

TrailerTrack gyro optimization

Basic idea

We want to automatically adjust the right rearview mirror / camera, so the driver always have the rear right corner of the trailer within sight, while performing a right turn. This is done by measuring the king pin angle, and adjusting the camera view accordingly. (The king pin is the pin that connects the trailer to the truck)

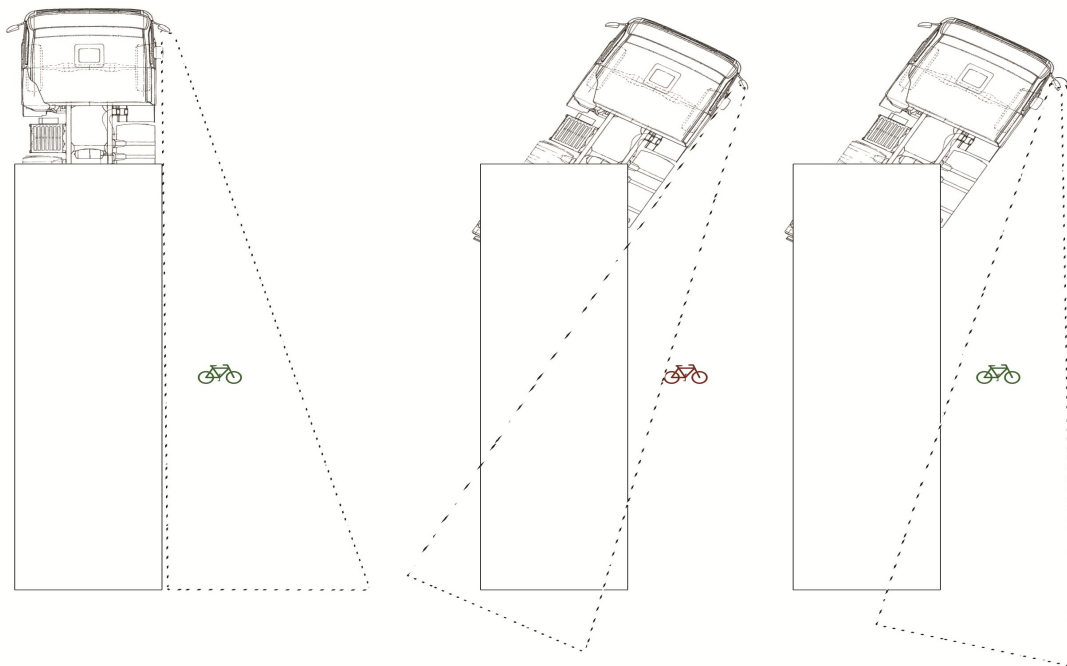


Illustration 1: Side rearview mirror view: 1. Driving straight ahead. 2. Performing a right turn without adjustment. 3. Performing a right turn with adjustment

Usage

Currently we are using 2 devices with a 1 axis gyroscope and a microprocessor. We use them to measure the current heading of the truck and trailer in order to calculate the king pin angle. One device is located inside the truck where its normally warm and well protected from shocks vibrations due to the trucks suspension. The other device is mounted directly on the trailer without any weather and shock protection. They are connected via a serial connection in order to exchange data. Our system also contains a main unit doing the calculations based on device headings, and a panning camera.

Sensor noise

The output from an accelerometer shows how many g's its being affected by. When lying steady I

will show a one g in the down direction, and the other directions should be zero. There is however some noise in the output, resulting in the zero and one g might contain a small. The output could be -0.01 and 1.01 respectively.

All gyroscopes drift. I.E. if you put a gyroscope steady on a table, the outputted heading will slowly move to either side. The direction and speed of this drift is largely dependent on the ambient temperature. Hence it is needed to periodically to measure the drift when the device is not moving in order to reduce drift. It may also be needed to adjust the “gain” of the gyroscope in order to read a 360 deg output when moving the gyroscope in a full circle.

Problem

There are two main problems with this solution: both gyros needs to be level, and gyro drift quickly affects the precision. Our plan is to use 2 devices containing 3 axis gyroscope and 3 axis accelerometer. This eliminates the need for the devices to be level, which is a problem on the trailer, and it allows us to use the accelerometer data to compensate for the gyro drift while driving, and to measure how much the sensor is tilted relative to horizontal plane.

There is an embedded algorithm in the sensor we are using that provides far lower gyro drift that what we get if we read the raw gyro values, but its not suited for our usage because it tries automatically to determine when the sensor is at rest and then performs a calibration. This does not always work due to the vibrations on the trailer. We are measuring the current speed and handbrake status, so we know when the sensors are at rest and calibration can be performed. The speed sensor is used to sense when the truck is stopped (gyro output is frozen), and when moving faster than approx 30 kmph. When driving faster than this the truck and trailer is almost always aligned which is used to turn the camera to the initial position, ignoring the gyroscope output.

Question: How to merge 3 axis gyroscope and 3 axis accelerometer sensor input data in order to get the lowest gyro drift on each device?

Question: Can accuracy be improved by sharing sensor data. E.G. let sensor 2 see sensor 1 gyro and accelerometer data, and vice versa.

Question: Can the accuracy be improved by using a compass/magnetometer, or will all the metal, and wires with possible high currents nearby make it unreliable.

Question: Is it possible to reliably use only the accelerometer data to detect when the truck and trailer is aligned (moving in the same direction)? This could improve the accuracy of the initial camera position.

For further information visit our homepage

www.trailertrack.dk

and watch this video on YouTube

<http://youtu.be/tiiMNoFZiZs>