

---

# Exploring Different Ways of Simulating Steering for Motorcycles

Christian G. Bäverstrand<sup>1,2</sup>.

<sup>1</sup>Chalmers University of Technology; garfve@chalmers.se; <https://orcid.org/0009-0008-0317-8505>

<sup>2</sup>Tenstar Simulation AB; christian.baverstrand@tenstarsimulation.com

---

Submitted: 25/02/2023

Revised: 25/06/2023

## Abstract:

Having tested a few different ways of controlling motorcycle simulators on riders with different backgrounds, it is apparent that all riders do not have the same expectation on how a motorcycle simulator should be controlled. The general idea that is taught in driving schools is that you use counter steering to turn the motorcycle. Slightly simplified this means you push the handlebars in the opposite direction of the turn. This makes the bike lean and the geometry of the tires makes the motorcycle turn. This can also be done by shifting the bodyweight of the rider but that is much more inefficient. Most riders trained in recent years are aware of the concept of counter steering, but untrained riders or experienced older riders are not. It seems you can't presume that if you replicate the physics of counter steering, all riders that can drive a motorcycle in real life should manage riding also the simulated motorcycle. Surprisingly many drivers just turn the handlebars the way they want to go as if it were a car they were driving. Why is this? The physics of driving a motorcycle is the same for everyone, so how can the driving technique be so different? Of the designs I have tried, the one that seems to be intuitive for all lever riders is the swivel type. It's where handlebars are fixed a bit under the center of rotation. It's similar to what the Honda Riding trainer does. The motion of steering resembles how the motorcycle would lean rather than replicating steering with the handlebars. That works well unless the aim of the simulator is to train riding technique.

The application of a counter steering control solution could be used for simulators for researching driver behavior. It could also be used for teaching new riders the concept of counter steering without risk of injury.

The most recent model I created utilizes load cells for sensing torque in the handlebars and servos to feedback the angle of the steering from the bike model simulation. To be able to use the controller for any simulator software, even those without support for counter steering input, the output from the controller is desired lean angle. All calculations including acceleration and braking are taken into account in the algorithm.



**Figure 1 - A picture showing the left handlebar with a white arrow marking the torque sensing load cell.**

Validation is planned to be done by letting drivers with different backgrounds maneuver a slalom course with a swivel type controller and a counter steering emulating controller.