Improving the Golfing Experience Using CFD

CIMdata Commentary

Companies are striving to design innovative products while reducing the cost of product development and time-to-market. The pace of product innovation has also increased dramatically and is a primary contributor to companies' overall profits and market share. Factors companies must address include increasing product complexity, the time and cost to create physical prototypes, and a lack of resources that can perform required analyses and simulations. More and more companies are recognizing the importance of using embedded simulation and analysis tools within their main product development processes and tools to better design their products. Computational Fluid Dynamics (CFD) is one type of analysis that is being applied to a wide range of products.

There is demonstrated real value in using CFD to analyze products earlier in the product development lifecycle. Embedding CFD analysis within the normal design environment (CAD) enhances the value of using CFD, allowing it to be used throughout the product definition lifecycle to guide decision-making and product validation. Ways in which companies can benefit by using CFD early and frequently in their product development process include:

- *Support Faster Design*—Allowing early simulation and evaluation of design decisions speeds up the design process.
- *Improve Product Design*—Designers and engineers can have a more complete and better understanding of design issues so they can make better design trade-off decisions earlier.
- *Avoid Rework*—Using CFD to validate designs helps avoid design errors that can result in costly rework.
- *Improve Quality*—Designers can try more iterations earlier, which can lead to better, higher-quality products that exceed customer expectations.
- *Reduce Prototypes*—Decrease the need for developing physical prototypes and running expensive physical tests.

One company that is using CFD to create a competitive difference in their products and improve the golfing experience is Adams Golf. Adams Golf designs, assembles, markets, and distributes premium-quality, technologically-innovative golf clubs. For Adams, reducing the time from ideation to product sales to consumers is the key to success in the highly-competitive golf equipment market. As in other consumer markets, companies must develop and release products and product variations more and more frequently—and these products need to continue to excite customers and improve their golfing experiences. The golf equipment market product life and release cycle has compressed from 18-24 months to less than 6 months and it continues to shrink.

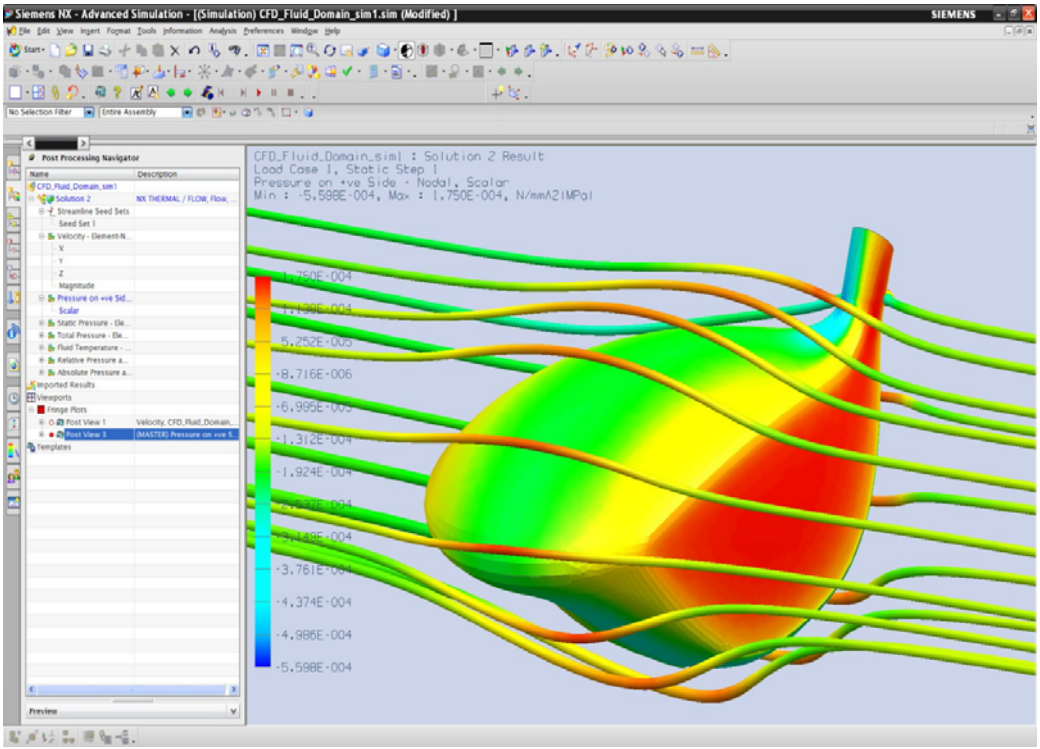
In golf equipment, the driver has always been the big club—literally. Over the past several years, the size of drivers has continually increased from approximately 250cc to today's 460cc maximum allowed by the rules of golf. Early in this trend, testing showed that the average PGA tour distance off the tee increased as the club head size increased. However, as club heads began to reach the current maximum size, even the best PGA tour players were seeing a decrease in their driving distance. This decrease in distance was cause for concern. What was

the problem? Why did the new drivers built with the latest technology deliver less distance than older, smaller clubs?

After extensive testing, Adams Golf determined that large MOI (moment of inertia) club heads are subject to aerodynamic forces large enough to impact club head speed. More specifically, Adams Golf found that the reduction in club head speed measured during player tests correlates strongly with the resulting increase in aerodynamic drag for extreme dimension club heads. In golf, faster club head speeds at impact mean more distance—the "Holy Grail" for golfers. So how could they make the larger club head designs that golfers wanted and still deliver improved club head speed? In their pre-CFD design process developing the original Speedline driver, Adams Golf made educated guesses about the aerodynamics of the club head. They made design tradeoffs without fully understanding the impact of those tradeoffs on the performance of the club.

For product development, Adams Golf uses solutions provided by Siemens PLM Software. They started by using NX for club design. Today they continue to design in 3D with NX but have added NX Flow to be able to perform CFD analyses on each iteration of the design as it is being developed. The CAE tools enable them to perform advanced mass property analysis and equipment durability testing as part of the process and get immediate feedback on parameters that impact club performance.

Using NX Flow for CFD, they have been able to design new drivers with larger faces that perform equal to, or better than older, smaller clubs. Initially they were able to expand the club face and execute multiple design iterations based on CFD analyses of each design variation. This enabled them to get the aerodynamic drag back down to the level of their original, smaller, driver. The following figure illustrates how Adams Golf is using NX Flow to help design their Speedline drivers.



As Adams Golf continued to refine their product development process to use more in depth and embedded CFD analyses, they have been able to achieve greater overall club performance.

CFD enabled them to make small modifications to both the face area and the transition area from the face to the body of the club, to help keep airflow attached and reduce drag even more. This has resulted in the 2009 release of its Speedline driver—a large-dimension and high-inertia driver with low aerodynamic drag forces, enabling increased club head speeds and greater distance for golfers.

Another advantage of using Siemens PLM's NX Flow software was that engineers could simulate different orientations seen by the club head as it moves through the swing. For the newest Speedline Fast 10 driver, Adams engineers are able to develop designs that ensure that the flow does not separate during the early stages of the swing, resulting in lower drag in all orientations, and thereby improving the overall design and club head speed throughout the golfer's swing.

In the competitive environment faced by Adams, bringing new innovations to market sooner can make all the difference. By using 3D design in close association with analysis tools, Adams has also been able to shorten its product development cycle significantly. "The typical manufacturing process for us—from conception to seeing actual prototype parts—is anywhere from 30 to 60 days," says Jeff Albertsen, an Adams Golf design engineer. "Now using the NX Flow software, we can design, test the design, validate that it's going to work and actually have a real-time working concept in probably less than 20 days. So by using the NX software, we can cut down on manufacturing lead times, we can cut down on manufacturing costs, we can cut down on testing times."

Tim Reed, Vice President of Research and Development at Adams Golf, concludes, "The role NX ultimately plays is speed to market, providing us extraordinary flexibility and adaptability to the ever-changing environment of the golf industry."

Expanding the use of simulation and analysis tools such as CFD is enabling companies like Adam Golf to reduce the time it takes to create more innovative and competitive products. The benefits are twofold. Adams continues to improve its market share and bottom line while giving golfers the one thing they really want—a better golfing experience with more distance off the tee. Adams Golf is just one example of applying CFD to improve products in ways that had not been done before.

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