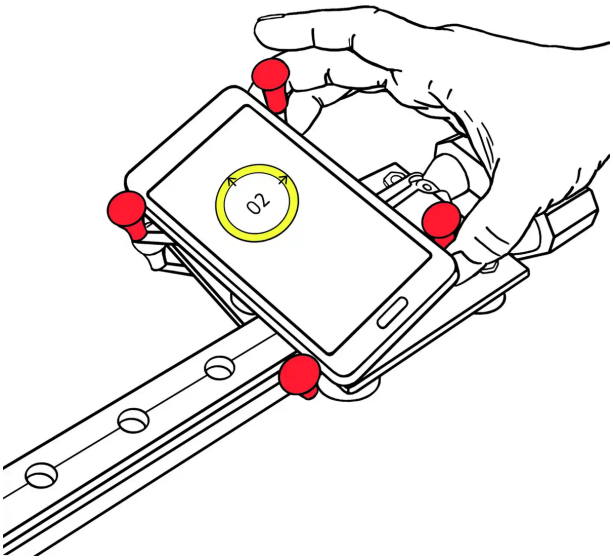
Measuring acceleration

Can you use your smartphone to measure how hard a train is braking?



Attach your smartphone to the small wagon with the x-holder.

Turn on your smartphone's accelerometer, for example via the phaeno Entdecker-App.

Activate the coordinate corresponding to the small wagon's direction of movement.

Gently give your smartphone a push, let it roll, and observe the measured acceleration values.

What do you measure when you turn the smartphone or mount it on the wagon at an angle? You can turn the x-holder using the clamp screw underneath it.

When you give your smartphone a push, you measure an acceleration, i.e. a change in speed over time. When your smartphone becomes faster over time, i.e. when given a push, the measured acceleration is positive because the speed increases over time. When it brakes, you measure a negative acceleration accordingly. You can also observe this process and measure it using the app the next time you take the train or bus.

Using the phaeno Entdecker-App you can measure your smartphone's acceleration in all three spatial directions x, y, and z (Fig. 1). Try to find out in which direction these are from your smartphone's point of view by accelerating your smartphone in different directions.

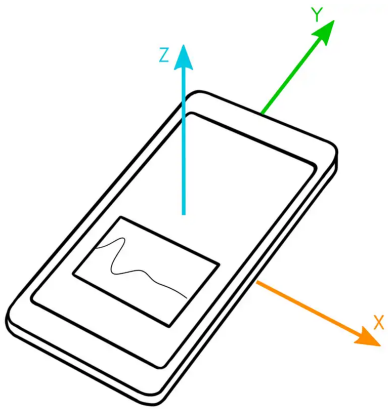


Fig. 1: The coordinate system in which the smartphone measures the acceleration.

But how does the smartphone measure acceleration? Smartphones do not offer space for large experimental setups as we may know from physics lessons. Instead, components and sensors were developed that are only 0.001 to 1 mm in size, so-called micro-electro-mechanical systems. Accelerometers consist of three silicon combs on springs, one for each spatial direction. When the smartphone, and thus the sensor, is accelerated, a force acts on the combs, causing them to bend. This bending can be converted into an acceleration value.

By the way, the accelerometer is used to align the smartphone display. The accelerometer shows in which direction the ground is located from the smartphone's point of view since the sensor measures the constant force of gravity. You do not need to calculate the force of gravity from the data gathered during your experiments as the phaeno Entdecker-App does this for you.