



Lisa Bentley — one of the most successful Ironman triathlon athletes — riding a Cervélo bicycle

Tour de Force!

Aerodynamic gains can be realized by studying the interaction between a bicycle and rider.

By Keith Hanna, ANSYS, Inc.

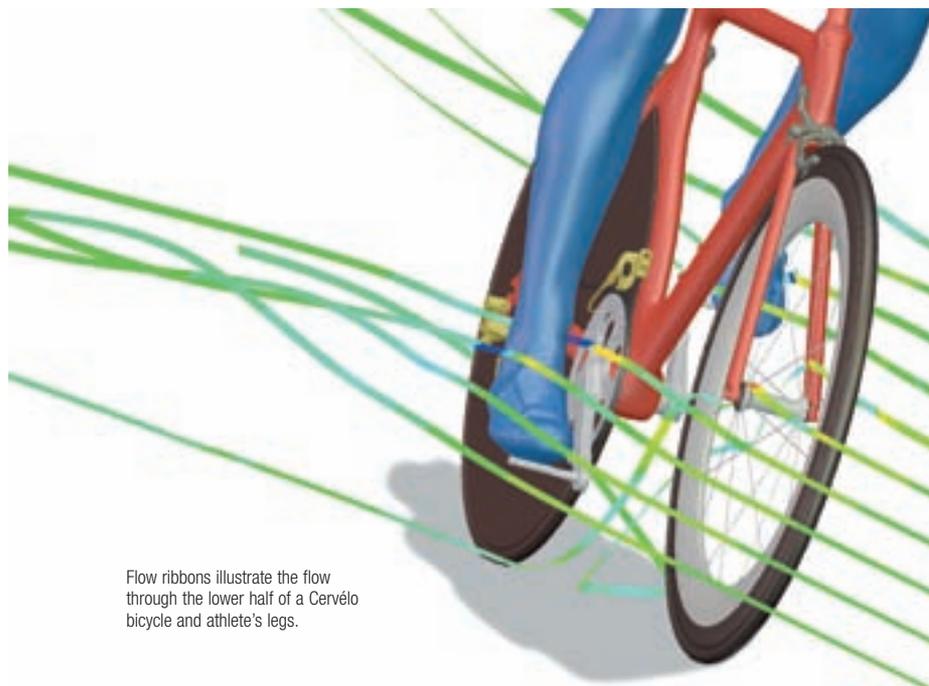
Cervélo Cycles was formed in 1995 when two engineers, Phil White and Gérard Vroomen, decided to take their fast time trial bikes to market. Involved in bicycle and human-powered vehicle design since 1986, Vroomen realized that professional cyclists did not have the interest or expertise to develop leading-edge designs with a focus on time trialing and aerodynamics. He also realized that he could not look at the many novel designs put before him and know if they were better or just different. Hence, when an Italian pro cyclist's team approached him to evaluate bikes then available on the open market, he set a design goal for a new bike design: to be unbeatable in terms of its aerodynamics, weight and stiffness characteristics. The one-off design for this particular rider turned out to be a radical bike that pushed the boundaries of existing bikes and tested well. This customized Cervélo bike attracted attention and started to sell itself at triathlon and road racing events. The duo set up their own company, and within two years their bicycles had won numerous triathlons and time trials.

Today many professional athletes use Cervélo bicycles. With eight full-time engineers in their small company, they continue to push the bike design envelope in every way possible while keeping a focus on technology and innovation. Today the rate of development has to be fast in order to stay competitive. The company has a simple mission statement: "To help our customers win races." This mission has come true for their cycling team, Team CSC, which is

currently ranked first in the world. Their P3 bike is the most successful triathlon model in Ironman history with more than 20 victories. Other Cervélo bicycles are used by racers in the Tour de France and amateurs touring along city streets and country roads.

Recently, Cervélo approached the ANSYS, Inc. office in Michigan, U.S.A., to employ their extensive aerodynamic experience to fashion a virtual design process using the computational fluid dynamics (CFD) package FLUENT. Phil White notes that in a typical one-hour time trial, perhaps 30 to 60 seconds can be taken off times through aerodynamic improvements to a given bike. Indeed, the biggest aerodynamic gain is usually in the design of the lower half of the bike, where many complex flow interactions occur. The

CFD studies demonstrated the benefits to be gained by this approach. Cervélo has acquired a wealth of wind tunnel data over the last decade and is now using it for benchmarking the numerical predictions. CFD is proving to be less expensive than wind tunnel measurements for the amount of data generated and is free of probe interference errors. It can pick up many effects associated with riders interacting with bike frames and can capture rotating wheels and moving ground effects. Looking forward, Cervélo believes that CFD will provide a better understanding of critical side wind effects with yaw angles in crossflows, overall aerodynamics and cyclist packages, racing tactics, and many other riding equipment enhancements. ■



Flow ribbons illustrate the flow through the lower half of a Cervélo bicycle and athlete's legs.