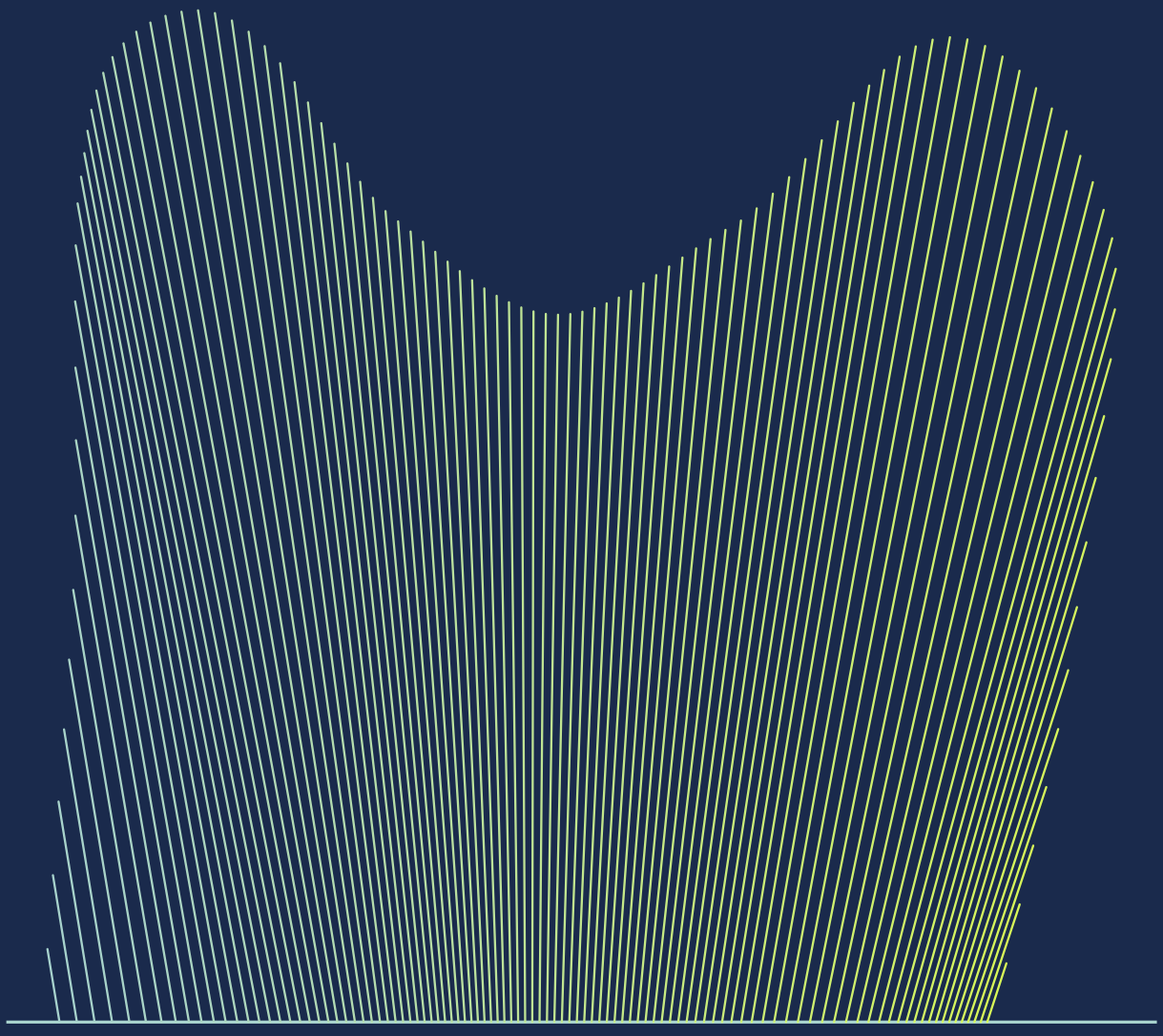
Movetrics

Movement, understood.

What the forces under your feet reveal, from your first step to the research lab.



On the cover: one walking step, drawn as forces, from braking to push-off. Page 12 explains how.

HOW TO READ THIS BOOKLET

Start where you are.

This booklet walks from the first principles of movement to the questions engineers ask. You do not have to read it in order. Pick the door that fits you, and come back for the rest.

4 — **New to all of this**
How we move, how movement changes over a lifetime, and what a force is.

10 — **You know movement, not force plates**
The bathroom scale, three directions, moments, and what one plate cannot see.

17 — **You want to see where this is going**
Force, pressure and video on one clock, our vision, and how Movetrics began.

19 — **You are choosing equipment**
Eight questions for any force plate, then our system, software and games.

26 — **You build, research or analyse**
Open data, AI connectors, the technical overview and every source.

Small numbers lead to the sources on page 31. Words in the margin explain the terms you need, where you first meet them.

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“...we can still endorse the old adage that to move things is all mankind can do, and that for such the sole executant is muscle, whether in whispering a syllable or in felling a forest.”

Charles Sherrington, physiologist, in Nature, 1924[1]

Watch anyone stand up, walk or jump, and you are watching a conversation with the ground. To stand up, you push down on the floor. To walk, each foot pushes down and back, and the floor pushes you up and forward. Gravity pulls; the ground pushes back. Much of how you move is written in that exchange.

That exchange can be measured. A force plate records how hard you push, in which direction and where, hundreds of times every second. Researchers have measured the forces of walking with force platforms since the 1930s,[2] but for most of that time the plates stayed in laboratories and elite sport. This booklet explains what they show, why it matters to anyone who moves, and why we think these measurements belong in every practice, gym and training hall.

We start at zero. By the last page you will understand the forces under your feet better than most people ever do, and you will know what a force plate can and cannot tell you.

Saad Jabir and Marius Schober

Duisburg

1 Sherrington, Nature 1924

2 Elftman, Science 1938

CHAPTER 1 · BASICS

How we move

Moving looks effortless. Behind every step runs a loop of planning, pulling, sensing and correcting that never pauses.

The brain plans

Every movement starts as a plan. The brain chooses what to do, sends commands through the spinal cord to the muscles, and predicts what the movement will feel like. Then it compares the prediction with what really happens, and corrects the next attempt. The neuroscientist Daniel Wolpert goes as far as calling movement the reason we have a brain at all.[3]

Muscles pull, bones turn

Muscles can only pull. They pull on tendons, tendons pull on bones, and the bones turn around the joints like levers. Even a single step needs many muscles in each leg, switched on and off in a precise order.

The senses check

Three systems tell the brain where the body is: the eyes, the balance organs of the inner ear, and sensors in the skin, muscles and joints that feel pressure, stretch and position. Even standing quietly depends on a remarkably complex control system.[4] When conditions change, on a soft surface or with the eyes closed, the brain shifts how much it relies on each sense.[4,5]

Proprioception The sense of where your body parts are, from sensors in muscles, tendons and joints.

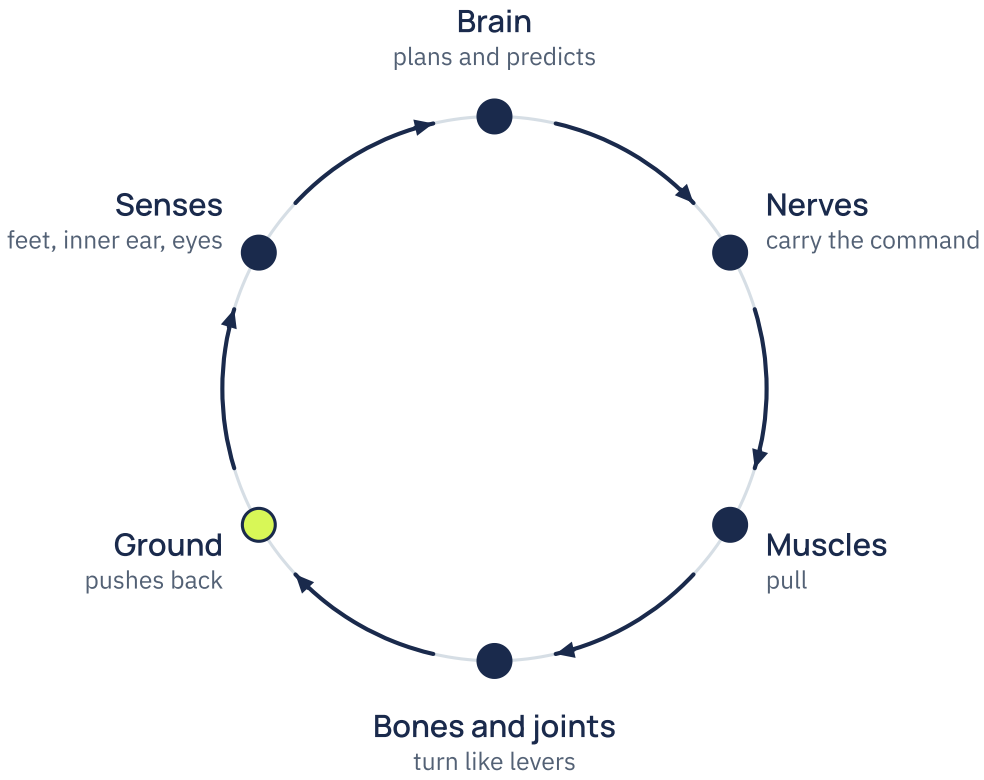
“We have a brain for one reason and one reason only, and that’s to produce adaptable and complex movements.”

Daniel Wolpert, neuroscientist, TEDGlobal 2011

3 Wolpert, TED talk 2011

4 Peterka, J Neurophysiol 2002

5 Horak, Age Ageing 2006



Balance is a skill, not a state

Even when you stand still, you are never quite still: the human body is never in perfect equilibrium.[6] It sways a little, the senses notice, and the muscles around the ankles and hips correct it, again and again. Balance is not one ability but many systems working together,[5] which is why it can change with age and with practice.

Reaction and coordination

Reaction time is the delay between a signal and the start of a movement. Simple reactions to an expected signal change little until about the age of fifty; choice reactions, where you must pick the right response, slow steadily across adult life.[7] Coordination is how well all the pulls are timed together. It is what makes a jump high, a sprint fast and a step smooth.

Stand, walk, run or jump: you push on the ground, and the ground pushes back.

5 Horak, Age Ageing 2006

6 Duarte & Freitas, Rev Bras Fisioter 2010

7 Der & Deary, Psychol Aging 2006

CHAPTER 2 · BASICS

A lifetime of movement

We spend years learning to move, reach our peak, and then change slowly for the rest of our lives. Measuring turns that slow change into numbers you can compare.

Learning, then strength

Children spend years learning to stand, walk, run and jump. Muscle strength keeps growing into early adulthood and declines later in life.[8] When the loss goes far enough, it has a name: sarcopenia. The European consensus defines it mainly by low muscle strength, confirmed by low muscle quantity or quality. It is most common in older adults, but it can begin earlier in life.

Walking changes too

A systematic review across the adult lifespan found that older adults walk more slowly, with a lower cadence and shorter steps.[9]

What helps

The World Health Organization recommends regular activity at every age: muscle strengthening for adults, and for older adults, varied activity that emphasises balance and strength.[10] The numbers are on the opposite page.

Where measurement fits

None of this happens overnight, and a force plate does not diagnose any of it. What it can do is show, in newtons and seconds, how someone stands up, jumps, lands or balances today, and how that compares with last month.

Cadence Steps per minute.

8 Cruz-Jentoft et al., Age Ageing 2019

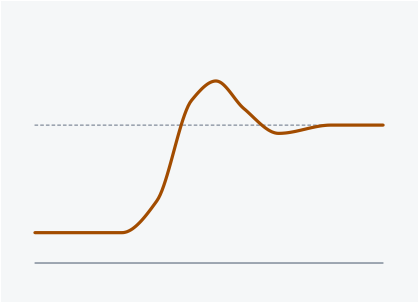
9 Herssens et al., Gait Posture 2018

10 Bull et al. (WHO guidelines), Br J Sports Med 2020

WHAT THE WORLD HEALTH ORGANIZATION RECOMMENDS[10]

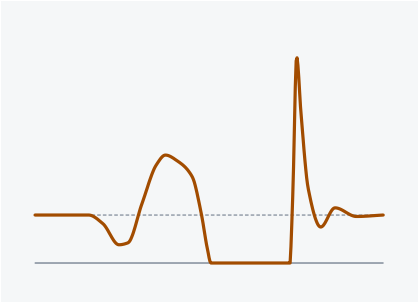
150–300 minutes a week	of moderate activity for adults, or 75–150 minutes of vigorous activity
2 days a week	at least, of muscle-strengthening activity for adults
3 days a week	at least, of varied activity that emphasises balance and strength, for adults aged 65 and over

THREE EVERYDAY MOVEMENTS, THREE FORCE PICTURES



Standing up from a chair

The force rises as you lift off, overshoots, then settles at body weight.



A jump

A dip, a push, a flight, a landing. Page 9 reads it step by step.



Standing still

The centre of pressure wanders in small loops. Page 15 explains why.

Illustrations. Orange: vertical force over time, with body weight as a dashed line. Blue: the path of the centre of pressure, seen from above.

Slow change is hard to see by eye. Numbers make it visible.

10 Bull et al. (WHO guidelines), Br J Sports Med 2020

CHAPTER 3 · BASICS

Force, the language of movement

A force is a push or a pull, and force is what changes motion. Three ideas from Isaac Newton, and the rest of this booklet follows.

Newton in one minute

A body keeps doing what it is doing unless a force acts on it. A force accelerates a mass: force equals mass times acceleration. And every force has an equal and opposite partner: when you push on the floor, the floor pushes back on you just as hard.[11]

Kilograms are not force

A bathroom scale shows kilograms but measures force. The kilogram says how much of you there is; the newton says how hard something pushes. Weight is a force: on Earth, each kilogram presses down with about 9.81 newtons.[12] A person of 70 kilograms standing still pushes on the floor with about 687 newtons, and the floor pushes back with exactly the same.

The ground reaction force

That push from the floor is the ground reaction force. When you stand, walk, run or jump, it is, apart from gravity, the only large outside force acting on you. So whenever your body speeds up, slows down or rises, the change shows in it. Push harder than your weight and you accelerate upward; push less and you start to drop.

How big it gets

In walking, the vertical force peaks at about one to one and a half times body weight, depending on speed.[13] In running at about 4.5 metres per second it reaches around three times body weight, with every stride.[14]

Newton (N) The unit of force. One kilogram weighs about 9.81 N on Earth.

Ground reaction force The force the ground exerts on the body.

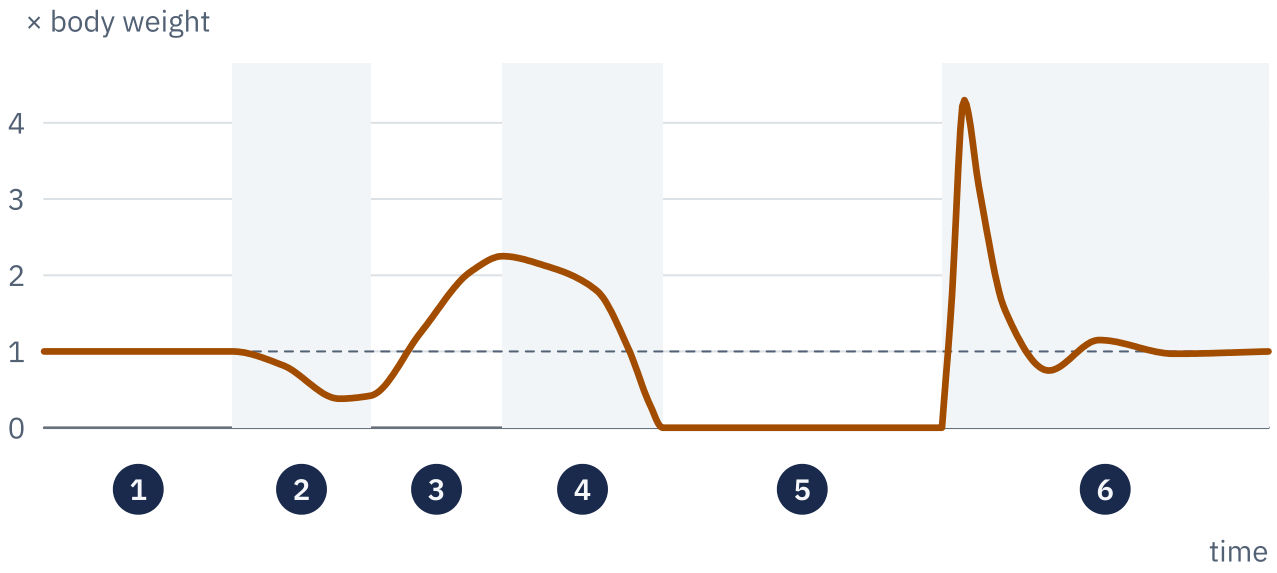
11 Newton, Principia, 1687

12 BIPM, SI Brochure 2019

13 Nilsson & Thorstensson, Acta Physiol Scand 1989

14 Cavanagh & Lafortune, J Biomech 1980

A JUMP, TOLD IN FORCE[15]



1. **Weighing.** Standing still: the force equals body weight.
2. **Unweighting.** You let yourself drop; the force falls below body weight.
3. **Braking.** You slow the drop; the force climbs above body weight.
4. **Propulsion.** You drive upward until your feet leave the plate.
5. **Flight.** Zero force: you are in the air.
6. **Landing.** A sharp peak as the legs catch the body.

Two ways to the jump height

From the flight time *t*: $h = g \cdot t^2 / 8$. Simple, but it assumes you land in the same position you took off in.[16]

From the force: the push above body weight, added up over time, gives the take-off velocity *v*, and $h = v^2 / 2g$. It uses the push itself, so how you land does not change it.[16] Flight time tends to give higher values; one comparison recommends the take-off velocity method.[17]

Your weight is a force: 70 kg presses on the floor with about 687 N.

Illustration of a typical countermovement jump: vertical force in multiples of body weight over time.

15 McMahon et al., Strength Cond J 2018

16 Linthorne, Am J Phys 2001

17 Moir, Meas Phys Educ Exerc Sci 2008

CHAPTER 4 · MEASURING

From a bathroom scale to a force plate

A scale gives you one number. A force plate gives you the whole story of a movement: how the force changes, hundreds of times every second.

One number

A bathroom scale waits until you stand still and then shows a single value. That is all it is built for.

A curve

A force plate measures continuously, so it sees movement. From the vertical force alone you can calculate a lot:

- **Jump height**, from the flight time or from the push itself.
- **Rate of force development**: how quickly force rises; a measure of how explosively someone pushes.[18]
- **Left against right**, with one plate under each foot. Whether a difference matters is still debated: studies link it with poorer jumping, kicking and cycling, while results elsewhere are inconsistent.[19]
- **Standing up from a chair**: how long five repetitions take,[20] and how the two legs share the load.[21]

Where one direction ends

A plate that measures only vertical force cannot see direction. It cannot tell whether a push went forward or sideways, or whether a landing braked or slid. For that you need the horizontal forces, and to know where the force acts and how it turns, the moments. Those are the next two chapters.

Rate of force development How fast force rises, in newtons per second (N/s).

Impulse Force added up over time, in N·s. It sets how much the body's speed changes.

18 Maffiuletti et al., Eur J Appl Physiol 2016

19 Bishop et al., J Sports Sci 2018

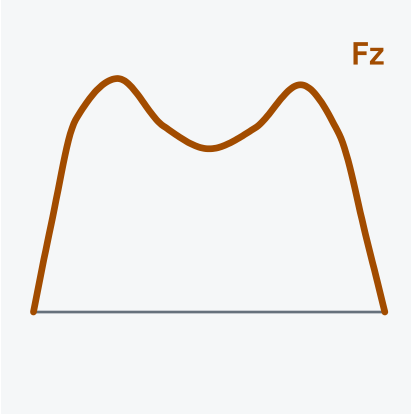
20 Bohannon, Percept Mot Skills 2006

21 Christiansen et al., Arch Phys Med Rehabil 2011

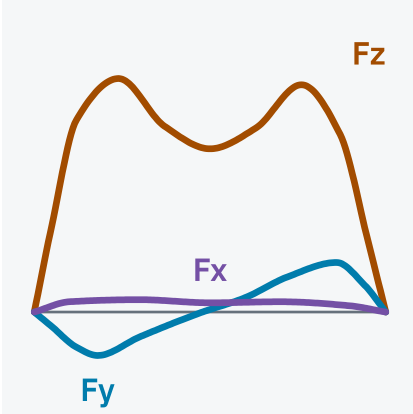
Bathroom scale
one number

70.0
kg

1D force plate
one curve: vertical force



3D force plate
three curves: every direction



WHAT YOU CAN CALCULATE

VALUE	WHAT IT IS	UNIT
Peak force	The highest force during a movement	N, or × body weight
Impulse	Force added up over time	N·s
Take-off velocity	Speed of the body's centre of mass as the feet leave the plate	m/s
Jump height	How high the centre of mass rises	cm
Rate of force development	How fast the force rises	N/s
Left–right difference	The gap between the two sides	%

Each value has a defined method, and different methods can give different numbers for the same jump. In Movetrics Cloud, every result names the method and the version that calculated it, so a number can always be traced back.

A scale tells you how much.
A plate tells you how, and when.

CHAPTER 5 · MEASURING

Three directions

Force has a size and a direction. To see the direction, a plate must measure the sideways and forward–backward forces too, not only the vertical one.

Three components

A three-dimensional force plate splits the force into three parts: Fz, up and down, and Fx and Fy, the two horizontal directions along the plate's sides. Together they give the full force: how big it is and where it points.

Walking: brake, then push

When your heel lands, the floor pushes back against your foot: you brake. Around the middle of the step the horizontal force passes through zero, and then the floor pushes you forward into the next step. Braking peaks at about a fifth of the time the foot is on the ground, push-off at about 85 per cent of it.[22]

The butterfly on the cover

Draw the force of one step as an arrow every few milliseconds, each starting at the point under the foot where the force acts, and the arrows fan out into the shape on the cover. Biomechanists call it the butterfly diagram, after Antonio Pedotti described it in 1977.[23] One wing is braking, the other is push-off.

Sprinting: aim beats size

In a study of twelve physically active men, two of them sprinters, 100-metre performance was related to the orientation of the force, not to the total or vertical force.[24]

Cutting and turning

A change of direction means braking one way and re-accelerating another; the forces depend on the angle of the turn and the speed of the approach.[25] Nothing moves the body sideways without a sideways push.

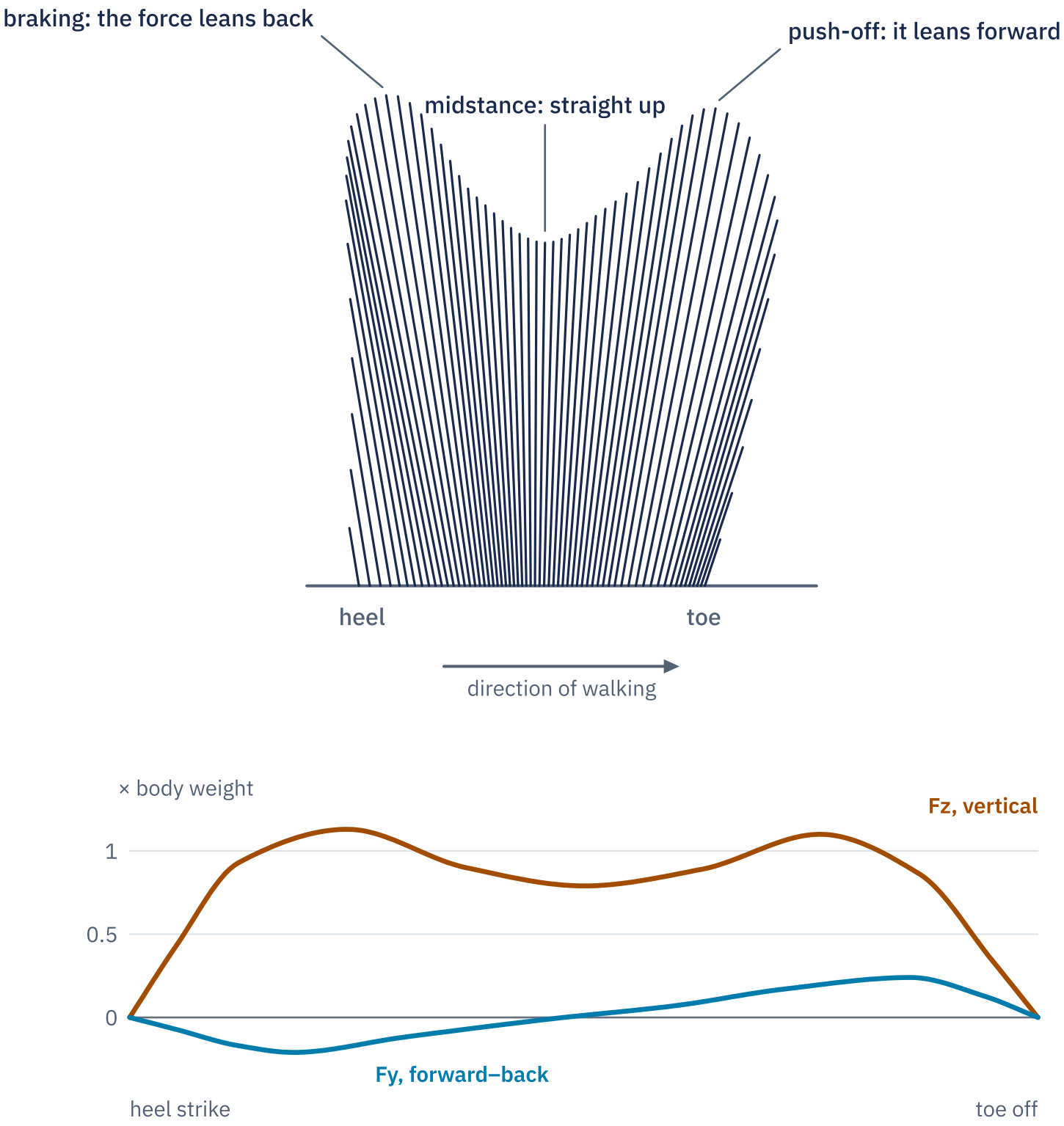
Stance The time one foot is on the ground during a step.

22 Revi et al., J Neuroeng Rehabil 2020

23 Pedotti, Biol Cybern 1977

24 Morin et al., Med Sci Sports Exerc 2011

25 Dos'Santos et al., Sports Med 2018



Top: the force of one walking step as arrows, drawn every few milliseconds from the centre of pressure: the butterfly diagram. Bottom: the same step as two curves, vertical and forward–back, in multiples of body weight. Illustration based on typical walking forces.[13,22]

13 Nilsson & Thorstensson, Acta Physiol Scand 1989

22 Revi et al., J Neuroeng Rehabil 2020

CHAPTER 6 · MEASURING

Moments: where force acts, and how it turns

Forces say how hard and in which direction. Moments say where on the plate the force acts, and whether the foot twists against the floor.

What a moment is

A moment is a turning effect: a force times its distance from a point. Push a door near its hinges and little happens; push at the handle and it swings. A force plate measures moments about its three axes. Mx and My appear when the force acts away from the plate's centre; Mz is a twist about the vertical axis.

The centre of pressure

From the vertical force and the moments Mx and My, the plate calculates the centre of pressure: the single point where the combined force acts.[6] Under one foot it travels from heel to toe as you walk. When you stand still, it wanders in small loops, because the body is never in perfect balance.

The free moment

Mz, the twist between foot and floor, is called the free moment. In running it grows as the foot rolls inwards, the movement called pronation.[26] In walking it is linked with the swing of the arms, which helps to balance the twisting of the body.[27]

Moment A force times its distance from a point, in newton metres (N·m).

Centre of pressure The point on the plate where the combined force acts.

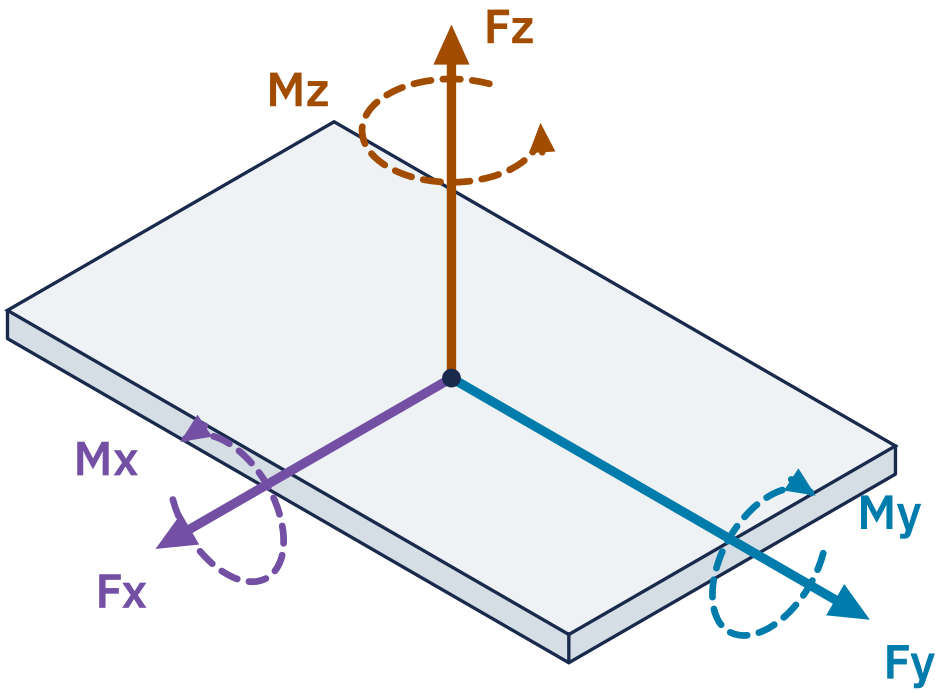
Forces say how hard and which way.
Moments say where, and how it turns.

6 Duarte & Freitas, Rev Bras Fisioter 2010

26 Holden & Cavanagh, J Biomech 1991

27 Li et al., J Exp Biol 2001

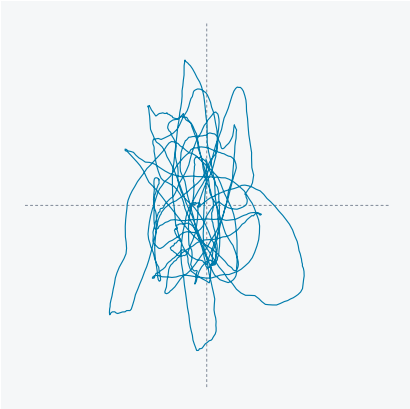
SIX COMPONENTS ON ONE PLATE



x violet, y blue, z orange Forces: solid arrows Moments: dashed arcs x across the plate, y along it

Six components

Three forces and three moments describe everything a rigid plate can feel from you: six numbers at every instant. The Movetrics F1-3D measures all six. The F1-3D S measures five as standard, Fx, Fy, Fz, Mx and My, and all six on request.



Standing still

The path of the centre of pressure over half a minute, seen from above (illustration). Its length, area and speed are classic balance measures. In one study, the mean speed of the centre of pressure set healthy young and older adults apart, with eyes open and closed.[28]

For engineers. In a common sign convention, with the origin at the centre of the top surface, the centre of pressure is x = −My / Fz and y = Mx / Fz. If the measuring origin lies below the surface, a term for that depth times the horizontal force is added.[6]

6 Duarte & Freitas, Rev Bras Fisioter 2010

28 Prieto et al., IEEE Trans Biomed Eng 1996

CHAPTER 7 · MEASURING

What a force plate cannot see

A force plate measures what the body does to the ground. It does not see which joint did it. Knowing the limits is part of understanding.

TOOL	MEASURES	MISSES
Force plate	Forces in three directions, moments, centre of pressure	Joint angles, muscle activity, how the load spreads under the sole
Pressure mat or insole	How the load spreads under the foot[29]	Horizontal forces, in most systems
Camera or motion capture	Positions and angles of the body's segments	Forces
Electromyography	Electrical activity of muscles[30]	Forces and motion
Inertial sensors	Acceleration and rotation of the segment they sit on	Ground forces, which they can only estimate[22]

Putting it together

Combine the forces from a plate with the motion from cameras, and you can calculate the forces and moments at every joint. The method is called inverse dynamics, and it is the standard in gait laboratories.[31] It needs several instruments, measuring at the same instants.

Seeing it whole

Each tool sees one part of the movement. Brought together, they show where the load goes, from the floor into the joints. The next two pages show how, and how the FM-3D brings them together.

Electromyography (EMG)
Recording the electrical activity of muscles.

Inverse dynamics
Working back from ground forces and motion to the forces and moments at each joint.

22 Revi et al., J Neuroeng Rehabil 2020

29 Orlin & McPoil, Phys Ther 2000

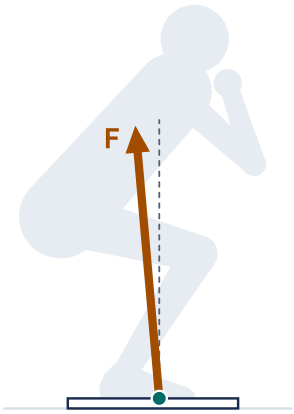
30 De Luca, J Appl Biomech 1997

31 Winter, Biomechanics and Motor Control of Human Movement, 2009

Three views, one clock

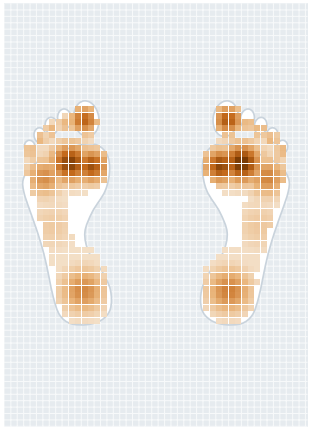
A force plate says how much, and in which direction. A pressure matrix says where under the foot. A camera says which joint. On one clock, together, they show where the load goes.

Force plate
how much, and which way



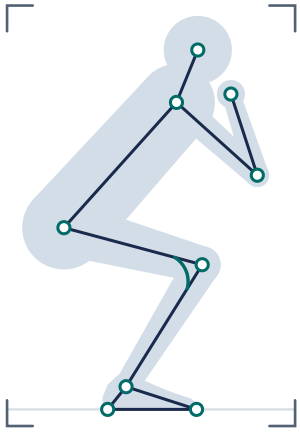
One force: how big it is, which way it points, and where it acts. The plate does not see the body.

Pressure matrix
where under each foot



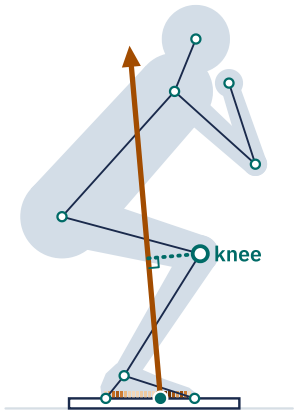
Hundreds of small sensors map how hard each part of the sole pushes down.

Camera
which joint, at what angle



Software finds the body's segments in the video and measures the angles between them.

Together, on one clock
where the load goes



The force line passes behind the knee: the farther away, the more the knee muscles must hold.

What each one sees

A force plate measures the total force under the feet: how much, in which direction, and where it acts. With both feet on one plate, it sees their sum. A pressure mat is made of many small sensors, each feeling only the push straight into it. Together they map how the load spreads under each sole.[29] The horizontal forces of braking, pushing off and turning run along the floor, so the plate measures them, not the mat. Software can now follow the body's segments in ordinary video, without markers; reviews still see limits in precision for clinical use.[32]

Why together

Draw the force from the plate into the video, and you see its line pass in front of or behind a joint. The farther it passes, the larger the moment the muscles around that joint must hold. Research tools already estimate these joint moments from smartphone video.[33] Add the pressure map, and you also see where under the foot the load enters the body.

Why one clock

A plate measures dozens of times between two frames of video. If separate instruments keep separate clocks, the forces end up drawn on the wrong pose. So we build them on one clock from the start.

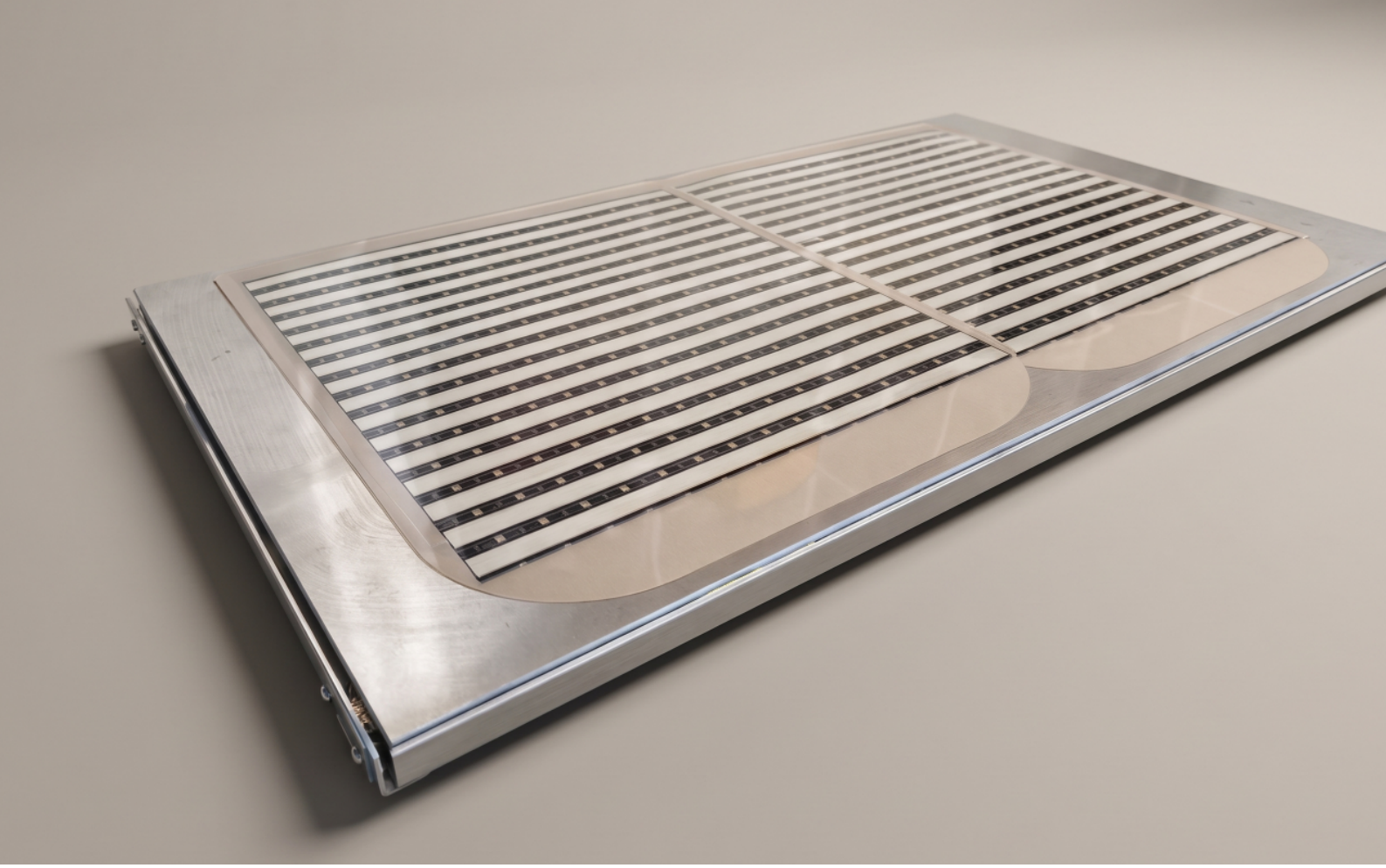
Pressure matrix A thin mat of many small pressure sensors in a grid.

Joint moment The turning effect a force has about a joint; muscles must match it.

29 Orlin & McPoil, Phys Ther 2000

32 Wade et al., PeerJ 2022

33 Uhlrich et al., PLoS Comput Biol 2023



The FM-3D: force plate and pressure matrix in one 18 mm platform.

CHAPTER 7 · FORCE, PRESSURE AND VIDEO

Force, pressure and video, on one clock

A gait laboratory uses separate systems for force, pressure and motion. The FM-3D puts force and pressure in one 18 mm platform; our apps add video on the same clock.

FM-3D

THE FORCE MATRIX

18 mm thin, for walking, balance and rehabilitation. A pressure matrix on top of force and moment sensors: how much force, which way, and where under each foot.

Camera

IN OUR APPS

The Movetrics app records video beside the force curve, so you see each force with the movement that made it.

Under a treadmill

MOVETRICS GAIT

Four F1-3D S under the feet of a treadmill measure every step, for as long as someone walks. Page 25.

One picture of where the load goes: from the floor, through the foot, into the body.

Eight questions to ask about any force plate

Why each one matters, and how Movetrics answers it.

1 One direction, or three?

Vertical force shows how hard someone pushes. Only all three directions show braking, push-off and sideways drift.

Movetrics: Every Movetrics plate measures forces in three directions.

2 Forces only, or moments too?

Moments locate the centre of pressure and reveal the twist of the foot against the floor.

Movetrics: F1-3D: all six components. F1-3D S: five as standard, six on request.

3 How fast does it measure, and how fast can it respond?

Landings are over in milliseconds. A plate needs many samples a second, and a natural frequency well above the movement, or it rings.[34]

Movetrics: Key figures on page 30; every figure, with its conditions, on our product sheets.

4 What floor does it need?

A plate is only as steady as what it stands on. A soft or uneven floor lets it rock and lowers the frequency at which it rings.

Movetrics: Portable on a flat, rigid floor, or flush in a recess frame. No drilling into the plate.

5 Can several plates share one clock?

To compare left with right, or to put plates under a treadmill, every plate must measure at the same instants.

Movetrics: Multiple plates on one FDT, one shared clock. Sync In and Sync Out for laboratory equipment.

6 Can you get the raw data out?

Raw data lets you check any result, and reuse it in any tool, years later.

Movetrics: CSV and C3D export, a documented open protocol, and an SDK under Apache-2.0.

7 Does measuring need a subscription?

It decides what your own measurements cost you over the years.

Movetrics: Never, for measuring, core calculations and exporting raw data. Movetrics Cloud is free to start, with paid plans for more.

8 Can you see how each result was calculated?

The same jump can give different heights with different methods.[17] Knowing the method makes numbers comparable.

Movetrics: Every result in Movetrics Cloud names its method and version.

17 Moir, Meas Phys Educ Exerc Sci 2008 **34** Robertson et al., Research Methods in Biomechanics, 2014. Natural frequency: the frequency at which a plate rings when struck, like a bell.

CHAPTER 8 · WHY WE EXIST

Out of the lab, into everyday practice

For decades, force plates that measure in every direction lived in laboratories and elite sport. The physics was never the problem. Getting it out was.

Force platforms have been used to study walking since the 1930s,[2] and treadmills that measure force were built for research.[35] Most such instruments were heavy, built into the floor, expensive, and run by specialists.

OUR VISION

Everyone who moves can see the forces behind their movement, and act on what they see.

Everywhere people move

Physiotherapy practices, gyms, training halls, schools and universities: wherever people want to understand how they move.

Seen, not guessed

In five years, practitioners see in newtons what they used to judge by eye, and show the people they work with what they feel: athletes, students, everyone who moves.

Systems, not plates

Plates, terminal, software and open data that work together, and the FM-3D adds pressure and video. From a saved layout, setup takes under a minute.

Open, by belief

Data belongs to the person who was measured, to take anywhere and ask any tool about, their own AI assistant included. The EU Data Act points the same way.[36]

The EU Data Act has applied since 12 September 2025. Its Article 4 gives users of connected products the right to access the data those products generate.

2 Elftman, Science 1938

35 Kram et al., J Appl Physiol 1998

36 EU Data Act, Regulation (EU) 2023/2854, Art. 4



See what you feel.

Every movement is a push against the ground.
You have always felt it. Now you can see it.

Two Movetrics F1-3D S in a gym.

CHAPTER 9 · HOW MOVETRICS BEGAN

The engineer who became the user

Movetrics began when a sensor engineer needed an instrument he had pioneered decades earlier.

A few years ago, Dr.-Ing. Saad Jabir found himself on the other side of the measurement. For almost a year, foot pain had made walking difficult. At a specialist shop for orthopaedic aids, he walked, balanced and stood on a pressure plate while a biomechanics specialist explained the results and designed an insole that relieved almost all of the pain.

Saad was surprised. Thirty years ago he had pioneered this technology, bringing it to the tyre maker Pirelli and to the orthopaedic market in Italy and worldwide. Hundreds of such devices were sold in Europe. Little had changed, in the hardware or in the software. As a user, he understood what he had built as an engineer: not a piece of electronics, but a device that helps people.

The specialist told him what was missing: an affordable plate that measures in all three directions, made for everyday practice rather than the laboratory, and above all a treadmill that measures force in three dimensions. Such treadmills existed, at prices few practices can pay. This defined Saad's goal for the years ahead.

Saad started building at Nur Engineering, the company he had founded in 2012. He invented the plates and leads their technology as CTO. To turn prototypes into products, he brought in Marius Schober as co-founder. Marius leads business and partnerships and shapes the larger vision: Movetrics as one ecosystem of plates, terminal, software and open data.

The treadmill came next. Movetrics Gait puts four plates under a treadmill: our first answer to the specialist's wish.

Thirty years ago

Saad brings pressure plates to Pirelli and to orthopaedics, in Italy and worldwide.

2012

Saad Jabir founds Nur Engineering.

Three years

of prototypes, from a very thin first plate to the F1-3D, strong enough for drop jumps by athletes of 120 kg and tested by biomechanics experts.

F1-3D and FDT

Plates, terminal and software, designed in Duisburg and made in Germany.

FM-3D

Force and pressure in one 18 mm platform, video on the same clock.

“What I pioneered is not a piece of electronics. It is a device that helps people.”

DR.-ING. SAAD JABIR, FOUNDER AND CTO



The answer: the F1-3D, measuring forces in three directions and all three moments, made for everyday practice.

Made in Germany

Everything is built or assembled in Germany. Plates, terminal and software come from one team: Nur Engineering GmbH in Duisburg.

CHAPTER 10 · PRODUCTS

The Movetrics system

Plates that measure, a terminal that puts them on one clock, and software on every screen.



From left: four F1-3D S as a Quad, two F1-3D, the FM-3D and the FDT.

F1-3D S

THE COMPACT PLATE

400 × 280 × 30 mm, 10 kg. Five components as standard, six on request. Two join into one 40 × 56 cm platform. Solo, Dual or Quad.

F1-3D

THE UNIVERSAL PLATE

600 × 350 × 30 mm, 20 kg, 8 mm steel top. All six components. For jumps and landings, strength, gait and balance. Option: a lighter aluminium top.

FM-3D

THE FORCE MATRIX

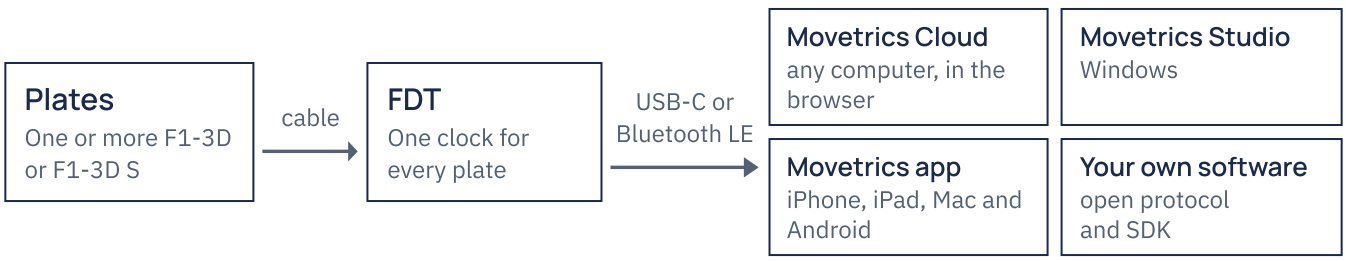
18 mm thin, for walking, balance and rehabilitation. A pressure matrix on top of force and moment sensors: where under each foot the load sits, and which way it pushes. Page 18.

FDT

THE FORCE DATA TERMINAL

Multiple plates on one clock. USB-C to a computer or phone, Bluetooth LE to a phone or tablet. 16 analog outputs, Sync In and Sync Out.

HOW IT CONNECTS







Movetrics Gait: four F1-3D S under the feet of a treadmill. Right: the app shows each step as it happens.

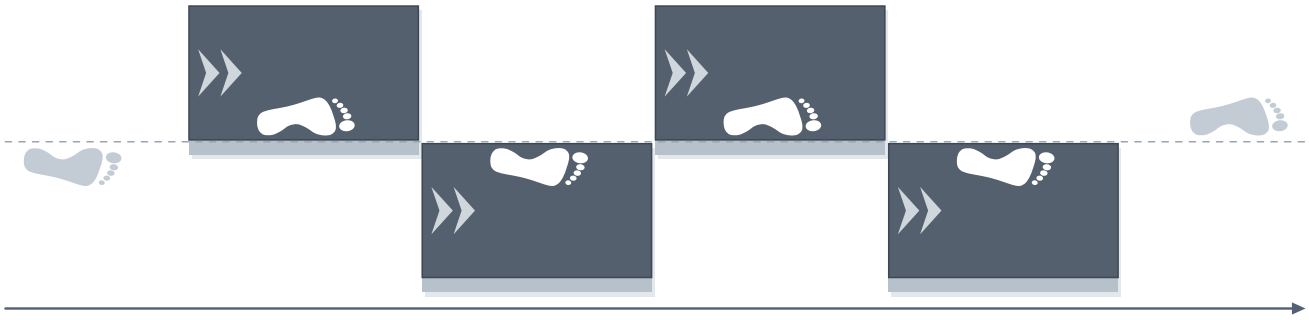
WALKING, STEP BY STEP

Movetrics Gait

Four F1-3D S under the feet of a treadmill, one FDT and the Movetrics app. Set up in under two minutes. In walking it shows the vertical force per side, steps, cadence, left and right step timing and the path of the centre of pressure.

Made for walking: horizontal forces under a treadmill and running are not part of it. The plates sit under the treadmill's own feet, with no drilling and no changes to the treadmill.

YOUR OWN SETUP



A walkway of four F1-3D, staggered: each foot lands on a plate of its own, and one FDT keeps them on one clock.

A walkway, a floor, or sensors in your product

We design installations of any size, and supply our sensor modules for your own product. We take on selected projects: write to contact@movetrics.com.

1. **Feasibility call**, free
2. **Concept and design**, paid, credited in full against the order
3. **Prototype**, measured with our bench tests
4. **Supply or licence**, of firmware and electronics

CHAPTER 11 · SOFTWARE AND OPEN DATA

Your data, your tools

Record in the browser with nothing to install, or use our apps for Windows, iPhone, iPad, Mac and Android. Your raw data goes wherever you want.

No app required

Plug the FDT into any computer over USB, open Movetrics Cloud in Chrome, Edge or Firefox, and record live at the full rate of the plates. Windows, macOS, Linux or ChromeOS.

Movetrics Cloud

In the browser · any computer

Upload files from most force plates: CSV, TSV and other text tables, Excel files and C3D. Every result names its method and version. An optional AI read explains each result in plain words. Everything downloadable, raw data included.

Movetrics Studio

Windows · included with every system

Countermovement jump, squat jump, drop jump, sit to stand, gait, balance and free recording. Exports CSV, C3D and PDF reports. Measuring and the CSV and C3D exports work offline.

Movetrics app

iPhone, iPad, Mac and Android

Every force and moment live, guided tests, Lift for counting squats and deadlifts, treadmill gait, and video beside the force curve. Works offline, over USB or Bluetooth.

Reports

Movetrics Studio and Movetrics Cloud

A one-page PDF for each person. In Movetrics Cloud every result in it names its method, and you design your own report template, or let your AI assistant draft it.

Your own AI

Claude, ChatGPT and others

Connect your AI assistant to your data through MCP and ask in your own words. Read-only by default; changes only if you allow them, and they can be undone.

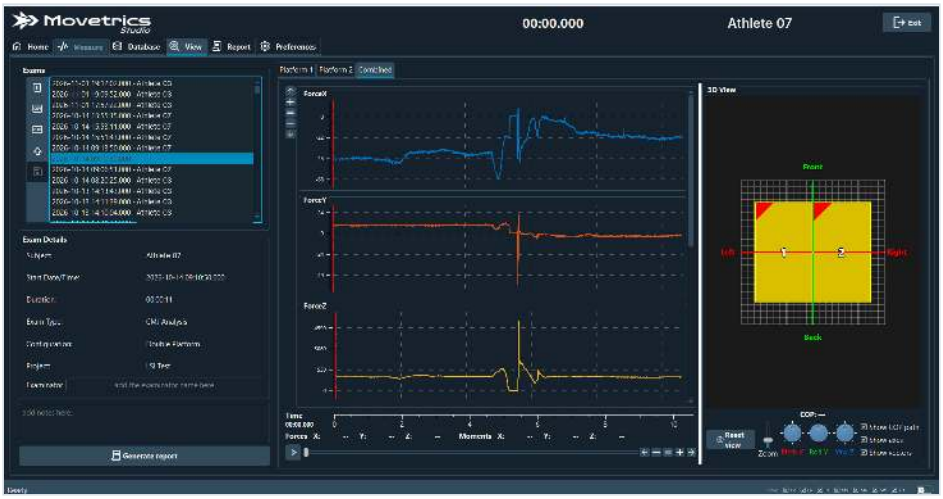
For developers

developers.movetrics.com

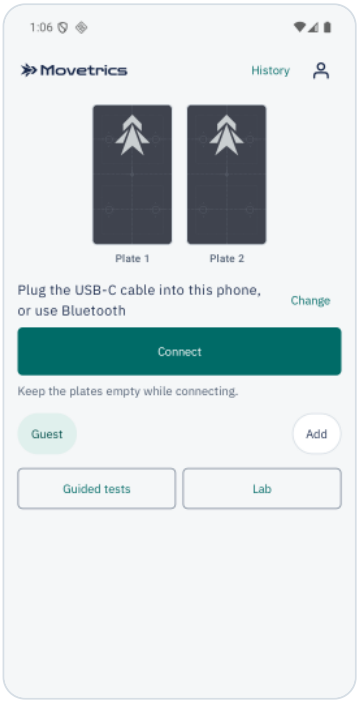
A documented, open protocol and an SDK under Apache-2.0: Python, TypeScript, MATLAB and Octave, an FDT simulator and Lab Streaming Layer. An API with tokens.

Measuring, core calculations and exporting your raw data never need a subscription. Movetrics Cloud is free to start, with paid plans for more; most AI features are part of the paid plans.

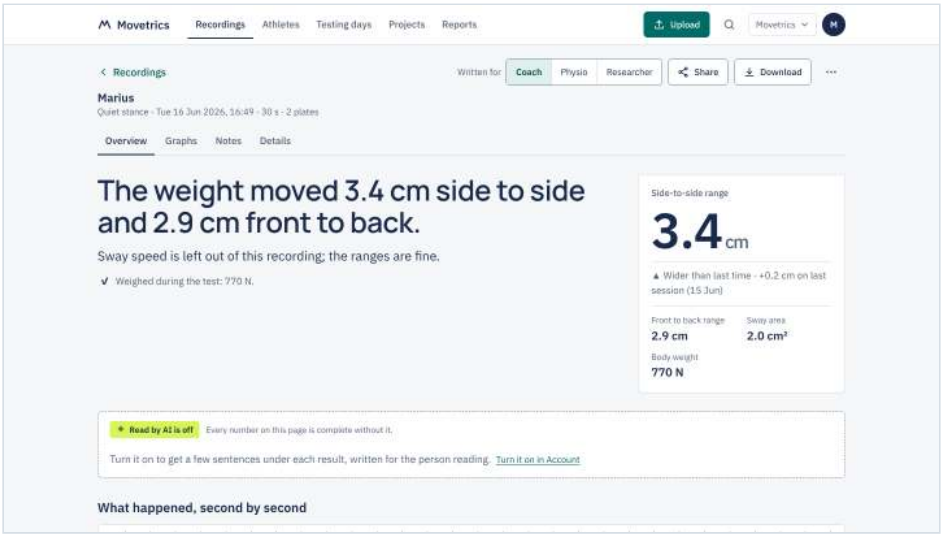
Your data is stored in the EU, with encrypted nightly backups in the EU. AI explanations are optional and processed in the US only with your consent.



Movetrics Studio for Windows. Athlete names shown as codes.



The Movetrics app on a phone.



Movetrics Cloud in the browser: a result with its method and version.

Open formats

CSV and C3D from every app, PDF reports, and the original files you uploaded.

ASK YOUR OWN AI

Which of my athletes landed more evenly on both legs this month than last month?

Athletes 03 and 07 landed more evenly in their last three drop jumps; Athlete 01 loaded the left leg more. Each value names the method that calculated it.

Make me a one-page report for Athlete 01 that I can print on Friday.

Here is a draft with the last six weeks and the method behind each result. Shall I save it as a template?

Yes. And add a note to today's jump: tested after a long run.

Saved, and the note is added. You can undo both.

Illustration. Your assistant connects to Movetrics Cloud through MCP, an open standard for AI assistants. It sees athletes as codes, reads by default and changes only what you allow. Tested with Claude; ChatGPT and other assistants that support MCP connect the same way.



Movetrics Play: step on, and the game starts.

CHAPTER 12 · MOVETRICS PLAY

More than a game

Step on a plate, and your body becomes the controller. Lean, shift your weight, push, twist, squat or jump: Movetrics Play reads every force and moment the plate measures, relative to body weight, so a child and an athlete play on equal terms.

Behind the fun runs real biomechanics. The games follow where your centre of pressure moves, how hard you push and twist, how evenly your legs share the load, how long you fly and how evenly you land. Each round ends with a result you can compare.

That is the difference from a console game. A console guesses movement from a controller or a camera. Movetrics Play reads it from measured force: the force under each foot, hundreds of times a second.

Body weight Play scales every force to the player's weight, so the same game fits everyone.

Windows 11 Movetrics Play runs on Windows 11, with a demo mode that plays without a plate.

WHAT THE GAMES READ

Six skills, read from force

Reaction
Median reaction time to a cue to push, hold, switch, twist or stomp.

Balance
Lean to steer, push to dodge, twist to carve, squat to duck.

Symmetry
How evenly left and right share the load.

Reach
How far you shift your weight towards targets in every direction.

Jump
How long you fly, and how evenly you land.

Aim
Lean to aim, push to throw, twist to curve.

HOW A ROUND WORKS

1 **Step on**
The plate takes your weight. No account, nothing to set up.

2 **Play**
Lean, push, step or jump: your movement steers the game.

3 **Your result**
Each round ends with a result for how you moved.

4 **Again**
Play the next round, and watch your result change.

A lifetime of results

Round by round, these results build a picture of how someone moves, and add up to one score that follows movement across a lifetime. It rests on what chapter 2 describes: strength, balance, walking and reaction change with age, slowly enough to miss by eye.

Why games?

Practice works only if people keep at it. Researchers who design games for rehabilitation argue that game features such as choice, rewards and clear goals can make repetitive practice more engaging, while saying that more research is needed.[37] A review of gamification for health and wellbeing found mostly positive effects, alongside mixed ones, in studies of mostly moderate quality.[38] In older adults, technology-based exercise programmes have shown high adherence.[39]

Fun to play. Read from force, not guessed.

Median The middle value: half the reactions were faster, half slower.

Relative feedback The values in the games are training feedback, not medical measurements.

37 Lohse et al., J Neurol Phys Ther 2013

38 Johnson et al., Internet Interv 2016

39 Valenzuela et al., J Geriatr Phys Ther 2018

TECHNICAL OVERVIEW · FOR ENGINEERS AND RESEARCHERS

The facts that stay true

	F1-3D	F1-3D S	FDT
THE PRODUCTS			
Size and mass	600 × 350 × 30 mm, 20 kg	400 × 280 × 30 mm, 10 kg	27 × 21 × 14 cm, 1.75 kg
Measures	Fx, Fy, Fz, Mx, My, Mz	Fx, Fy, Fz, Mx, My; Mz on request	Multiple plates on one clock
Top	8 mm steel, R12 anti-slip; aluminium option	R12 anti-slip	–
Install	Portable on a flat, rigid floor, or flush in a recess frame	Portable; two join into a 40 × 56 cm platform	–
Connect	One cable to the FDT for data and power	One cable to the FDT	USB-C, Bluetooth LE, 16 analog outputs (±10 V), Sync In and Out (TTL 3.3 V)
Use	Indoors; CE	Indoors; CE	CE; rechargeable
KEY FIGURES			
Nominal ranges	Fz 8,000 N; Fx, Fy ±2,000 N; Mx ±600, My ±400, Mz ±300 N·m	Fz 4,000 N; Fx, Fy ±1,000 N; Mx ±200, My ±140 N·m	–
Centre of pressure	5 mm maximum error	5 mm maximum error	–
Resolution	1 N and 1 N·m; 24-bit delta-sigma converters	the same	–
Samples per second	2,000 with one or two plates on an FDT; 1,000 with three or more	the same	One clock; timestamps in 0.1 ms steps
Natural frequency	509 Hz, the first mode of the plate's own structure; mount it rigidly for the best results	–	–
Calibration	Certificate for each plate; every 12 months	the same	–

Read the product sheets

Every figure with its conditions: safe overloads, sensor layout, the coordinate system and moment reference, analog scaling, power, what is in the box and system requirements. One sheet per product: F1-3D (2 pages) · F1-3D S (2 pages) · FDT (2 pages) · Movetrics Studio · Movetrics app · Movetrics Cloud · Developers · Movetrics Gait · Movetrics Play. Figures for the FM-3D on request.

Check us. Raw data in CSV and C3D, an open protocol and a simulator, and every Cloud result names its method and version. Nominal ranges are the ranges we specify; the natural frequency on a real floor is lower, as page 19 explains.

movetrics.com/specs

SOURCES, IN ORDER OF APPEARANCE

To find a source, type doi.org/ followed by its DOI into a browser, or give the reference to your AI assistant.

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KEEP GOING

Where to go from here

Read

Biomechanics and Motor Control of Human Movement, by David A. Winter, and Research Methods in Biomechanics, by Gordon Robertson and colleagues.

Ask

Photograph a page and ask your AI assistant to explain it at your level, or to suggest the next paper to read. We send the PDF of this booklet on request.

Share

Pass it on to a colleague, or take one chapter to your next team meeting.

Try

Ask for a demonstration, and stand on a plate yourself. Call +49 15678 616 529 or write to contact@movetrics.com.

movetrics.com
contact@movetrics.com
+49 15678 616 529

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Support in English, German, Italian and Arabic, by email and phone.

movetrics.com/contact

Movetrics systems measure forces and moments, calculate metrics and display them, for sport, research, education, and practitioner-led training and rehabilitation. They are not medical devices. They do not diagnose, treat, monitor or predict any disease or condition, and their results do not replace professional judgement.

Product photos: real photographs of the products; settings, backgrounds and the TV were created or edited with AI. Screens show our own software with example data. Figures are illustrations unless stated otherwise. Edition 1.

Movetrics

Movement, understood.

MADE IN GERMANY