Tech Focus

Volume 3, Issue 2

Focusing on the advancement of dynamic measurement technology

Cutting-edge measurement solutions for compliance testing

In a continuing effort to make vehicles safer, computer-controlled systems such as anti-lock braking systems and electronic stability programs have become increasingly prevalent. And with mounting pressure from governmental organizations such as the NHTSA, the need to accurately measure the performance of these systems has never been more significant.

For compliance testing, such at the NHTSA fishhook test, effective instrumentation is crucial. Optimized for simultaneous measurement of longitudinal, transversal and magnitude velocity, as well as angle, the CORREVIT® SF II-P Non-Contact Sensor provides an outstanding solution.

Weighing just 250 g, this ultra-compact sensor is ideal for applications that require mounting on the vehicle wheel. Foremost among these applications is tire-slip angle, which is an important component of many measurement applications, such as ESP (Electronic Stability Program) testing.

Compact and robust by design, the SF II-P Sensor enables mounting positions – such as under the vehicle – that were virtually unimaginable until now. Long-life, vibration-resistant infrared LED illumination and digital filters with advanced DSP technology provide improved performance, even under harsh environmental conditions. Equipped with 4 analog and 4 digital outputs, the sensor features high-speed data transfer via CAN Bus, RS232 and USB, and can be used with all current data acquisition systems. The USB output also enables direct connection to PC or laptop

The SF II-P is configured with a protective optical-glass lens that prevents damage to the optics and the illumination source. The lens is optimized to the wavelength of the LED illumination source, and can be easily replaced without any special tools. Durable and easy to use, the SF II-P Sensor provides speed linearity of <±0.5% of the measured distance and distance linearity of <±0.2%. Distance resolution is an outstanding 2.08 mm. Illumination is provided by via long-life, high-power infrared LEDs.

Fishhook testing

As part of the NHTSA's responsibility to fulfill the requirements of Section 12 of the Transportation Recall, Enhancement, Accountability and Documentation (TREAD) Act of November 2000, the United States Congress directed the NHTSA to "develop a dynamic test on rollovers by motor vehicles for a consumer information program; and carry out a program conducting such tests."

Instrumented for NHTSA fishhook testing, the SUV shown here is fitted with one CORREVIT® S-400 Optical Speed & Distance Sensor (rear), and four HT-500 Height Sensors.

The Fishhook test is applied to measure the speed at which the wheels lift off the ground (< 4 cm), before the vehicle rolls over. In this test, the path the vehicle follows is shaped like a fishhook, thus giving the test its name.

As in all testing methodology, reproducibility is essential. This is one of the many areas in which CORREVIT® Optical Sensors excel. For additional information about this feature, please see **Sensor Comparison Report: Brake Testing**, also in this issue of ***TechFocus***.

Testing for ESP development

The evaluation of Electronic Stability Programs (ESP) requires instrumentation that can simultaneously evaluate steering and yaw in a variety of driving applications.

These include such maneuvers as:

- Steady-state, circular-course
- Braking when cornering
- Double lane-change maneuver
- Transient behavior
  - Sinusoidal steering angle input
  - Steering angle jump

The CORREVIT® SF II-P Non-Contact Sensor is an ultra-compact, ultra-lightweight iteration of the proven CORREVIT® S-400 Optical Sensor.

ABS testing

The anti-lock braking system must provide optimum utilization of wheel grip on the track surface; steerability must have priority over reduction of braking distance.

The main criteria for the assessment of ABS are:

- Steerability
- Stability
- Optimum braking distance

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Helping you meet government regulations

Andrew Jesudowich, Sales & Marketing Director

In this special edition of CDS ***TechFocus***, we've placed a strong emphasis on governmental regulations, and how they're changing the work you do. From the government perspective, each of these issues is related to quality of life. Clearly, no one would disagree that vehicle safety and environmental consciousness are important. But with equal clarity, we can say that the drive to make vehicles safer, more fuel efficient, and more environmentally friendly has significantly increased the pressures we face on a day-to-day basis.

At CORRSYS-DATRON, we offer quality products. Over the years, this fact has been proven and replicated by testing engineers and technicians the world over. By offering testing instrumentation that works smarter, faster, easier, more reliably and with greater accuracy – and by providing support you can count on to be there when you need it – CORRSYS-DATRON is dedicated to giving you more than just products. We provide solutions to the challenges that you face – day in and day out.

At the bottom line, it's all about quality – in your life and in the vehicles you bring to market. At CORRSYS-DATRON, quality is our business.

Testing methodology overviews now online

Available now from the testing experts at CORRSYS-DATRON is a constantly expanding library of tips and techniques for maximizing the accuracy and effectiveness of crucial vehicle dynamics tests. Among these are application studies covering topics such as dynamic ride height with laser triangulation sensors, aquaplaning testing, Electronic Stability Program (ESP) evaluation, NHTSA fishhook testing, slip-angle measurement and more. Check out our testing methodologies library online today at **www.corrsys-datron.com/faqs**.

A complete 3-axis measurement system

Now, with the CORRSYS-DATRON HF-250 Height Sensor and the CORREVIT® SF II-P Optical Sensor, you can have a complete 3-axis measurement system that weighs less than 400 g. The profile of the new HF-250 and HF-500 Laser Height Sensors is shaped to match the CORREVIT® SF II-P Optical Sensor. This enables HF and SF II-P Sensors to be mounted together for simultaneous 3-axis measurement from a single mounting point.

Pitch and roll measurement – simplified

Add three additional HF-250 Sensors and you have a complete, lightweight system for pitch and roll measurement. Used in conjunction, the HF-250 and SF II-P Sensors effectively generate a plane, which is defined by the sensor mounting positions as they are affixed to the vehicle. This innovative system calculates pitch and roll dynamically, using height measurements acquired by the sensors as they move through all the possible inclinations and projections relative to the longitudinal and lateral axes.

Non-contact optical measurement of sensor position over ground has been established to be more accurate than measurement with inertial navigation platforms, which provide output relative to an artificial horizon. The efficacy of non-contact optical sensors becomes even more pronounced when multiple sensors are joined together in a network. Doing so enables simultaneous acquisition of numerous dynamic variables, each at a level of accuracy that is only available when measurements are made relative to the road surface, which is the major frame of reference for vehicle dynamics testing.

An HF-250 Sensor mounted alongside a CORREVIT® SF II-P Optical Sensor (bottom).

US DOT proposes electronic stability control for new vehicles

A new regulation proposed by the US Department of Transportation could require auto manufacturers to equip all new passenger vehicles under 10,000 pounds with electronic stability control (ESC), as soon as the 2009 model year. The proposed regulation would also require the feature as standard equipment on all vehicles by the 2012 model year.

NEW PRODUCT SHOWCASE

The new IPW Tire Pressure Monitoring system enables dynamic air pressure monitoring while the wheel is in motion.

CORRSYS-DATRON HF-250 and HF-500 Sensors are designed for use in dynamic vehicle testing applications that require accurate measurement of:

- **Ride height**
- **Displacement**
- **Pitch and roll angle**
- **Tire deflection**
- **Chassis torsion**

Measuring range:

- **HF-250: 100 ... 350 mm**
- **HF-500: 125 ... 625 mm**

Resolution:

- **HF-250: 0.1 mm**
- **HF-500: 0.2 mm**

Linearity: ±0.2%

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International Headquarters
P.O. Box 1349 • 35523 Wetzlar
Phone: +49-6441-9282-0
Fax: +49-6441-9282-17
e-mail: sales@corrsys-datron.com

American Headquarters
21654 Melrose Avenue • Southfield, MI 48075
Phone: 248-204-0850 • Toll-free: 800-832-0732
Fax: 248-204-0864
e-mail: usa-sales@corrsys-datron.com

CORRSYS DATRON
Sensorsysteme GmbH

See our complete range of solutions for dynamic vehicle testing online at www.corrsys-datron.com

Sensor Comparison Report: Brake Testing

In a recent brake testing session conducted by one of the world's largest auto manufacturers, we compared several of the most widely used sensor technologies to find out how they stacked up.

The technology

First, we'll begin with an overview of the instrumentation. Chances are, you're already familiar with the accuracy of CORREVIT® L-400 and S-400 Non-Contact Optical Sensors. Both employ proven non-contact optical technology to measure a variety of vehicle dynamics parameters. In this test, vehicle speed and distance traveled were considered.

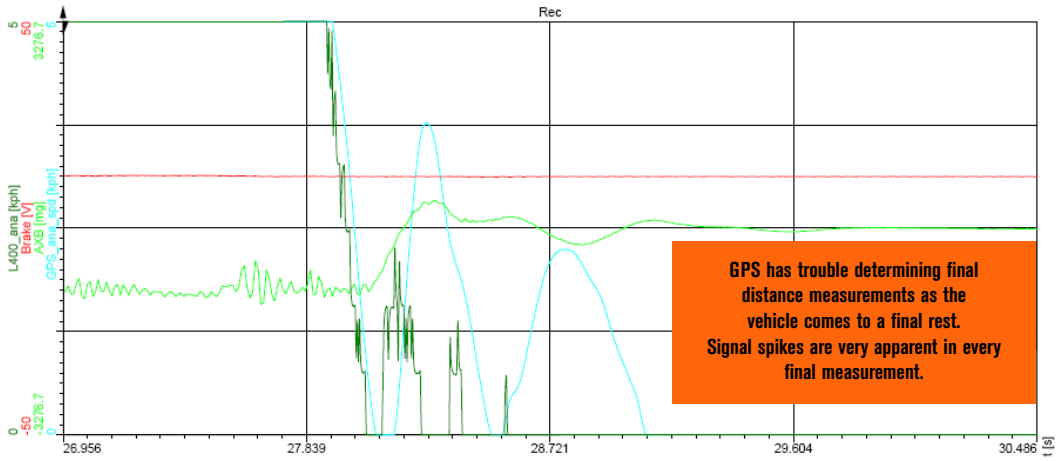

Figure A

Also tested was a well-known, high-end GPS sensor. It should be noted that throughout the entire testing period, the skies were clear and there were no obstructions in or around the test site that could have compromised GPS performance by limiting necessary line-of-sight communication with GPS satellites.

A radar transponder system and a strap-down platform (inertial platform) were also included in this testing session. However, because both systems performed inconsistently, the signals acquired from these systems are not included in this report. Complete findings are available by contacting your CORRSYS-DATRON Applications Expert.

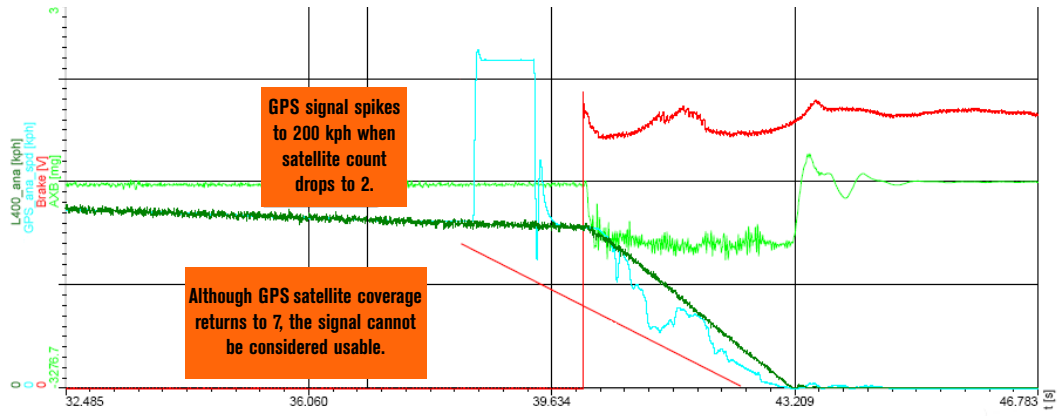

Figure B

Notes about the tests

The results shown here are actual data, as taken directly from the data acquisition system. No post-test processing of any kind was performed.

Further, the CORREVIT® L-400 and S-400 sensors were set to provide an unfiltered, raw signal. Signals from the GPS sensor are also as acquired and do not use Kalman filtering.

As is widely known, the limitation of all GPS sensors is that they rely on available GPS satellite signals as a frame of reference. When one or more satellite signals is lost, GPS sensors utilize Kalman filtering to create an approximation of the data that would have been acquired during the time that the satellite signal is unavailable. Although this provides a smooth and apparently viable signal, the actual data is not representative of true vehicle behavior. A complete explanation of the effects of Kalman filtering is available at **www.corrsys-datron.com/faq_gps**.

Findings

1. As shown in Figure A, the CORREVIT® L-400 and S-400 Sensors uniformly indicate standstill as the vehicle is in its final pitch. However, the GPS system continues to increment speed in the form of signal spikes of up to 5 kph as the vehicle body settles at the end of the run. This artifact repeatedly contributes to errors in distance measurements from the GPS sensor. In all cases, the GPS system reports distances that are longer than other technologies (see Figures C and D).

2. Despite clear skies and a test site that was completely clear of visual obstructions, loss of satellite signals rendered some of the GPS measurements invalid (see Figure B).

3. The CORREVIT® L-400 and S-400 Sensors consistently produce the most accurate results, as compared to the distance values derived using a measuring tape (see Figure C).

4. GPS sensors become increasingly inaccurate as speed and/or vehicle dynamics increase. In Figure D, we see a significant discrepancy in braking distances, even though the L-400 Sensor and the GPS sensor report identical total measured distance results.

5. The CORREVIT® L-400 and S-400 Sensors consistently exhibit outstanding reproducibility and sensor-to-sensor consistency.

Conclusions

Because optical sensors measure relative to ground, they provide a true distance-over-surface measurement. To receive the complete findings of this testing report, please contact your CORRSYS-DATRON Applications Expert.

Distance accuracy as compared to a tape measure

Tape Measure: 23.46 m / 76.97 ft

Sensor	L-400	S-400	GPS
Brake Distance	23.48 m 77.03 ft	23.52 m 77.17 ft	23.8 m 78.08 ft

Tape Measure: 20.70 m / 67.91 ft

Sensor	L-400	S-400	GPS
Brake Distance	20.67 m 67.82 ft	20.73 m 68.01 ft	21.8 m 71.52 ft

Figure C: CORREVIT® L-400 and S-400 Sensors consistently provide more accurate results than GPS, as shown by comparison to measuring tape.

Accuracy in ABS testing

177-0 kph / 109.98 mph, 1.3 g

Sensor	L-400	S-400	GPS
Total Distance	2000.6 m 6563.65 ft	2001.1 m 6565.29 ft	2000.6 m 6563.65 ft
Brake Distance	139.98 m 459.25 ft	140.13 m 459.74 ft	142.0 m 465.88 ft

Figure D: results of high-speed ABS testing.

How can you be certain you're meeting today's strict fuel economy standards?

Since 1983, vehicle manufacturers have paid more than $618 million in Corporate Average Fuel Economy (CAFE) penalties. In order to stay on the plus side of this crucial equation, more and more manufacturers are turning to the outstanding accuracy of CORRSYS-DATRON CDS-DFL Fuel Flow Meters. Designed specifically for mobile vehicle instrumentation, including both passenger car and truck applications, these precision instruments provide exceptionally accurate fuel consumption measurement and outstanding ease of use.

The CDS-DFL measurement principle

Proven in both test-stand and mobile applications, the measurement principle employed by CDS-DFL Fuel Flow Meters is simple, yet precise. Fuel consumption is measured using a value that is based on the quantity of fuel required to maintain a constant volume.

All CORRSYS-DATRON CDS-DFL Systems utilize a precision four-piston counter connected to a single crankshaft. Non-contact Hall sensors convert the rotation of the crankshaft into pulse signals, which are then used to provide fuel consumption data.

Staying cool under pressure

As fuel is circulated through the vehicle system, its temperature constantly changes. Cooler in the fuel tank and warmer in and around the engine, temperature variations within the system can produce corresponding increases and

decreases in fuel volume. Consequently, fuel temperature must be held within a known range.

The CDS-DFL-WT Heat Exchanger ensures maximum accuracy by keeping fuel temperature – and volume – constant. Used in combination with the CDS-DFL 1 Fuel Flow Meter, the CDS-DFL-WT provides an outstanding basis for assuring compliance in passenger car and light truck applications.

Heavy duty accuracy

Although government standards have placed a great deal of emphasis on fuel economy for passenger cars and light trucks, fuel consumption is no less important in the heavy truck industry. Faced with increasing pressure for improved fuel economy from fleet owners, as well as from tightening governmental regulations, heavy truck manufacturers also appreciate the advantages of CDS-DFL Systems.

The CDS-DFL3 Sensor, which is designed for high-volume, diesel fuel applications, makes heavy-duty testing easy and accurate. Like its lighter-duty counterpart, the CDS-DFL3 Sensor features automatic ventilation and heat exchanger components.

Easy to set-up, easy to use

CORRSYS-DATRON CDS-DFL Systems use quick-connect couplings to make test set-up fast and easy. The systems also incorporate new filtering technology to maintain fuel system integrity and function.

For more information about CORRSYS-DATRON CDS-DFL Fuel Flow Measurement systems, contact your nearest CORRSYS-DATRON Applications Specialist today, or visit us online at **www.corrsys-datron.com/fuel_flow_meters**.

Consider the advantages of CDS-DFL Fuel Flow Measurement Systems:

- For all commercial or passenger vehicles
- Gasoline or diesel fuel
- Fuel-injected or traditional carbureted systems
- For in-vehicle and test-bench applications
- High measurement accuracy
- Heat exchanger holds fuel temperature, volume constant
- Installs directly into the fuel system via quick couplings
- Negligible service and maintenance requirements as a result of durable technology
- Tested and used under extreme environmental conditions

Cutting-edge slip-angle measurement solutions for government compliance testing *(continued from page 1)*

A typical ESP test set-up includes these CORRSYS-DATRON Sensors:

Sensor	Measured Parameters
CORREVIT® SF II-P	Wheel slip, longitudinal and transversal speed
Wheel Pulse Transducer	Wheel speed
HT-500	Ride height
RV-4	Wheel position
Measurement Steering Wheel	Steering wheel position, angle, torque
Pedal Force Transducer	Brake pedal force

A typical ABS test set-up includes:

Sensor	Measured Parameters
CORREVIT® SF II-P	Wheel slip, longitudinal and transversal speed
Wheel Pulse Transducer	Wheel speed
Pedal Force Transducer	Brake pedal force

Complete testing configuration information is available online at www.corrsys-datron.com/faqs

Contact CORRSYS-DATRON today for more information about these and many other outstanding dynamic measurement solutions:

www.corrsys-datron.com