The often-heard complaint that motorcycles can influence the outcome of races is justified

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Experiment with a rider cycling behind a motorcycle in the wind tunnel of Eindhoven University of Technology. Credit: Bart van Overbeeke

In professional cycling, in-race motorcycles such as TV motorcycles drive in between the riders. In the slipstream behind the motorcycle, cyclists can gain time. For the first time, the exact extent of this advantage has been scientifically investigated. It turns out to be even more advantageous than expected. Using computer simulations and wind

tunnel measurements, Professor Bert Blocken of Eindhoven University of Technology and KU Leuven—in collaboration with software company ANSYS—investigated the effect. He found that a motorcyclist 30 meter in front of a rider reduces drag by 12 percent. A rider who cycles behind this motorcyclist for one minute therefore can gain 2.6 seconds.

In recent years, many cycling teams, riders and commentators have complained that the motorcycles influence the races, and sometimes even determine the results. However, the exact extent of the advantage for a rider cycling behind a motorcycle had not been investigated before. It is not uncommon for motorcyclists to remain in front of a single rider or a group of riders at twenty to thirty meters for several minutes. Even distances of a few meters occur in short bursts.

Professor of Building Physics Bert Blocken is surprised at the enormous time gains that his research shows: "Even if a motorcyclist only rides for a few seconds in front of the riders, a considerable time advantage can still be gained. For a rider cycling for 10 seconds at 2.5 meters behind a motorcycle, this gain can exceed 2 seconds."

Winning or losing

Blocken investigated the drag using two methods that independently show the same results: computer simulations and measurements in the TU/e wind tunnel. A rider who cycles at a distance of approximately 2.5 meters from a motorcyclist experiences up to 48 percent less drag. If he or she would ride at 54 km/h without motorcycle, the presence of the motorcycle will allow him or her to ride at about 67 km/h. This provides a time gain of 14.1 seconds every minute. This advantage becomes smaller as the distance increases, but at a distance of 50 meters a 7 percent reduction is still measurable. This represents a gain of 1.4 seconds per minute at a reference speed of 54 km/h. At reference speeds

above 54 km/h, the time gain is even bigger.

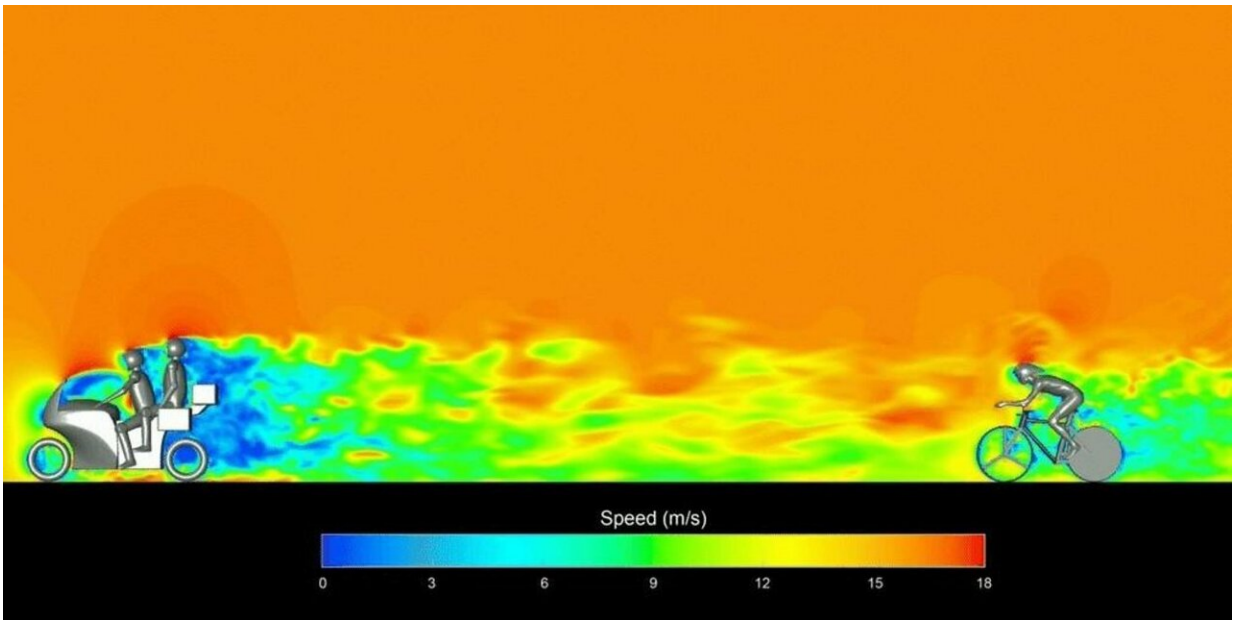
Intermediate distance	Drag reduction	Speed increase	Time gained per minute
0.48 m	-71%	48.9%	29.3 s
2.64 m	-48%	23.6%	14.1 s
4.8 m	-36%	15.6%	9.3 s
10 m	-23%	8.8%	5.3 s
15 m	-18%	6.7%	4.0 s
20 m	-15%	5.4%	3.3 s
30 m	-12%	4.2%	2.6 s
40 m	-10%	3.5%	2.1 s
50 m	-7%	2.4%	1.4 s

The decrease in drag, speed increase and time gained per minute for each measured distance between rider and motorcyclist. Assumption: rider without help of motorcycle rides at reference speed of 54 km/h. Credit: Bert Blocken

"We repeated the wind tunnel measurements and our calculations a few weeks after the first tests because I couldn't believe the size of the effects. But we always found the same results. Because races are

sometimes decided by seconds, these differences can determine whether you win or lose. The often-heard complaint that motorcycles can influence the outcome of races is therefore justified," says Blocken.

The time gains cited above are calculated and measured without head wind, tail wind or crosswind. Blocken: "If there is head wind, the time gains are larger. If there is tail wind or crosswind, the time gains are smaller. The stronger the crosswind, the more difficult it is for a rider to get in the motorcycle's slipstream."



Computer simulation of a rider cycling at a distance of 10 meters from a motorcyclist. The green and yellow colors in front of the rider show that the airspeed here is substantially lower than in front of the motorcycle. Credit: Bert Blocken

Insufficient and unenforced guidelines

The International Cycling Union UCI issued new guidelines for motorcyclists in 2017. Blocken's research shows that these are not sufficient to prevent time gain for the riders. Moreover, these rules are not enforced during the race, which means that in reality motorcycles are much closer to the riders.

Dr. Fred Grappe, performance director at the UCI World Tour Team Groupama-FDJ substantiates that the aerodynamic effects of the motorcycles affect the performance of the riders. "It is therefore necessary to define a kind of 'free zone' around the rider in which no motor vehicle is allowed for more than a few seconds. Bert Blocken's new scientific study in cycling dynamics provides the knowledge to determine such a zone effectively. Given the influence of even a few seconds on a ranking, it is unacceptable to ignore this knowledge and its importance."

Provided by Eindhoven University of Technology

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