

Scapote

A SIMPLE METHOD FOR AERODYNAMIC AND ROLLING RESISTANCE MEASUREMENTS IN CYCLING

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Purpose.

The purpose of this study was to propose and to test a simple method for aerodynamic (SC_x , in m^2) and rolling (CR , without dimension) coefficient measurements in cycling locomotion.

Methods.

In a 80 m corridor (no wind), the cyclists rode and stopped to pedal before rolling on 3 contact bands (C1, C2, C3) of the chronometer system. Between C1 and C2 (5 m) the initial velocity was quantified (including negative acceleration in this part). Between C2 and C3 (20 m) the mean velocity was measured. From C2 to C3, total resistances (RT), acceleration, velocity and distance covered were calculated step by step ($\Delta t=0.01s$). RT depends on both SC_x and CR : $RT = [SC_x 0.5 \rho V^2] + [CR m g]$, where ρ = volume mass of the air, V = cyclist velocity, m = mass of rider + bicycle, and g = gravity. SC_x

and CR were determined by iteration, by minimizing the sum of the min squares between the real distance from C2 to C3 and the calculated covered distance (at the last step). To test reproducibility, a cyclist, in aero-posture, has repeated 8 times the same measurement series (8 x 15 = 120 runs at different initial velocities from 2.8 to 10 m . s⁻¹). The method sensibility was tested by successive changes of the tires' inflation (2, 4, 6, 8, 10 and 12 bars), and of cycling position. In the last experimental condition, four positions (30 runs x 4 positions = 120 runs) were studied : upright posture (UP), Obree's posture, upper limbs linked with the trunk (PO), aero-posture (AP), dropped posture (DP).

Results and discussion

In tests of reproducibility, mean error was 1.5% for both SCx and CR (0.319±0.006, 0.0046±0.0001, in line with previous studies in wind tunnel). Moreover, an exponential decrease of CR (0.006 to 0.003) in function of the tires' inflation was observed (r=0.983, p<0.01, n=6). Finally, an Ancova analysis showed that SCx was significantly (p<0,0001) different between the 4 positions (Fig.1).

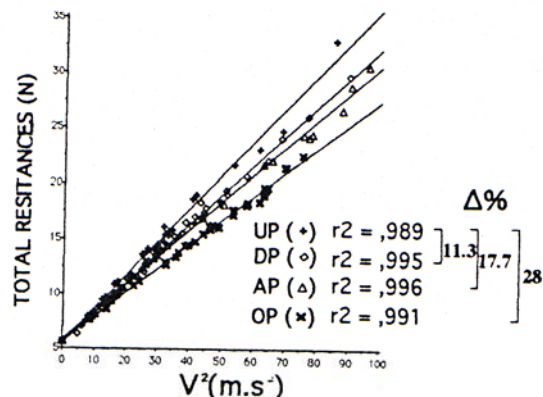


Figure 1. Total resistances in function of the squared of the initial velocity of the cyclist (V^2) in 4 different positions. $\Delta\%$ = Difference between positions normalized with respect to upright posture

These results suggest that the proposed methods is reproducible, sensible, and usable to investigate aerodynamic and rolling resistances.