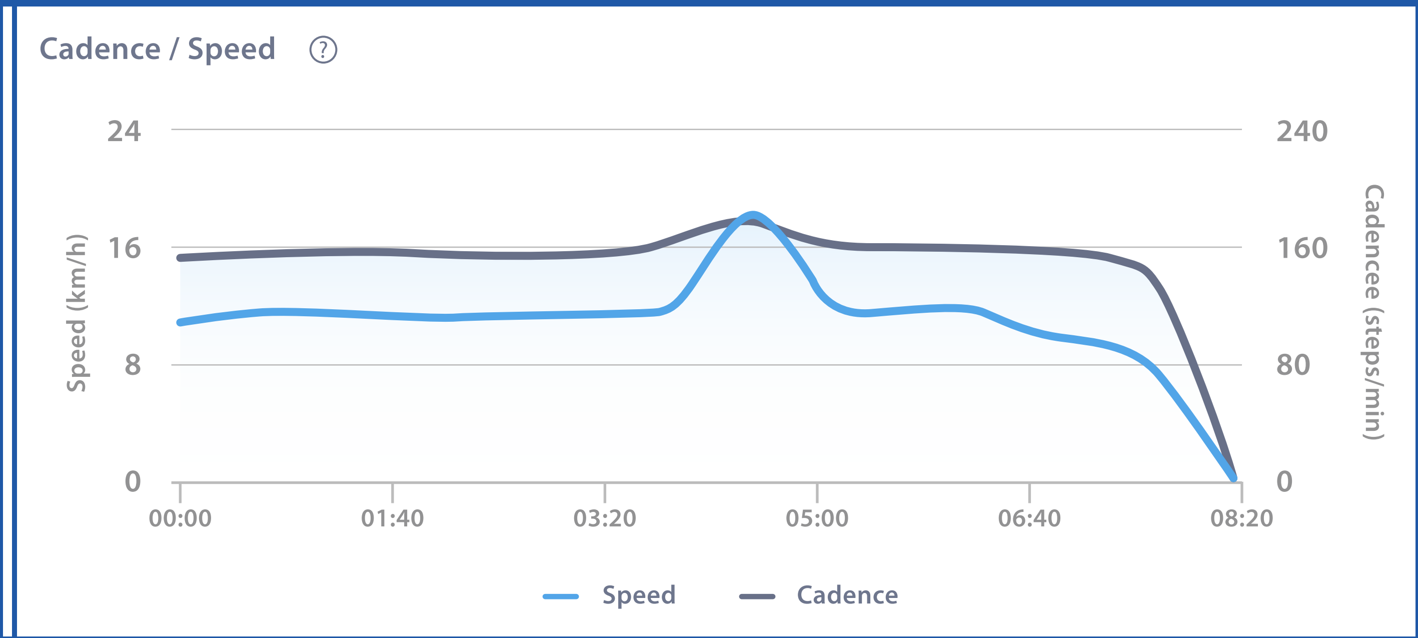
PAINS	WALKING AID	SHOES	PATHOLOGIE
+	+	+	+

As with walking analysis, **you can fill** in the elements directly **related to the recording** before and after the recording to obtain **a "snapshot" of the conditions** in which the recording took place and thereby improve the relevance of your comparisons.

This information includes:
- Pain: locoregional and intensity.
- Any walking aids used.
- Footwear: type, fit, cushioning and wear area.
- Pathologie.

The interface presents in this initial screen the general parameters of the recording:
- The type of running (outdoor or treadmill).
- The duration of the recording.
- The average speed.
- The pace.

Running Speed and Pace



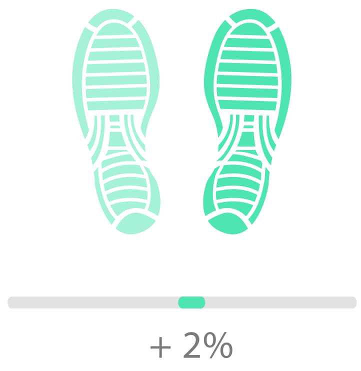
This graph provides dynamic monitoring of **average running speed and pace.** The aim here is to gain an insight into the development of the running session as a whole.

In this graph, we are looking for information on a possible disruption of the running process to distinguish between:

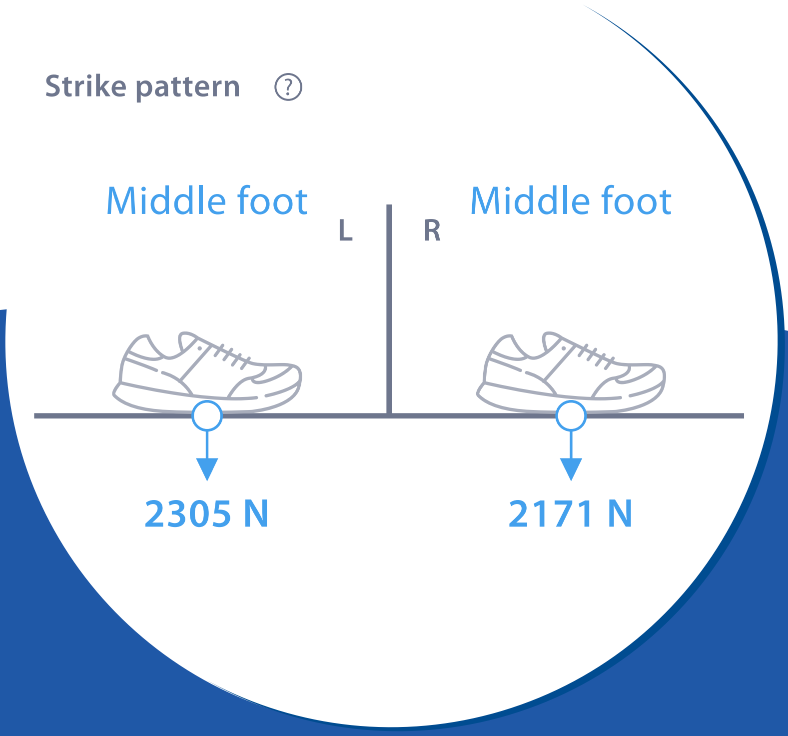
- On one hand, timing: the time of onset of the problem
- On the other hand, the type of development: continuous (lasting development of the disturbance) or acute (break in the development of the curve) and the significance of this disturbance.

Asymmetry

In this first panel, we find an index of **symmetry of the contact phases,** highlighting the extent of asymmetry between the two lower limbs, as well as **the limb** that appears to be the **strongest**



Type of Approach and Force of Impact



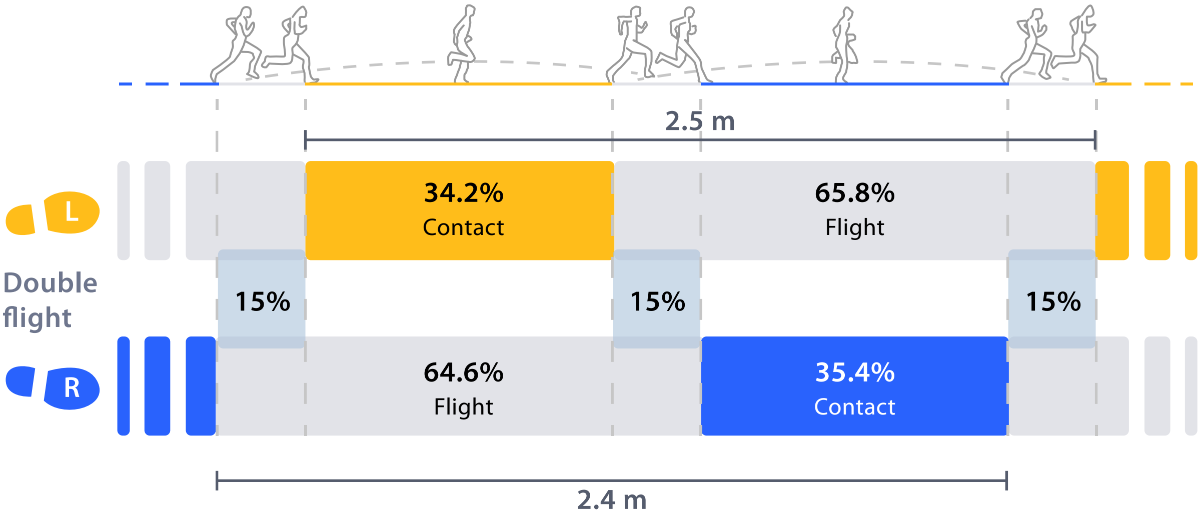
The type of approach is the way in which the foot is placed on the ground, starting either with the heel, the midfoot (foot flat to the ground), or the forefoot.

Note that this is the "average" of the approaches carried out during this recording.
The impact force is the deceleration force experienced by the foot on first contact with the ground for each stride.

This force depends on the patient's weight, the elevation of the pelvis during the stride, the length of the stride and the running speed.
The risk of injury may increase with the magnitude of this force, although there is no scientific consensus on this issue.

Running profile

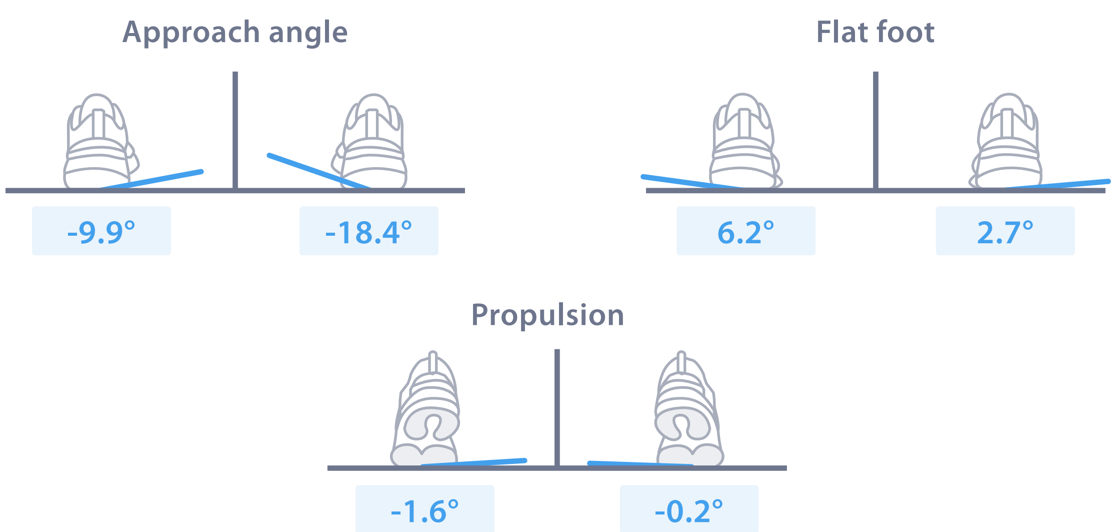
Running profile



This graph shows all the average spatio-temporal parameters of this recording.
The average stride length, the distribution of contact, airborne, and double airborne phases for each limb are assessed.

Approach Angle and Propulsion Angle

Pronation/supination angles



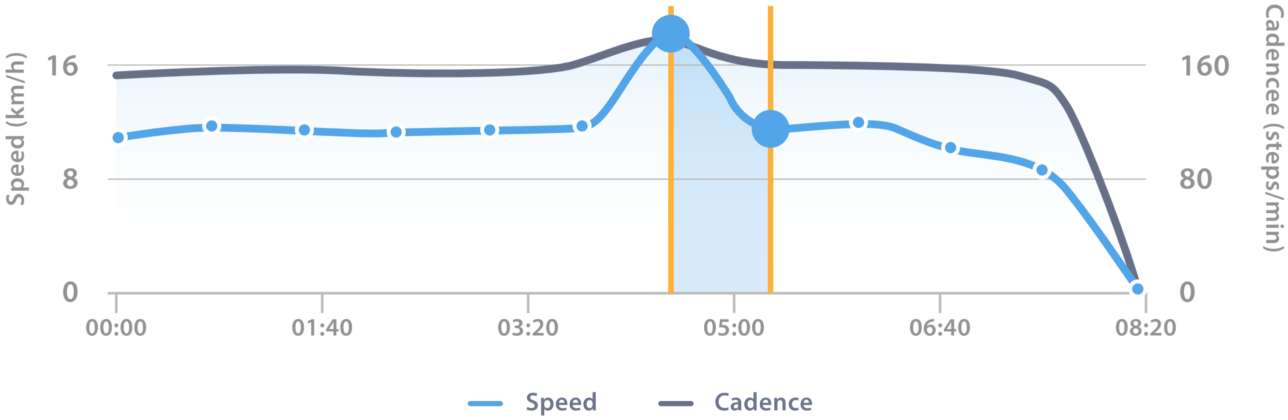
This is **the angle of pronation/supination** measured at the moment **the foot lands on the ground** (approach angle), at the moment the **foot is stationary**, either on the ground during a heel or mid-foot approach, or in the air, where the heel no longer descends and does not yet rise in the case of a forefoot approach (flat foot angle) and at the **take-off of the toes** (propulsion angle).

This angle makes it possible to highlight the quality of the plantar movement, from the approach to the propulsion, and to highlight certain high-risk behaviours or those that reveal pathologies.

Thanks to **the advanced mode,** by clicking on the corresponding button, you can **follow the development of this angle** during the course of the ground contact.

You will be able to assess the duration of the cushioning and propulsion phase, by finding the average angle (black line) at the three time points described in the paragraph above, as well as the standard deviation of these measurements (grey lines), which gives information on the variability of this angle and therefore of the patient's ability to reproduce the same movement at each stride.

Analysis



By selecting two distinct time points on the speed and pace graph for the running session, you can **compare all of the spatio-temporal and kinematic parameters** relating to these time points.

The objective here is to be able **to locate one or more events or disturbances** that occurred during the recording and to be able **to compare** the parameters of the running process **before and after** this event, in order **to understand the consequences**, trace the source of the disorder and explain it objectively.

	L	R	L	R
BIOMARKERS				
Asymmetry	 + 0.2%		 + 1.6%	
Strike pattern				
Attack angle	-7.3 °	-5.4 °	-5.3 ° ↑	-4.4 ° ↑
Impact force	2641 N	2621 N	2100 N ↓	2037 N ↓
METRICS				
Stride length	3.6 m	3.3 m	2.5 m ↓	2.4 m ↓
Contact time	30.8 %	31.2 %	36.1 % ↑	36.8 % ↑
Swing time	69.2 %	68.8 %	63.9 % ↓	63.2 % ↓
Double flight	19 %		14 % ↓	
Attack duration	32.3 %	33.3 %	34.6 % ↑	37.7 % ↑
Propulsion duration	67.7 %	66.7 %	65.4 % ↓	62.3 % ↓
ANGULATION				
Strike angulation	-14.2 °	-19.9 °	-10.6 ° ↑	-17.2 ° ↑
Mid foot angulation	7.4 °	0.4 °	5.7 ° ↓	2.7 ° ↑
Propulsion angulation	-1.4 °	-1.3 °	-2.9 ° ↓	0.4 ° ↑

Tips

Pace : it is ideal at around 180 bpm for running while it can be lower (~160 bpm) for jogging. Increasing the pace decreases the vertical movement and therefore decreases the load rate, decreases the oxygen consumption, increases the elastic stresses, and therefore reduces the muscular workload.

Running speed : Increased pace should not be confused with acceleration. Trying to increase speed with a higher pace has many advantages, but is 10 times less effective than lengthening your stride.

Approach type : There are three ground approach methods:

- **Through the heel :** With a back to front movement, the knee and hip flexed and the pelvis in retroversion.

This type of approach is **more economical**, but the workload and **force of impact is greater, so the risk of injury** to the shin, knee, hip, pelvis and back is **increased.**
Also, due to the repetition of the impacts, it is possible that this type of approach induces talalgia (8 ;11)

- **Through the midfoot :** Just in between the heel and forefoot approach, during the midfoot approach, the foot is placed flat on the ground, without movement from back to front or vice versa, but just from top to bottom.

This approach has **a very limited braking** component (related to the back-to-front movement) and is therefore **less traumatic** for the lower limb. It allows a better loading of the elastic components of the muscles and tendons to restore the stored force than during a heel approach, but is nevertheless **less effective than a forefoot approach.**

- **Through the forefoot :** With a "clawing" movement from front to back, this is **more efficient** and brings the elastic components into play more, with the leg stretched and the pelvis high.

This type of approach is still more demanding but has the advantage of being less traumatic, although it can cause foot or ankle injuries if the force of the impact becomes too intense.
A change in the type of approach that favours the forefoot may be a sign of possible compensation for talalgia (8 ;11)

Generally speaking, impact is not the main cause of injury, but it increases weaknesses and fragility, and therefore the severity of pathologies.

Symmetry : There is a **natural level of asymmetry,** greater for running than walking, between the two lower limbs, even in healthy runners.
This can depend on differences in length, muscle strength or running patterns between the two legs.
However, there is **no correlation between a slight (natural) asymmetry and an increased risk of injury.**
On the other hand, **too little or no asymmetry may be considered problematic** and indicate a degree of stiffness in the lower limbs.

On contrary, **too much asymmetry**, due to the repetitions linked to the activity, will have harmful consequences on the limb most solicited and subject to the most stress on the structures that **can lead to injuries.**

Stride length : There are two types of strides

o Longer strides : **Improve recovery** because gas exchanges only occur during the oscillating phase, but are **more energy consuming,** increase vertical movement (decrease in efficiency) and increase muscle workload during the landing and propulsion phases. They are therefore **less efficient.**

o short strides : They are **more efficient and more effective** (more economical), because they reduce vertical oscillations and reduce the muscular stresses for landing and propulsion as the foot is closer to the projected centre of gravity. Finally, since they go hand in hand with an increase in pace, the stress on the elastic components is greater.
The stride length will be considered suitable if it does not slow down the landing and propulsion phases and if the vertical movement and workload are reduced.

Contact time : It is about **40%** of the stride for a **normal run** and decreases with increasing speed to about **25%** for **sprinters.**
This parameter is interesting to study in order to **compare the two lower limbs and to define the stronger one** (the longer duration)

Airborne time : This is approximately **60%** of the stride for a **normal run** and increases with speed or stride length, resulting in greater kinetic energy on landing and propulsion, and therefore a higher workload.

Duration of the double airborne phase : It is about **10%** of the stride at the beginning and end of the airborne phase and its value tends to increase with speed.

Approach, flat foot and propulsion angles : These angles are relevant in the search for elements that may favour the appearance of certain pathologies specific to running, notably as a result of the repetition of movements and the load imposed.

Thus, certain pathologies could potentially be identified, such as:

- Iliotibial band syndrome (1 ; 2 ; 3): extension (approach, flat foot and propulsion) or at least supinated approach.
- Achilles tendon tendonitis (4 ; 5 ; 6 ; 7): supinated propulsion, indicated by a predominantly forefoot approach or a pronated heel approach.
- Pes Anserinus tendinitis (9 ;10): pronated extension.

Run analysis

Parameters	*Definition*	*Accuracy*
Stride length	Distance travelled by the foot in a gait cycle.	+/- 5cm
Analysis time	Running time during data capture.	+/- 5%
Speed	The average speed at which the body moves in a straight line while running.	+/- 0.7km/h
Pace	Number of steps taken per minute.	+/- 5pas/min
Asymmetry	The ratio of the exposure time of the right foot (respectively, the left foot) and the sum of the exposure times of the right and left feet.	+/- 2%
Attack type	Defined as the part of the foot that makes contact with the ground at the start of a stride.	NA
Attack angle	Angle between foot and ground at initial contact.	+/- 7°
Contact	Contact is calculated as the interval between initial contact and toe lift off for each foot throughout the stride cycle as a percentage of the length of the period of the stride cycle during which the limb is in contact with the ground.	+/- 50ms
Swing	The swing is the proportion of time during the running cycle when the limb is not in contact with the ground, measured as the interval between foot lift and initial contact for each foot during the stride cycle.	+/- 50ms
Double swing	For a running cycle, the percentage of time when no foot makes contact with the ground.	+/- 70ms
Pronation and supination angles	Angle of inclination between the foot and the earth's surface. Supination is a negative angle, while pronation.	+/- 7°
Impact force	Maximum vertical ground reaction force in the gait support phase.	+/- 0.5kN/m
Parameter changes during running	Allows for the comparison of two running moments.	NA

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Help and assistance

Help

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Contact

Do you have a question or a suggestion? Do not hesitate to contact us.

DIGITSOLE PRO

Digitsole France : 13 Rue Héré 54000 Nancy

DigitsolePro.com
contact@digitsolepro.com

DIGITSOLE
13 Rue Héré
Place Stanislas
54000 Nancy
France

CE

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