An overview of bicycle balance rider control

Arend L. Schwab
Delft University of Technology
Biomechanical Engineering

Abstract

The bicycle, being unstable at low forward speed and marginally stable at high speed, is clearly in need for rider control. To balance a bicycle, under normal operation, one has to get the support underneath the centre of mass. In a moving bicycle this can be done by steering into the undesired fall. Stability analysis on a simple mechanical model of the bicycle, consisting of four rigid bodies connected by revolute joints and with idealised non-holonomic rolling constraints, shows that this "steer-into-the-fall' is indeed one of the necessary stability criteria. Remains the question: how does a rider balance the bicycle? What sensors does he use to determine the state of the system, and how does he steer, by applying a steer torque to the handlebars or indirectly, by moving his body or body parts relative to the bicycle? These are the questions which I like to address in my talk. I will discuss the sparse literature on rider control in cycling and show experimental results on rider control in cycling which we did at the TU Delft bicycle lab in past few years.