Developping a method to accurately measure air flow velocity fields on a recumbent bicycle equipped with a streamlined shell, at a low Reynolds number

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Résumé

Today's calculation methods to design aerodynamic shapes come from last century's aeronautic development projects, which were mainly focused on military and commercial flights. However, vehicles that surround us, such as bicycles, cars or civil drones, are far from being as fast as planes. Minimising the power consumption of these engines has become a crucial matter. Those last decades, the priority has been put on the improvement of mechanical efficiency, while the aerodynamic optimisation has suffered from a lack of knowledge on moderate speed air flows. Our main mistake is that we still tend to extrapolate what we have learnt on planes on vehicles that are much slower and that evolve in conditions that are not really comparable (Reynolds number, Mach number).

Lowering the air flow drag of a shape efficiently is only possible if we can determine with precision the position of the laminar-turbulent transition area of that shape. At low speeds, today's windtunnels cannot provide us with reliable data since the air flow turbulences created by the structure itself moves that transition area. Likewise, measurement tools used today in real conditions are intrusive, disturbing the transition area localisation.

This study aims to develop an accurate and repeatable tool to measure air flow velocity fields around streamlined shapes in transitional regimes in real conditions. Different methods are being studied, compared and used. For each tool, a calibrating process is developed in a windtunnel with a turbulence ratio of only 0.4%.

Thereafter air flow velocity fields will be measured on a streamlined recumbent bicycle, which already holds a French speed record. These measurements will be used as a calibrating database to develop a new air flow simulation algorithm.

Mots-Clés: aerodynamics, laminar turbulent transition, velocity fields measurment

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