
Development of the Rider-Balanced Fytssimulator

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Abstract:

While the number of fatal car accidents has decreased over the past years, in half of the European countries, the number of bicycle accidents has increased, even without considering the unreported accidents in which no other road users are involved (European Commission, 2020). In each of the past three years in The Netherlands, more people died in bicycle accidents than in car accidents (Statistics Netherlands, 2023). Also, cyclists are the largest group by far involved in severe non-fatal accidents, a number that is also still increasing (Bos et al., 2022). Loss of balance is a major contributor to cycling accidents. To be able to study events leading up to a fall, there is a need for a bicycle simulator that is balanced by the rider by steering and leaning very similarly to a real bicycle. Such a simulator should give users a realistic experience of bicycle control, also at low-velocity cycling. Moreover, the simulator should be able to simulate the behaviour of a range of bicycles, and it should be able to enhance the lateral stability for training and relearning purposes.

To this aim, we are developing a new bicycle simulator (Frisian: *Fytssimulator*). An important difference compared to existing simulators is that the lean angle, next to the steering angle and forward velocity, is controlled by the rider, as is the case on a real bicycle. In contrast to bicycles on treadmills and roller banks, our simulator is fully actuated and feedback-controlled to enable full control of the vehicle dynamics and to ensure safety. Our simulator will emulate the forces generated by an underlying bicycle dynamics model, replacing those otherwise due to the velocity and road interaction. This way, we aim to develop a simulator that can be used for: 1) studying the cycling behaviour of healthy participants and their interaction with other traffic; 2) training less-experienced riders and 3) rehabilitation of cyclists with sensorimotor impairments.

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