BECOME A CHAMPION

By Thierry Marchal, Industry Director, Sports, ANSYS, Inc.

The Centre for Sports Engineering Research at Sheffield Hallam University, working with Badminton England, the sport's national governing body, used ANSYS CFD software to understand the specific flow-field differences between traditional goose feather shuttlecocks and synthetic versions. ANSYS Fluent simulation revealed the influence of individual feathers, a result that would not have been attainable by other means. Image shows the total pressure over the surface of the shuttle with a volume rendering of vorticity magnitude in the shuttle wake.

Athletic innovations like Olympic swimsuits and racing yachts might seem worlds away from everyday business challenges. But there is much to learn from sports leaders.

This issue of *ANSYS Advantage* features a number of fascinating stories about how innovators such as Speedo and HEAD are changing the face of sports today.

Why are these stories so interesting? Perhaps it's because when we engineers watch a world championship event or a Formula 1 race, we feel that we have some secret knowledge of the technology at the heart of the competition. Or maybe it's because we like impressing our friends at the tennis court or the golf course with some little-known insights about how engineering simulation has shaped the equipment we're using. Whatever the reason, articles about engineering racing yachts and swim goggles never fail to capture our collective interest.

At the same time, these stories might seem worlds removed from the engineering challenges we face every day. How many of us can expect to see a world record broken or a championship podium mounted, based on our own product development efforts?

However, there is much to learn from engineering for sports, which you can apply in your own day-to-day engineering simulations. Design teams at sporting goods companies face the same challenges you do: shorter product lifecycles, growing competition, pressures to drive time and costs out of product development, and ever-increasing regulation.

For most athletic equipment designers, the ultimate rewards include not only competitive victories but a larger share of consumer markets, higher long-term profits, and the lower warranty costs that go along with product integrity. These innovation leaders are not very different from your own company. And today, all

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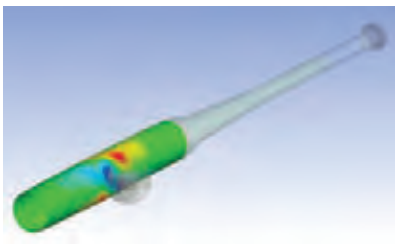
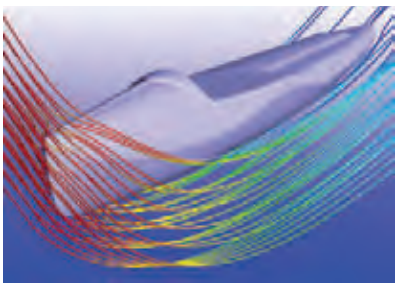
organizations are dealing with the same set of engineering imperatives.

ROBUST DESIGN: A PRIORITY FOR EVERY TEAM

One company that can yield many lessons is Red Bull Racing, a longtime ANSYS customer and vocal proponent of engineering simulation. Only five years after introducing its first Formula 1 car, Red Bull Racing won back-to-back championships in 2010 and 2011. In a sport in which milliseconds matter, the aerodynamics of a million-dollar race car are just as important as driver skill — and Red Bull has acknowledged this fact by using engineering simulation to drive extremely robust vehicle design.



The same composites and explicit dynamics technology used to simulate a baseball bat can be used to design other lightweight, high-impact products.



Using computer simulation, Intelligent Fluid Solutions designed a more stable and better-draining surfski for Red7 without compromising speed. Top racers confirmed improved times, and sales of the product increased.

At Red Bull, much of the vehicle — from airflow and stress points to tires and suspensions — is designed and analyzed virtually before prototypes are ever built. This saves significant costs and time over traditional wind-tunnel tests, and it also provides an incredibly clear picture of how the finished vehicle will behave. Potential performance shortfalls are identified far earlier in the process, which allows for the kind of game-changing, rapid innovation that drives Red Bull into the victory lane, week after week.

Another world-class innovator, Emirates Team New Zealand, focuses on robust design in creating yachts for grueling events like the well-known America's Cup and globe-spanning Volvo Ocean Race.

By relying on computational fluid dynamics (CFD) simulations and parametric analysis, the team is able not only to optimize the performance of its all-important sail inventory but also to ensure that the boat's hull and all appendages are built to maximize the sails' contribution. As yachts embark on races that can span nearly 40,000 miles of uncertain wind and weather conditions, it's obvious why Emirates Team New Zealand places a premium on robust design and product integrity.

AMPLIFYING RESOURCES: FAST TRACK TO RESULTS

Emirates Team New Zealand espouses another universal engineering priority: making the most of product development resources. With only months to design an entirely new yacht for a specific race, the team depends on the power of engineering simulation to analyze thousands of sail configurations, rapidly and reliably. By automating CFD runs and relying on the country's largest high-performance computing (HPC) cluster, Emirates Team New Zealand amplifies its internal resources to meet pressing design schedules and support fast, ongoing innovation.

Large or small, specialized design teams face incredible competitive pressures. Many other athletic equipment and apparel manufacturers have taken this lesson to heart. For those companies focused on winning, engineering simulation is a critical tool for maximizing throughput and launching innovations before their competitors do.

HEAD Sport, a leading maker of tennis rackets, leverages simulation to energize and accelerate its product development efforts, maximizing investments. While HEAD once was able to evaluate only one design prototype each week, today this innovative company uses ANSYS software and a parametric design approach to evaluate a million racket iterations in the same time period. HEAD's efforts to amplify its resources have paid off. Last year, tennis star Novak Djokovic won three Grand Slam titles using a lightweight, high-strength HEAD racket that was designed via engineering simulation.

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SYSTEMS-LEVEL DESIGN: A WINNING STRATEGY

Today, pioneers in engineering simulation are applying a systems-level, multiphysics approach to not only optimize each individual product component, but to ensure that all components are working together as a high-performing system. This holistic design approach is taking the world of sports by storm.

Speedo is known for its innovations in swimwear, particularly its application of CFD science to maximize fluid flows and minimize drag around competitive swimmers. As you'll see in these pages, Speedo has recently developed an entire "racing system" that incorporates goggles and swim caps into its winning formula. For the first time, Speedo is combining structural analysis with its CFD studies to design revolutionary new swimming equipment that works as a complete system.

Similarly, Avanti Bikes has developed design-award– and championship-winning bicycles by simulating components individually and then as a system, optimizing the machines for the best performance. In a sport in which every second counts, systems-level simulation could help make the difference between winning and placing.

Bicycle designers are using engineering simulation to transform traditional bicycles into advanced, fine-tuned and customized equipment. Today three European universities — Katholieke Universiteit Leuven, Eidgenössische Technische Hochschule Zürich and the University of Eindhoven — are taking this one step further, assuming a systems-level view of competitive bicycling teams.

These academic researchers are focusing on optimizing the position of cyclists on their bikes to reduce drag. Recently, they scanned every member of the Belgian national bicycling team so that each individual's physical profile — and ultimate race performance — could be improved via engineering simulation.

Coupled with ongoing improvements in bicycles, helmets and other equipment, this broader perspective has the potential to revolutionize the sport of bicycle racing. We will continue to follow these developments with great interest — and monitor other ways in which systems-level simulation is impacting the world of athletics.

JUMP-START YOUR OWN INNOVATIONS

Perhaps the stories in this issue of *ANSYS Advantage* will indeed provide fascinating insights that you can share around the swimming pool or tennis court.

But most of all, I hope you find these real-world examples inspiring as you undertake your own Simulation-Driven Product Development efforts.

There might not be a Grand Slam title or a world championship medal in your own future — but, by using engineering simulation to drive innovation in your company, you can emerge as a champion and a hero. Learning how these innovation leaders are focusing on robust design, resource amplification and systems-level simulation can help you and your team to achieve world-class results, whatever your arena.

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A collaborative team of European academic researchers may be the first to apply a systems-level approach to optimize performance of competitive bicycling teams. Drag minimization coupled with ongoing equipment improvements by manufacturers promises to take the sport to an entirely new level.

COURTESY KATHOLIEKE UNIVERSITEIT LEUVEN, TU EINDHOVEN AND ETH ZURICH.