

Patrick Canupp: Finding the Flow

Aerodynamics is one of the more complicated aspects of racing, in large part because you can't see the air passing over the car. Aerodynamics is, however, one of the most important factors in racing because the air exerts forces on the car that can make it go faster (by pushing the tires into the track harder and giving the car more grip), or slower (by making the car push the air out of the way). Advanced aerodynamics uses high-powered math and physics coupled with powerful computers. Techniques such as computational fluid dynamics (CFD) help aerodynamicists calculate and visualize how air flows over the car. Wind tunnels provide experimental tests of the cars and the CFD calculations.

It might surprise you then that someone who uses advanced mathematics every day struggled with pre-algebra, but that's exactly what happened to Joe Gibbs

Racing's Director of Aerodynamics Patrick Canupp. "I just wasn't interested," he said, "Something happened in 9th grade—my Mom, who is a retired guidance counselor, wishes she could figure out what it was—but I just put my mind to it. It took awhile, but by the time I was finishing high school, I was taking all the courses I needed for college."

Although Patrick's job is making race cars faster, he never loses sight of the inherent elegance of aerodynamics. "There is a certain beauty to seeing, for example, a flow bifurcation (when the flow can alternate between two seemingly stable conditions)," he says. He also enjoys figuring out how to put his results in visual form so that other people can appreciate not only getting results on the track, but the artistic elements of aerodynamics.



"One of the things that motivated me was that people occasionally would tell me that I couldn't do things. That, to me, is like a challenge to prove them wrong."

On The Job

Q: What does a Director of Aerodynamics do? I run the part of the shop where the bodies get put on the cars, plus the research and development side. The two parts are interwoven. On the one hand, I work on the cars that are going to be racing in the next few weeks, but I also work with computer simulations and scale models that we test in a wind tunnel so that we can continue to make improvements.

Q: What aspects of math and science do people in your department use? One of the things that is most important in my area is being able to describe objects in three dimensions. A car is a complex surface and every curve can affect the aerodynamics. We verify that every part of the car is in exactly the right location using sophisticated measurement software that is largely based on trigonometry. At times, we find it helpful to express three dimensional data on a two dimensional surface like the car body. For example, you could use colors to show how the pressure varies over the car. I like representing complex data in ways that anyone can understand.

Statistics

NAME: Patrick Canupp

POSITION: Director of Aerodynamics, Joe Gibbs Racing

FAMILY: Wife, Paula Stathakis

EDUCATION: Bachelors degree and Masters degrees (Aerospace Engineering), North Carolina State University; Ph.D. (Aeronautical and Astronautical Engineering), Stanford University

EMPLOYMENT: Professor at Gardner Webb University; worked at Wright Patterson Air Force Base; returned to North Carolina to work in an aerodynamics consulting firm that worked with NASCAR teams; aerodynamics jobs at Petty Enterprises, Robert Yates Racing and, since 2004, Joe Gibbs Racing.

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About Patrick

One course I didn't take in school that I wish I would have taken is... Literature. I find reading enjoyable, although I don't get much time right now. I love the style of authors like Faulkner and Joyce.

My favorite part of my job is... Getting to do aerodynamics and getting a paycheck for it. I like working with fluid flow. It's heavily mathematical and difficult to understand or predict. But there is a certain beauty to it that I never get tired of.

My least favorite part of my job is... Dealing with the frustration when we don't perform up to our potential.

The most challenging part of my job is... making the cars go faster. There's no

straightforward way to do it and there are very objective measures of your performance, like lap time on the race track.

Something I wish someone would have told me when I was in school... It's really up to you to learn when you're in school. It took me until college to realize that I should be reading the textbooks and trying to learn on my own from them. You should never completely rely on someone else to teach you. You should get in the habit of becoming self-sufficient.

When I'm not working, I like to... Chill out. I work hard when I'm at work, but when I'm not, I like to relax. My wife and I have season tickets to the opera and I enjoy listening to lots of different types of music. I also enjoy competing in 5-K road races.

The best advice for a student who wants to work in motorsports is... Get involved in Formula SAE (a collegiate racing program) early in college. We hire almost exclusively from people involved in that program. Formula SAE gives you a lot of really practical experience with all aspects of racing.



Getting There

Q: Did you like math and science when you were in school? A: As I mentioned, I almost failed 8th grade pre-algebra, but I did generally enjoy math and science, especially from high school forward. I think one of the things that motivated me was that people occasionally would tell me that I couldn't do things. That, to me, is like a challenge to prove them wrong.

Q: What would you be doing if you didn't work in motorsports? I wouldn't mind being a tornado chaser. I remember seeing pictures of tornadoes when I was younger—they're just beautiful if you look at how the fluid flow comes together. The downside of that is that you might drive a couple hundred miles in a day and not see anything at all.

Q: Is there someone in your life who served as a role model? My parents, of course, were a huge influence, but professionally, it would be my thesis advisor at Stanford, Bob MacCormack. As stellar as he is—he is a member of the National Academy of Engineering—he is one of the best human beings you'll ever come across. He was always concerned with what you were doing scientifically, but he also always asked about your personal life, how things were going.

“The biggest challenge is making the cars go faster. There's no straightforward way to do it.”