

Newman-Haas Wins More Races with MATLAB®-based Data Analysis System

Formed in 1983 as a partnership between actor Paul Newman and racing businessman Carl Haas, Newman-Haas Racing (NHR) engineers, partially manufactures, and fields cars in the Championship Auto Racing Teams (CART) series. CART is “the fastest and most competitive open-wheel racing series in the world” according to Racer magazine.

When the difference between first and second place can be a fraction of a second, staying ahead calls not only for world-class drivers but also for an optimal car setup—one based on a firm understanding of the way the car behaves on the track.

To this end, Newman Haas used MATLAB® to develop a state-of-the-art data analysis and visualization application called Race Car Data Analysis (RCDA). According to NHR engineer Michael Hegel, MATLAB was “a natural fit” for this task.

The Challenge

Engineers at NHR needed to quickly extract the most salient data from the car’s on-board computer, display the results, and make critical decisions about the car’s setup. (The specifications for such factors as spring rates, suspension geometry, and ride heights are all part of the setup.)

Each Newman-Haas car is fitted with over 30 chassis sensors that measure damper positions, wheel loads, body accelerations, angular rates, speeds, rack travel, and an assortment of pressures and temperatures. During a test, the sensors feed information to an on-board data logger, yielding about 8MB of data for a 5- to 10-lap test outing. At the end of the test session, drivers are debriefed, data is analyzed, and setup changes are made—all under extreme time pressure. (Engineers often have to make crucial changes to the car’s setup in a matter of hours between the test session and the actual race.)

Analyzing the data involves two core processes: data reduction, which compresses unwieldy amounts of raw data into fewer, more comprehensible sets; and data visualization.

Initially, NHR engineers relied on a custom data analysis application written in C, but this application proved inadequate; adding new features meant programming them from scratch in C, a costly and time-consuming process. Moreover, the advent of newer operating systems made the application obsolete.

NHR could have resorted to the standard racing analysis package used by most CART competitors, but this package just couldn’t handle the complex

The Challenge

To create optimal setups for a fleet of championship race cars

The Solution

Use MATLAB® to develop a software package that enables engineers to fine-tune a car’s performance by conducting advanced analyses of data logged by an on-board computer

The Results

- One-of-a-kind data analysis capabilities
- A maintainable, extensible application
- More race victories

“MATLAB® helps Newman-Haas create better car setups. This in turn translates into better lap-times, better qualifying performances, and more race victories.”

— Michael Hegel, Newman-Haas Racing

Application Area

Automotive
Data analysis

MathWorks Products Used

MATLAB®
Signal Processing Toolbox
Control System Toolbox

algorithms that NHR uses for data reduction. Hegel describes it as “really more of a data viewer than an analysis package. It is a non-extensible product with limited functionality, just the basics.”

What Newman-Haas needed was a system powerful enough to handle their proprietary data reduction models (which typically consist of over 250 equations) and flexible enough to let them develop new algorithms and implement advanced visualization techniques. Says Hegel, “We wanted to go beyond what everybody else was doing to get an advantage.”

The Solution

Working in MATLAB, NHR developed their own Race Car Data Analysis program. MATLAB enabled NHR to design, manage, apply, and interpret data reduction algorithms, all in a unified software environment. “MATLAB gave us a rich computational engine on top of which we could build a data reduction package,” says Hegel.

NHR engineers used Visual C++ to create a custom GUI that works with MATLAB in a client/server configuration. This front-end client application sends raw data to the MATLAB server. It also sends the data reduction algorithms, in the form of MATLAB scripts, or M-files, which are applied to the data. The Signal Processing toolbox allowed NHR to design signal filters that further refine the data.

NHR also used MATLAB to develop a custom data viewer. Results, which are displayed in the data viewer as MATLAB graphics, can be customized either by using built-in GUIs or by choosing a script from the front-end application.

The Results

- **One-of-a-kind data analysis capabilities.** MATLAB allows NHR to perform analyses that would be impossible with the standard racing analysis package. This gives them a distinct advantage. As Hegel points out, “We are the only team on the CART grid that has our own analysis package. We can add capability with new analysis and visualization techniques that other teams can’t.”
- **A maintainable, extensible application.** MATLAB enables NHR to quickly add new features as the technology evolves. They are currently exploring 3D plotting, color variation, and animation for identifying relationships between the various sub-systems in the car.
- **More race victories.** NHR implemented their RCDA application in 1998. Between 1998 and 1999, their pole positions and race victories doubled. SpeedCenter’s 1999 Mid-season Scorecard showed that Newman-Haas had accumulated the most total points of any CART team.

To find out more:
www.mathworks.com
www.newman-haas.com



3 Apple Hill Drive
Natick, MA 01760-2098 USA
Tel: 508-647-7000
Fax: 508-647-7101
E-mail: info@mathworks.com
www.mathworks.com