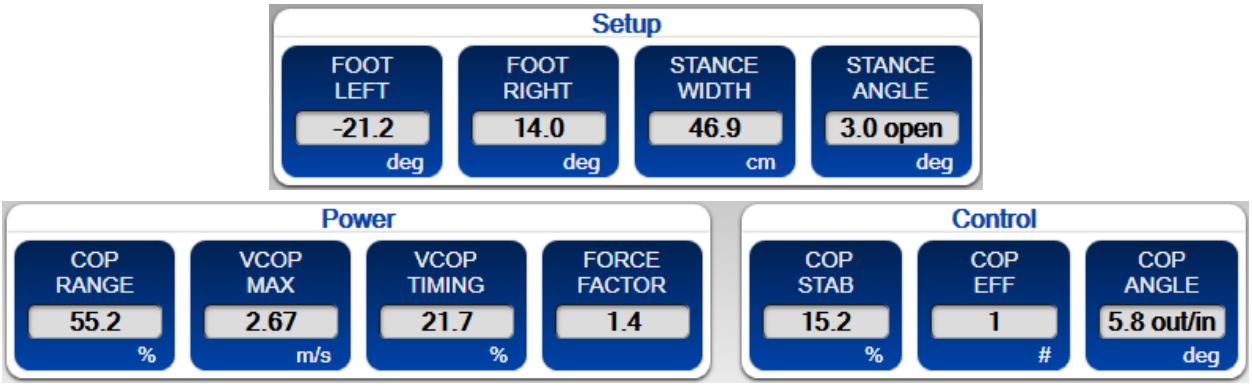
Science & Motion Sports

SAM BalanceLab

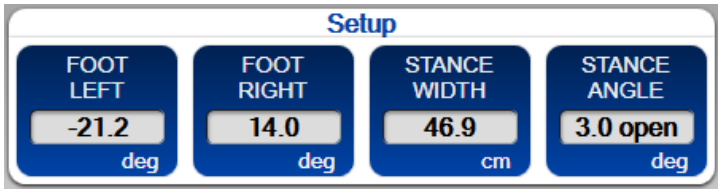
SAM BalanceLab 3

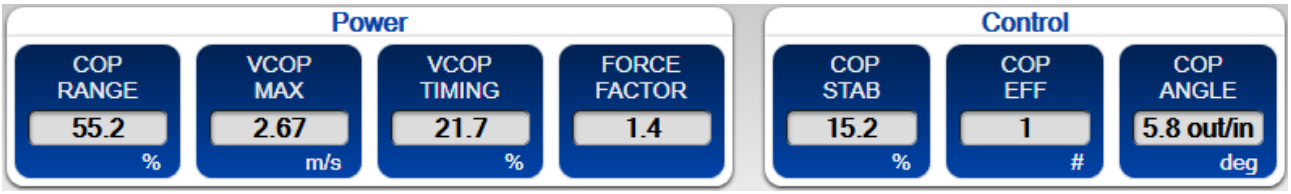
Ultimate Edition

Performance Parameters Manual



Performance & Setup Parameters





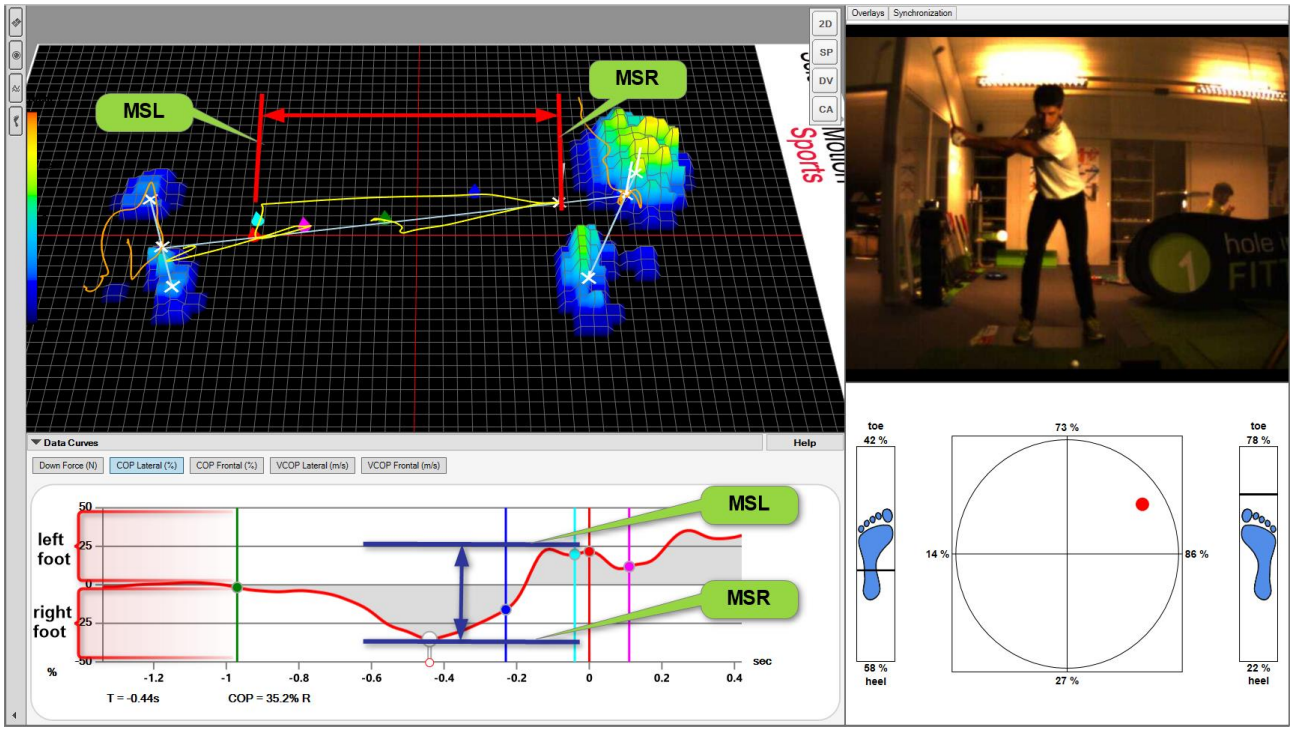
Category	Parameter	Short Description
POWER	COP RANGE	The range between the maximum lateral weight shift to the right and the maximum shift to the left
	VCOP MAX	Describes the maximum lateral COP speed in right/left direction during the downswing, which is the maximum change of lateral COP position per time.
	VCOP TIMING	Describes the time of the maximum lateral COP speed (see VCOP MAX) in the downswing. The timing is calculated relative to the time between TOB and Impact.
	FORCE FACTOR	Describes the amount of downforce at Impact relative to the reference downforce at Start.
CONTROL	COP STAB	Describes the COP stability in frontal direction. It shows the range between the maximum weight shift to the toes and the maximum shift to the heels
	COP EFF	Describes the efficiency of the lateral COP shift by counting the number of changes in direction of the lateral COP movement between Setup and Impact
	COP Angle	Describes the main direction of the COP movement between Start and Impact relative to target direction.
SETUP	FOOT LEFT	Indicates the angle of the left foot relative to the force plate orientation (target) at *Setup*. Negative angles mean open orientation with the foot pointing to the left.
	FOOT RIGHT	Indicates the angle of the right foot relative to the force plate orientation (target) at *Setup*. Positive angles mean open orientation with the foot pointing to the right.
	STANCE WIDTH	Measures the distance between the feet at *Setup* position.
	STANCE ANGLE	Measures the orientation of the feet line relative to the force plate orientation (target) target at *Setup* position.

COP RANGE

POWER

The parameter **COP RANGE** describes the range between the maximum weight shift to the right (MSR) and the maximum shift to the left (MSL) in lateral direction (left / right) during the swing. Data from *Start* to *Impact* will be considered.

To load and unload your body and to transfer this energy to the club, a lateral weight shift is necessary. If the weight shift is too small then the corresponding golf swing lacks of power and is controlled by the upper body. A big lateral weight shift range means, that you are actively using your lower body to build up power and to accelerate the club properly.



In the lower left data curve the time course of the lateral COP position is displayed. This player reaches his maximum weight shift right (MSR=-35%) about 200 ms before the top of backswing *TOB* (blue line). The maximum shift left (MSL=24%) is reached shortly before *Delivery* (light blue line). The total lateral **COP Range** for this player is then 35%+24% = 59%

A COP position of -35% from the center to the right corresponds to a lateral weight distribution of 85% at the right foot (50% + 35%) and 15% at the left foot.

Recommended data:

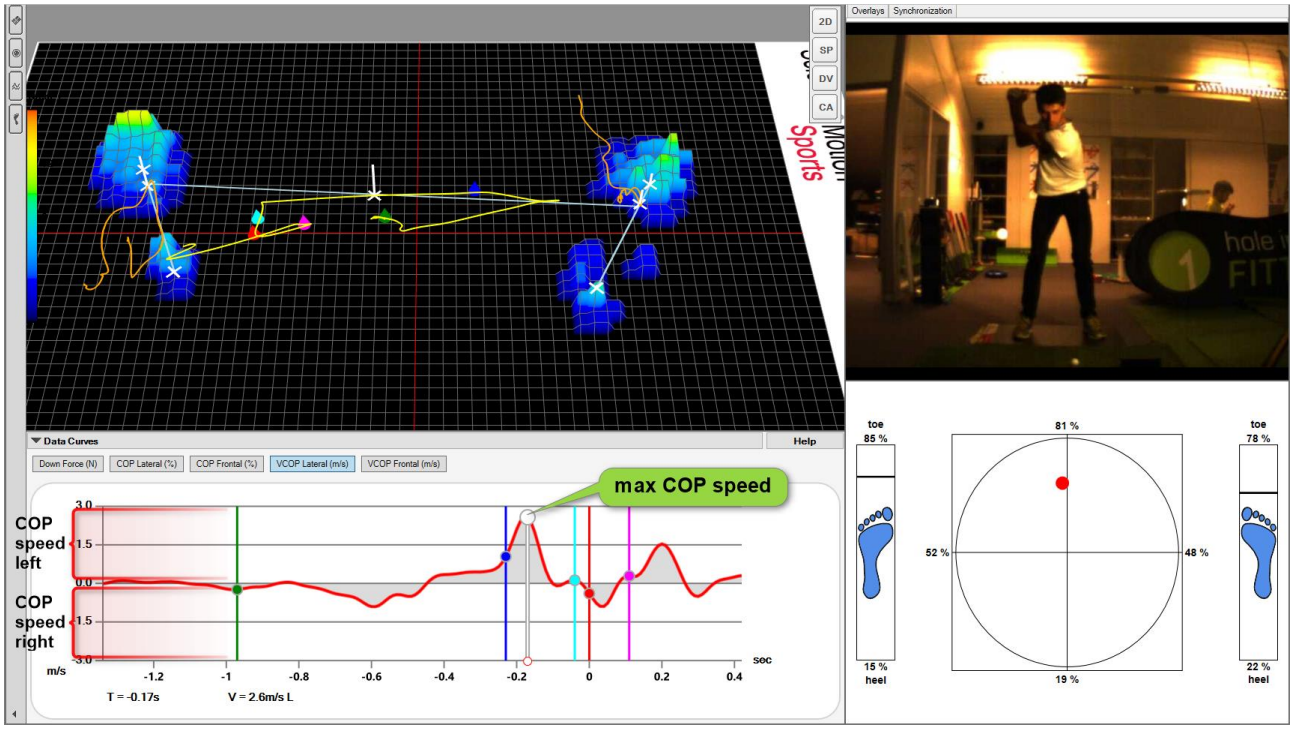
COP RANGE [%]	Reference	Tolerance Range
Driver	60%	55% - 65%
Iron	50%	45% - 60%

VCOP MAX

POWER

The parameter **VCOP MAX** peak describes the maximum lateral COP speed in right / left direction during the downswing, which is the maximum change of lateral COP position per time.

The speed of the lateral weight shift is important to create maximum power. The higher the COP speed, the faster the COP is moving. A high lateral COP speed peak at begin of downswing corresponds to a distinct activation of the lower body and helps players to increase their clubhead speed and thus their total distance.



In the lower left data curve the time course of the lateral COP speed is displayed. This player reaches maximum COPX speed (2.6 m/s) shortly after the top of backswing *TOB* (blue line). After VCOP Max the velocity steeply drops and is zero at *Delivery* (light blue), and is even negative through *Impact* (red line). At *Delivery* the COP movement has stopped allowing the upper body to start to accelerate.

Recommended data:

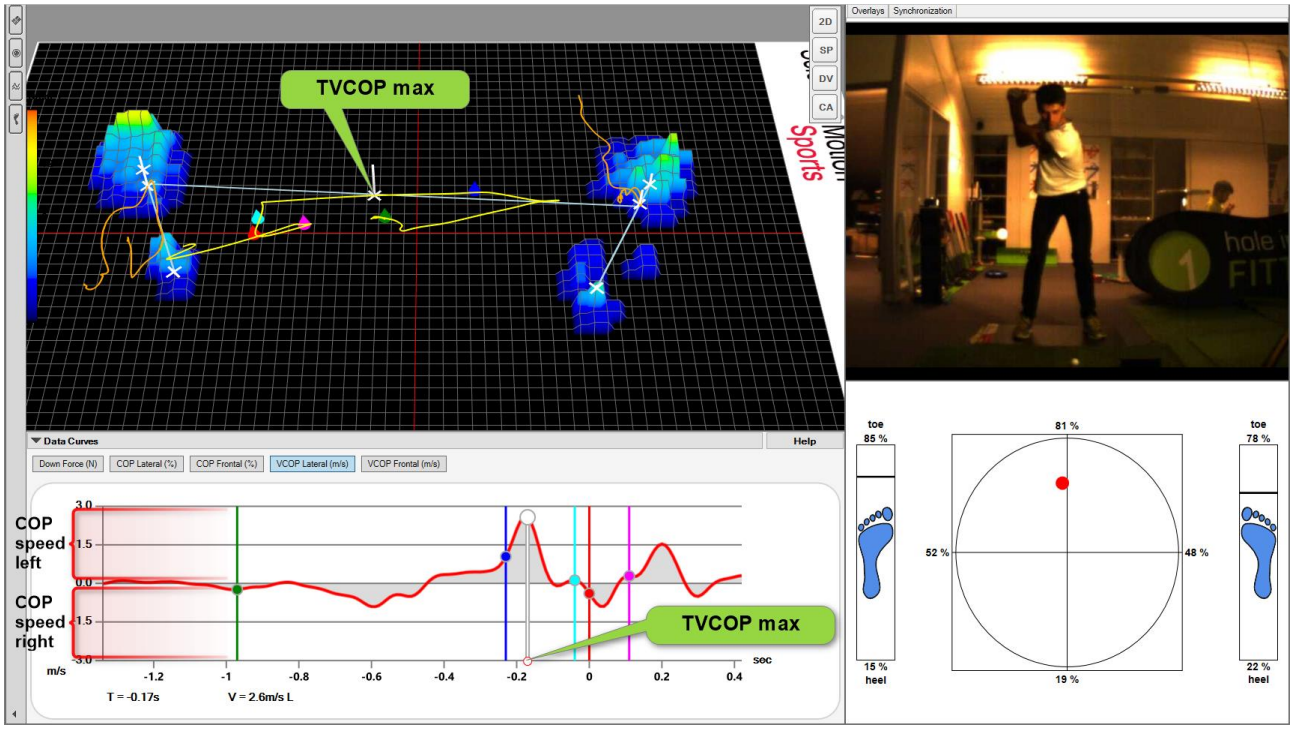
VCOP MAX	Reference	Tolerance Range
Driver	3.0 m/s	2.5 m/s – 4.0 m/s
Iron	2.0 m/s	1.5 m/s – 3.0 m/s

VCOP TIMING

POWER

The parameter **VCOP TIMING** describes the **time** of the maximum lateral COP speed (see VCOP MAX) during the downswing. The timing is calculated relative to the time between *TOB* and *Impact*.

Not only the amount of maximum lateral weight shift speed is important, also the timing of the lateral COP speed maximum is important to create maximum power. If the maximum COP speed is reached too early or too late in the downswing, then the swing rhythm and the sequence of the kinematic chain can be affected. As consequence, the quality of impact and the maximum clubhead speed can suffer.



In the lower left data curve the time course of the lateral COP speed is displayed. Shortly after the top of backswing *TOB* (blue line) this player reaches his maximum lateral COP speed (red arrow). On a relative time scale from top of backswing *TOB* (0%) to *Impact* (100%) this player reaches VCOP Max after 22% of this time span. The more dynamic a player is moving, the closer VCOP Max will normally be to *TOB*, and the lower this timing parameter will be.

Recommended data:

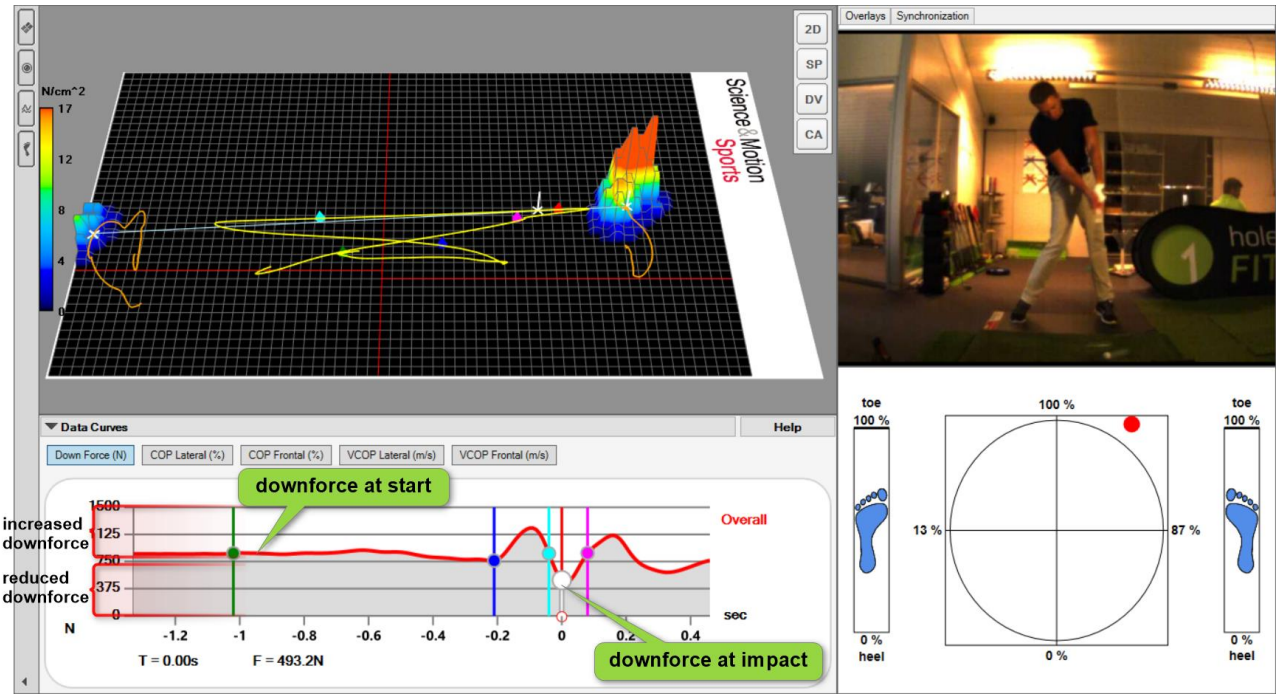
VCOP TIMING	Reference	Tolerance Range
Driver	20%	10% - 25%
Iron	30%	20% - 40 %

FORCE FACTOR

POWER

The parameter **FORCE FACTOR** describes the amount of downforce at *Impact* relative to the reference downforce at *Start*. The more the player is moving up through impact, and thus reducing the downforce, the lower the factor will be.

At top of backswing *TOB* a better golfer is slightly bending his knees to be able to squeeze off with the rear foot to move his body up through impact. Squeezing off will first result in a downforce peak and then after the body was moving up will result in a downforce minimum, which normally is very close to *Impact*. Moving up through impact can help to significantly increase the speed of the clubhead (for the driver). Moving up through impact can also increase the angle of attack.



In the lower left data curve the overall downforce (corresponding to the overall down pressure) is displayed. The downforce at *Setup* (green line) for this player is about 860N. The downforce maximum in the downswing is 1130N and the downforce at *Impact* (red line) is only about 490N. The corresponding FORCE FACTOR is then 490/860 = 0.57, meaning that at impact the downforce is only 57% of the reference downforce at setup. The lower the Force Factor the more the body is moving up to impact.

Recommended data:

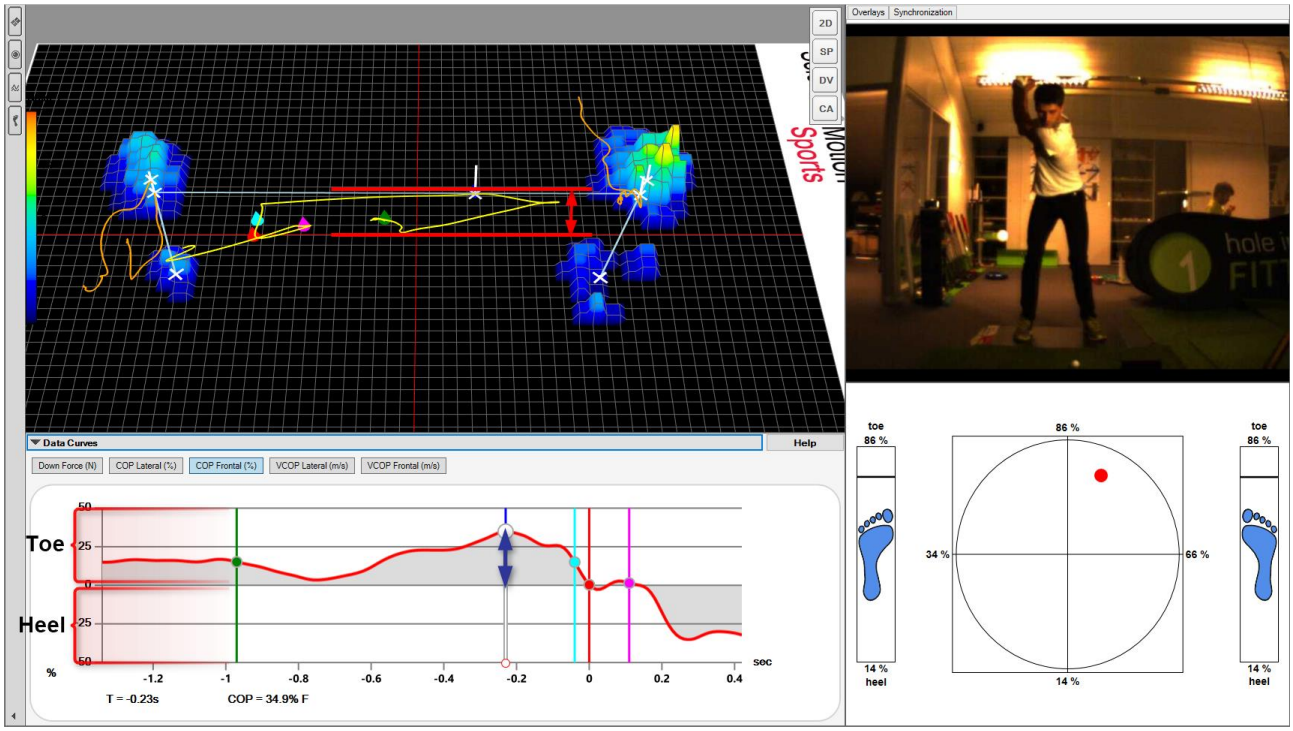
FORCE FACTOR	Reference	Tolerance Range
Driver	0.8	0.6 – 0.9
Iron	1.0	0.9 – 1.1

COP STAB

CONTROL

The parameter **COP STAB** stands for COP stability. It describes the range between the maximum weight shift to the toes and the maximum shift to the heels in y-direction (frontal). Data from *Start* to *Impact* will be considered.

For a stable and consistent swing it is necessary to minimize the weight shift and imbalance between heels and toes. Inappropriate weight shift into front/back direction often ends up in off center hits and an improper club path. The most likely problem is having too much pressure at the toes which is very often the result of instable hips (--> early extension).



In the lower left data curve the time course of the frontal COP position is displayed. In this example the frontal COP curve stays above the zero line between *Start* (green line) and *Impact* (red line), indicating that the weight is always more at the toes. The minimum COP value is 3.5% towards the toes and the maximum is 35% towards the toes. The **COP STAB** for this player is then 35%-3.5% = 31.5%.

A COP position of 35% from the center to the toes corresponds to a frontal weight distribution of 85% at the toes (50% + 35%) and 15% at the heels.

Recommended data:

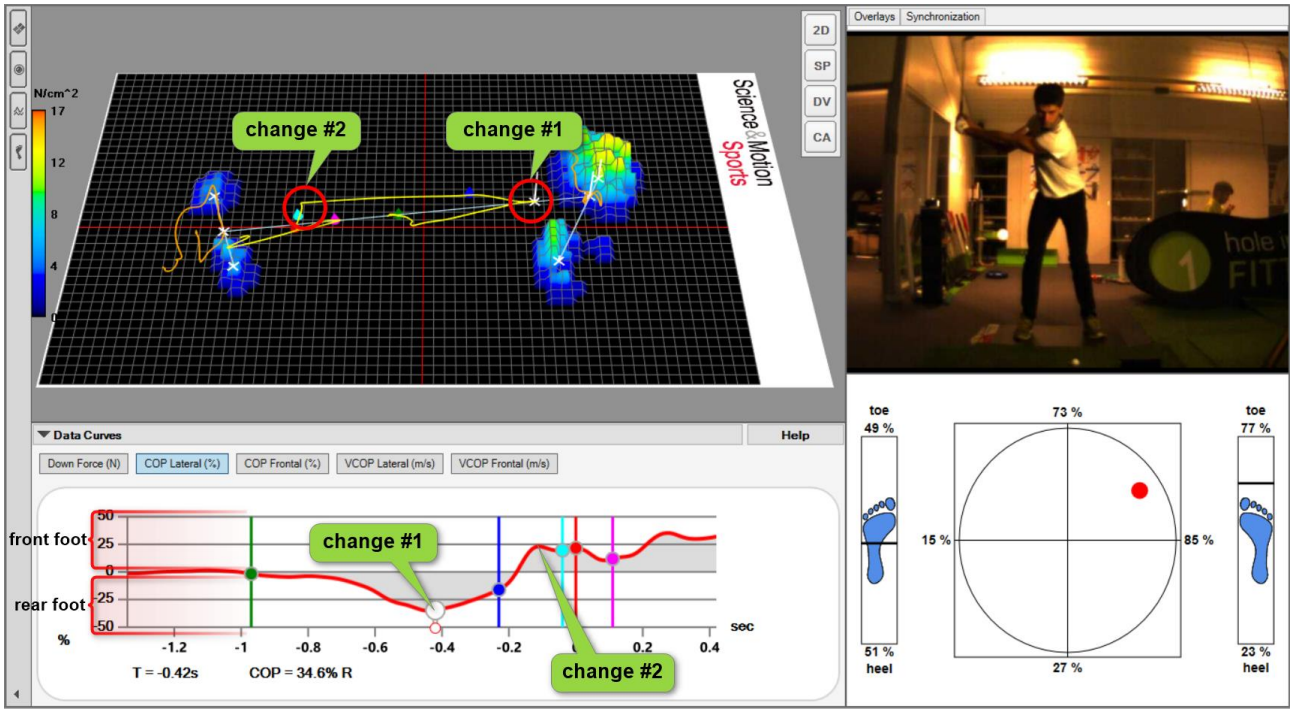
COP STAB [%]	Reference	Tolerance Range
Driver	25%	15% - 30%
Iron	20%	10% - 25%

COP EFF

CONTROL

The parameter **COP EFF** describes the efficiency of the lateral COP shift by counting the number of changes in direction of the lateral COP movement between *Setup* and *Impact*.

In an efficient golf swing the different parts of the body need to move and accelerate into the same direction, in particular in the downswing. Changing the direction of the COP movement in frontal and/or lateral direction (e.g. by shifting the lower body to the front and shifting the upper body to the rear foot at the same time) will cost power and thus will reduce the efficiency of the swing and the clubhead speed.



In the lower left data curve the time course of the lateral COP position is displayed. Better players only show two changes in COPX direction: The first change between *Start* and *TOB* is a consequence of reaching the maximum shift right (MSR). The second change around the *Delivery* position is a consequence of reaching the maximum shift left (MSL). Many players use this second change of direction at MSL around *Delivery* to stop accelerating their lower body and to start accelerating the upper body (hips, shoulders, arms, wrists, club). Worse players sometimes show 5 changes in COPX direction. High numbers in COP EFF indicate an inefficiency of the swing and will not allow to reach the optimal maximum clubhead speed.

Recommended data:

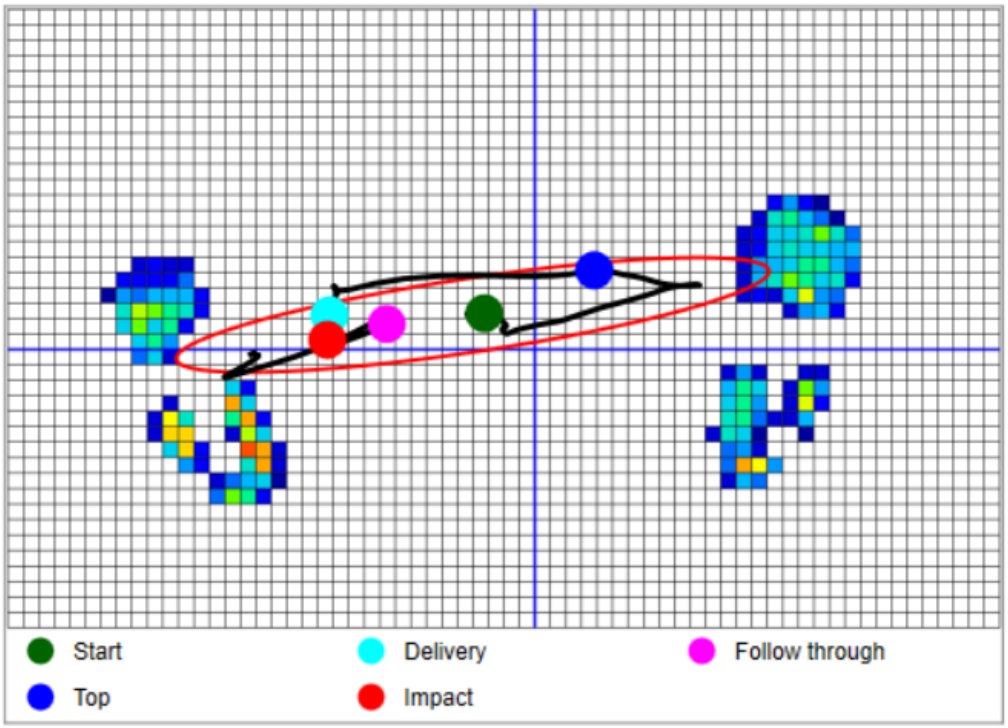
COP EFF	Reference	Tolerance Range
Driver	2	1-2
Iron	2	1-2

COP ANGLE

CONTROL

The parameter **COP ANGLE** is calculated by fitting an ellipse to the COP curve and describes the direction of the COP movement between *Start* and *Impact*. The lateral extension of the ellipse corresponds to the parameter COP RANGE and the vertical extension of the ellipse corresponds to the parameter COP STAB. The ellipse angle corresponds to the overall direction of the COP movement, and can be open (IN/OUT), neutral or closed (OUT/IN).

The ellipse of the COP curve of a player indicates the direction and general characteristic of a player's weight shift. A positive ellipse angle (outside to inside) is often a consequence of an out to in swing path. The result might be a fade, pull, pull hook or slice.



In this graph the COP Ellipse is displayed in red color. As this player is moving from the outside to the inside his COP Ellipse angle is positive. From the top of backswing towards impact he is shifting his weight from the right toes into direction of the left heel. Such a moderate outside/in COP pattern can improve the accuracy of a shot but might not maximize the shot distance. It is more often seen for players to prefer to hit a fade instead of a draw. To create more power and to hit the ball further (especially with the driver) the Ellipse has to be negative (inside/out) resulting more in a draw.

A positive Ellipse Angle corresponds to an outside/in movement of the COP resulting more in a fade. A negative Ellipse Angle corresponds to an inside/out movement of the COP resulting more in a draw.

Recommended data:

COP ANGLE	Reference	Tolerance range
Driver	-6 deg (out)	-2 to -10 deg (out)
Iron	-4 deg (out)	0 to -8 deg (out)

FOOT LEFT / FOOT RIGHT Angles

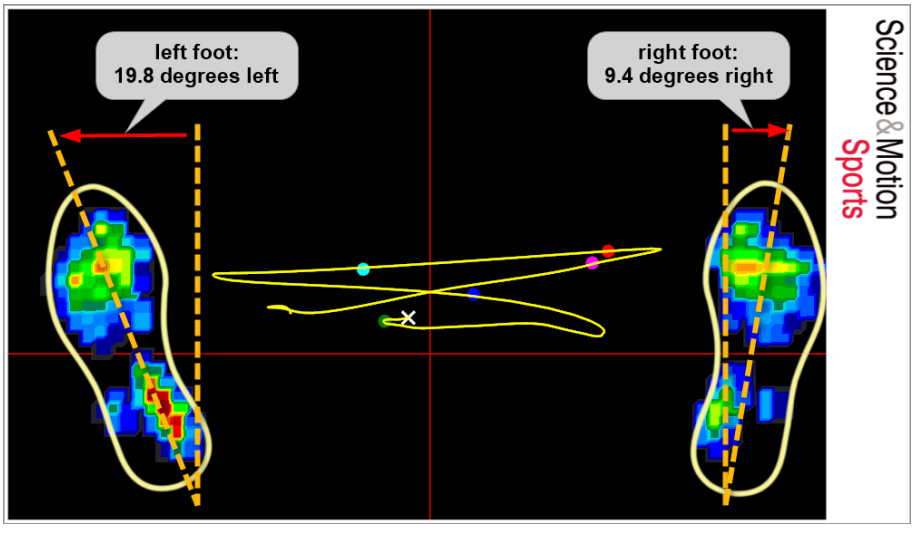
SETUP

The parameter **FOOT LEFT** and **FOOT RIGHT** indicates the respective foot angle relative to the force plate orientation, which should match to the target line. The foot pressure pattern is fitted into a surrounding box during the calibration position at *Setup*. Negative angles mean that the feet are pointing relatively left of square, positive angles mean that the feet are pointing relatively right of square.

In a standard setup position both feet are aligned so that they are parallel to each other while at the same time perpendicular to the target line. Having the feet parallel promotes consistency through the fact that the feet are always positioned the same way which is also more easy to replicate. It also seems easier to align the stance with the target line. A drawback of a parallel foot position is that is may constrain the swing amplitude which is especially true for golfers with flexibility issues.

Opening the left foot (to the left) tends to rotate the hips slightly towards the target. This will lead to an outside-to-in swing path that will promote a Fade or at least left-to-right sidespin. One advantage of opening the left foot is that there is more room for body rotation occurring past Impact. This will lead to a fuller and easier to perform follow through. However, creating more room for the follow-through happens at the expense of room available for the body's rotation back, and the backswing tends to be somewhat reduced in amplitude.

Opening the right foot (to the right) tends to close the hip line in relation to the target line. This promotes an inside-to-out swing path and promotes a draw or at least right-to-left sidespin. Opening the right foot creates more room for the backswing to operate in and leads to a more comfortable position at the top of the swing. This leads to a fuller backswing amplitude that can help to generate more clubhead speed and more distance. However, creating more room for the backswing is achieved at the cost of room available for the follow-through. Opening the right foot can be helpful to players with flexibility issues that restrict how far back they can turn their hips and shoulders.



This player has his left foot 19.8 degrees open (turned to the left) to the target line (if the force plate has been properly aligned to the target). The right foot is 9.4 degrees open (turned to the right) to the target line.

STANCE WIDTH

SETUP

The parameter **STANCE WIDTH** indicates the distance between the feet at the calibration position during *Setup*. More precisely, the width of the stance is measured between the center of each foot.

A normal stance width (distance between the feet) matches the width of the shoulders. The outside of the shoulders should line up with the middle of the feet. This is also where the width of the stance is measured with SAM BalanceLab. This neutral stance width can be used for most normal golf shots. Nevertheless, specific situations might require to change the stance width.

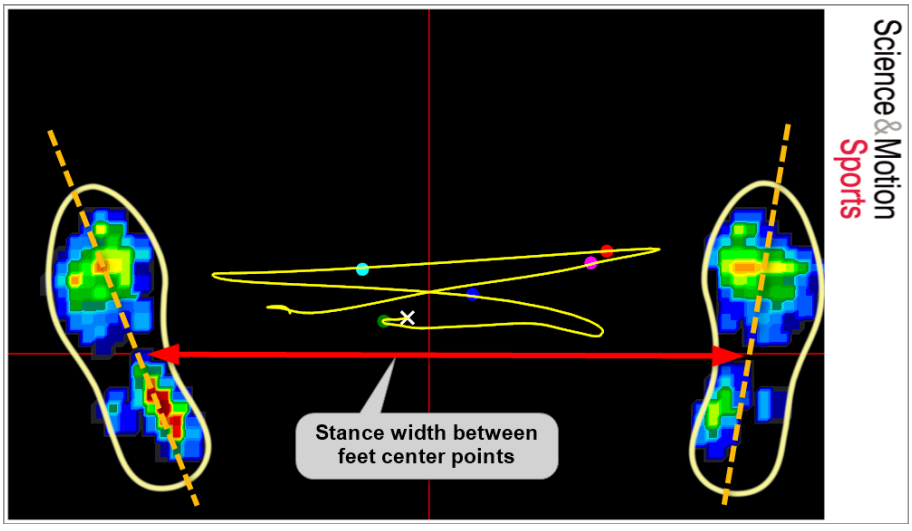
Wide Stance

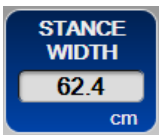
Generally it is recommended to adopt a wider stance whenever you are using a longer club that demands a wider and full swing. Specifically drivers and woods are best used with a wider than normal stance. A wider stance lowers the center of gravity slightly, increases stability and improves connection to the ground, which is particularly helpful for power shots. A wider stance also helps to maintain balance if playing on windy days or if standing on a slope.

Biomechanically, lowering your center of gravity will also tend to lower the bottom of the swing arc and thus can result in hitting fat shots. This can be helpful if hitting bunker shots, where the club is meant to travel below the ball. As a downside, a wide stance can inhibit hip and shoulder rotation which is often compensated by swaying resulting in unwanted consequences.

Narrow Stance

Certain types of shots can require a more narrow stance. A narrow stance features a higher center of gravity, which makes it a more unstable position. As such, it is best used with very delicate shots that require the small swing amplitudes. For example, wedge shots or small chips from tight lies can be best performed with a narrow stance.





This player has a stance width of 62.4 cm which is a slightly increased stance width. This is the preferred setup for a driver shot. For a normal stance a width of about 50 cm would be assumed.

STANCE ANGLE

SETUP

The parameter **STANCE ANGLE** indicates the orientation of the feet relative to the target at the calibration position during *Setup*. The orientation is calculated by connecting the center of the feet with a line and by measuring the angle of this line relative to the orientation of the force plate, which should match the target line.

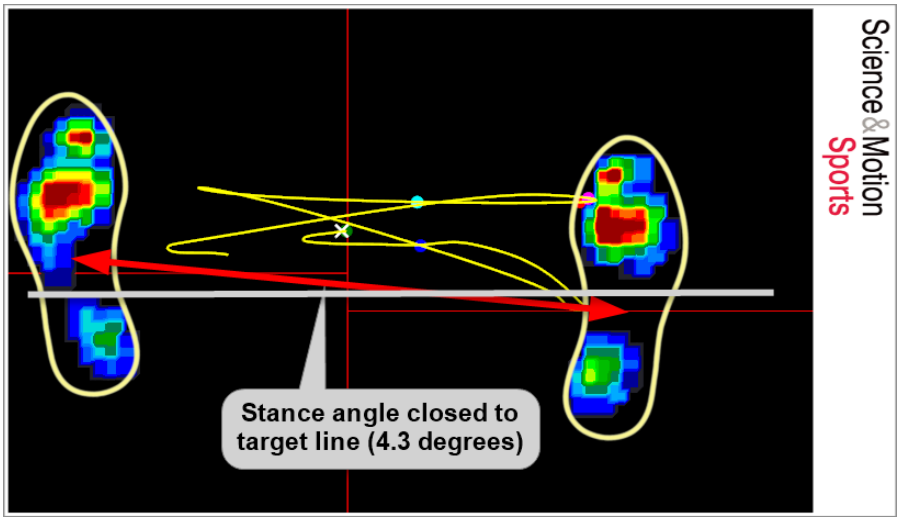
A square stance with the feet parallel to the target line promotes a swing plane which is parallel to the target line and a corresponding natural inside-square-inside swing path, which supports a straight ball with only little sidespin. A square stance also leaves the loft of the club unaltered. This means that the ball should launch with the angle and spin the club was designed for.

Open Stance

An open stance is one where the orientation of the feet line is to the left of the target. In a proper open stance the complete setup is rotated slightly to the left, but the feet are still parallel and in line. Using an open stance will normally open up the clubface relative to the swing plane, and will also increase the loft of the club. As a consequence the shots will be higher in altitude than normal. Although the clubface at impact might still be square to the target it will now be open in relation to the outside-in swing path which will result in a ball with left-to-right sidespin and a corresponding Fade or Slice ball flight curve.

Closed Stance

A closed stance is one where the orientation of the feet line is to the right of the target. In a proper closed stance the complete setup is rotated slightly to the right, but the feet are still parallel and in line. Using a closed stance will normally close the clubface relative to the swing plane, will also decrease the loft of the club. As a consequence the shots will be lower in altitude than normal. Although the clubface at impact might still be square to the target it will now be closed in relation to the inside-out swing path which will result in a ball with right-to-left sidespin and a corresponding Draw or Hook draw ball flight curve.



This player has an open STANCE ANGLE of 7.8 degrees to the left of the target. An open stance will promote a Fade shot and an increased launch angle.