Indy Innovation

The heart of Indy racing will always be technology, but innovation and public interest may depend on a new face.

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ASSOCIATE EDITOR

When IndyCar racing took a hard look at itself, it saw a need for greater innovation and creativity: the cars are nearly identical, and innovation — when it happens at all — is incremental. It wanted something new.

A FRESH PAIR OF EYES

The league asked the Art Center College of Design in Pasadena to reimagine the 500 and the whole IRL experience. The IRL chose students because it felt racing enthusiasts would be less creative. The students, some of whom had never seen a race, were not hampered by technological concerns.

Thirty undergraduate students visited the Brickyard last May, taking extensive notes, snapping hundreds of photos, and doggedly questioning IndyCar Series and Indianapolis Motor Speedway officials. The research, part of a semester-long project called IndyCar 2011, was designed to propose a dramatic new look for the IndyCar Series, and possibly all of motorsports. The students — from the transportation, product, entertainment, and environmental-design departments — were asked to design a new kind of car and to rethink other aspects of the sport, up to and including the racetracks.

"What we saw was evidence of why this transdisciplinary approach works so well," says Terry Angstadt, president of the commercial division of the **Indy Racing League.** Most of the student

Danica Patrick or Speed Racer? Students from the Art Center College of Design in Pasadena conjured this new look as part of the IndyCar 2011 project.

designs (possibly influenced by the student trip to the Brickyard) adhered to the familiar open-wheel, rear-engine design.

The work was done progressively, like a normal 14-week semester, and the students made presentations about three-fourths of the way through. This gave IRL and Honda a chance to offer guidance. About half of the students designed cars while the rest worked on such things as graphics.

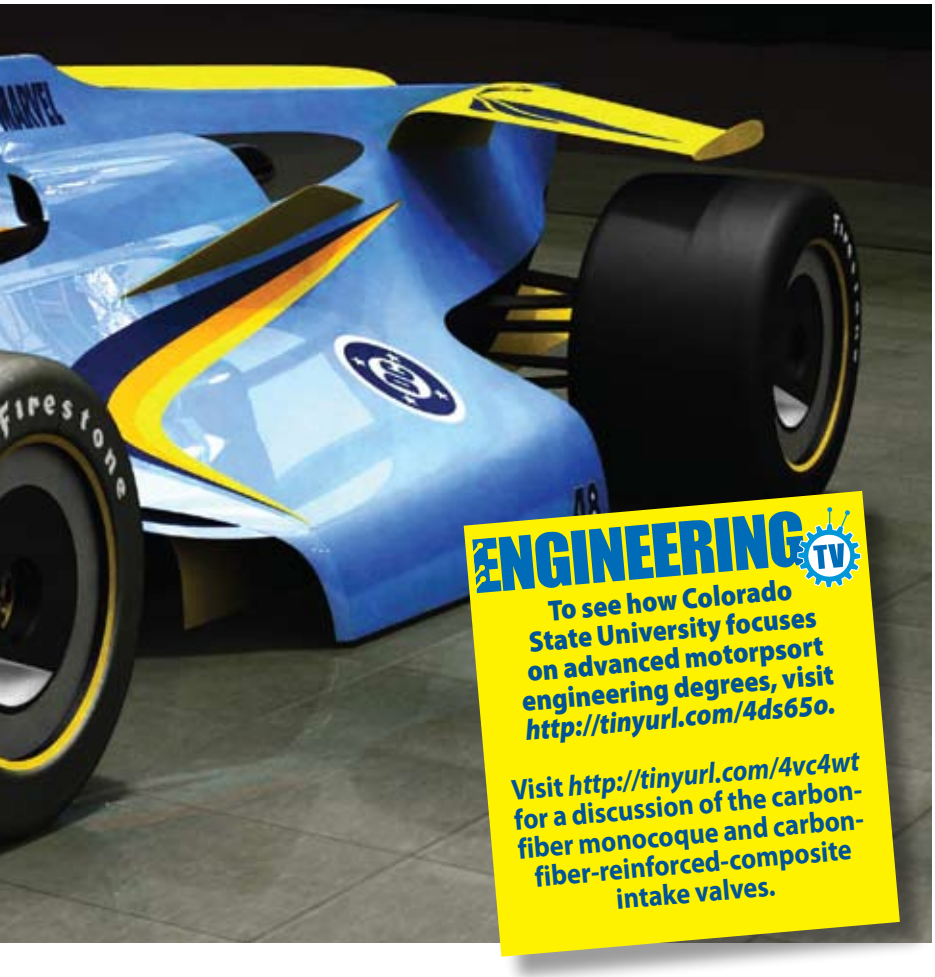
The project arose when IndyCar officials and Honda Performance Development President Robert Clarke visited the school and were inspired by an Acura-sponsored project in which students designed a new vehicle. "All racing cars have evolved over time. They've become more pieces of engineering than design. I think it's critical to bring back the design element. But you can't have one without the other," says Clarke.

Honda and IRL management were looking for something beyond incremental improvements, and IndyCar 2011 could set the pace.

LISTENING IN

Driving an open-wheel rocket around an oval track with a few dozen of your friends is not without considerable risk, but plenty of effort goes into making professional motorsports as safe as possible. One example is an earpiece sensor from **Delphi Corp.,** Troy, Mich., that measures dynamic forces to a driver's head during impact. The device is used by the Indy Racing League, NHRA, GM Racing, and Champ Car.

Small accelerometers in the earpiece measure changes in linear force. Three accelerometers



ENGINEERING TV

To see how Colorado State University focuses on advanced motorpsort engineering degrees, visit *http://tinyurl.com/4ds65o.*

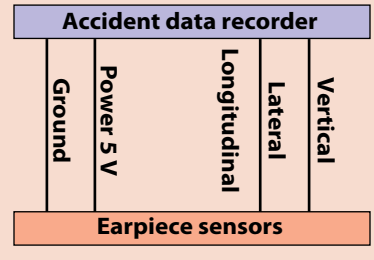
Visit *http://tinyurl.com/4vc4wt* for a discussion of the carbon-fiber monocoque and carbon-fiber-reinforced-composite intake valves.

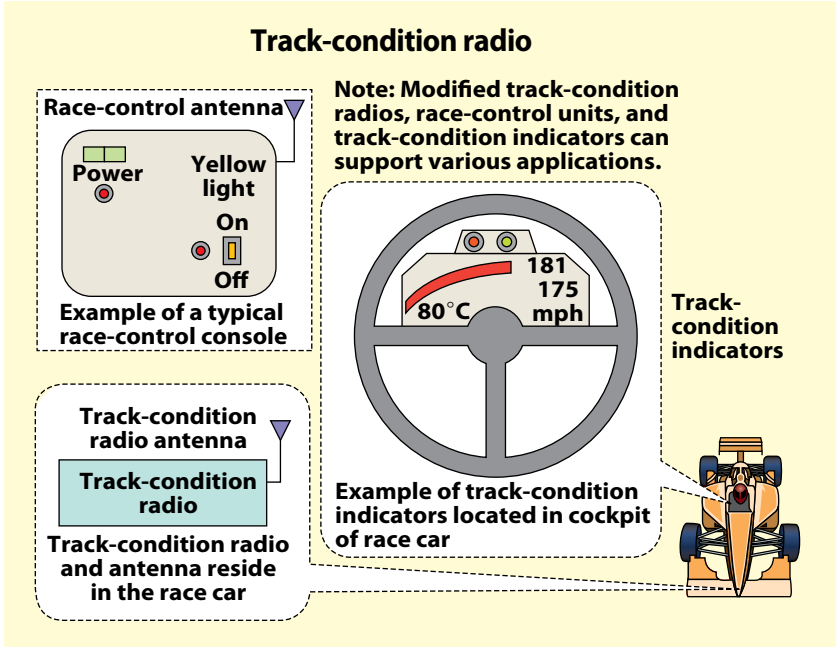
INSIDE THE DELPHI EARPIECE SENSOR

The earpiece sensor measures the dynamic forces applied to a driver's head during an accident. The radio earpiece contains six small accelerometers — one for each of the three axes on each side — to measure head acceleration during an accident. Combined data from the earpiece sensor and the onboard accident-data recorder offer a detailed picture of what happens in a wreck.

Dimensions	0.39. × 0.41 × 0.26 in.
Weight	0.105 oz
Temp. range	–0 to 70°C
Supply voltage	5 V
Supply current	3 mA
Output voltage range	0 to 5.0 V
Measurement range	±250 *g*
Sensitivity	8.5 mV/*g*
Filtering	400-Hz, two-pole Bessel filter
Prefilter headroom	1,400 *g*

Earpiece sensor wiring diagram





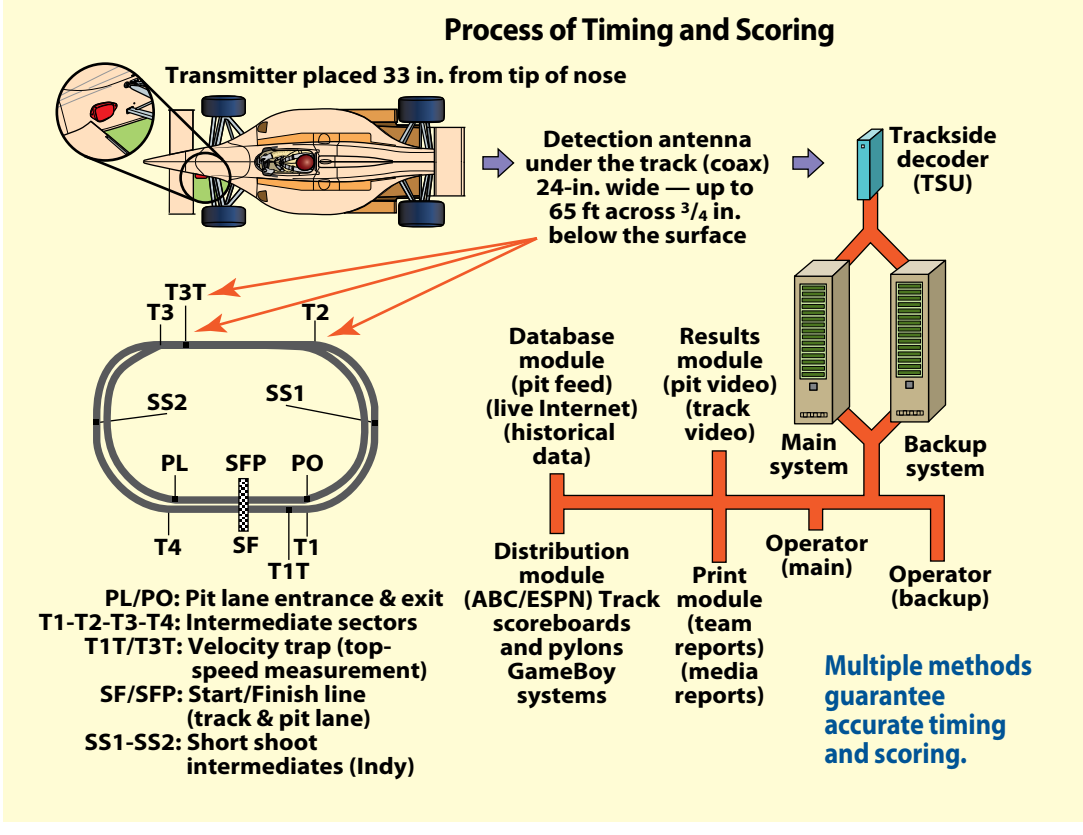
in each earpiece measure vertical, lateral, and longitudinal *g* forces at the moment of impact. Instruments interpret accelerometer signals as changes in the car's direction or velocity. The amplitude of the accelerometer voltage corresponds to the *g* load at the time of the incident.

Following a crash, information from the earpiece downloads to an accident data recorder or "black box." The information is also sent to a laptop and analyzed. The data helps engineers evaluate safety devices such as shoulder harnesses, seat belts, and head and neck restraints.

All IndyCar Series drivers since 2003 and Indy Pro Series drivers since 2004 have worn earpiece sensors. The device not only records crash data, but it blocks exterior sound and wind from the driver's ears and handles pit-to-car audio communication. But race-car drivers aren't the only ones getting knocked around.

The IndyCar Series shares crash-impact and injury data with engineers at the Air Force Research Laboratory at Wright-Patterson Air Force Base in Ohio. Researchers at the base can't duplicate the gravitational forces that IndyCar Series drivers experience so they borrow the data to aid development of safer helmets, harnesses, and ejection seats for pilots. Military researchers were amazed at the forces race-car drivers endure without incurring serious injuries.

The Air Force intends to develop the ejection seat and harness for the Joint Strike Fighter (JSF), the next-generation, all-purpose fighter jet. Pilots ejecting from a JSF can get slammed by 700-mph blasts of wind, and get hit again when their parachutes open. The forces can injure a pilot's head, neck, and upper body. The IndyCar Series also shares its research with the automotive industry.



KEEPING "TRACK"

On the side of each Indy car, 33 in. from the tip of the nose cone, is a radio transponder with a special identification number. Multiple detection-loop antennas in and around the track re-

cord the passing time and ID of the radio transponder attached to each car. The information is recorded and relayed to the timing and scoring booth via a trackside decoder. The data includes all passings and times, to the ten-thousandth of a second. Primary and secondary scoring computers, also known as servers, determine the results of each session.

Several other systems back up the main electronic scoring. A high-speed camera, which takes 10,000 pictures/sec, records all Start/Finish line passings. The camera played a vital role in determining the winner at Kansas Speedway in 2004 when Buddy Rice edged Vitor Meira by 0.005 of a second. Two high-frame-rate cameras connected to a digital video system also record the Start/Finish line passings. In addition, manual scoring provides a written record of all crossings.

The scoring computers feed live timing data to each team's pit via the timing and scoring stand in pit lane at the Start/Finish line. All data recorded at each race is archived and available to teams, manufacturers, and race officials via the Internet.

SEEING IS BELIEVING

The IRL Dallara race-car model was specifically designed for the Striker Simulator, a formula open-wheel trainer. The trainer offers an authentic racing experience for professional drivers, teams, or anyone who wants the thrill of driving a race car without the risk.

One electric stepper actuator controls each of the trainer's three axes of motion. The user operates the trainer just as they would a real race car. Data acquisition provides feedback on runs for driver or team review. The lifelike experience comes courtesy of 50-in. plasma displays, force feedback steering, paddle and sequential shifters, adjustable hydraulic pedals, remote management, and motec data-logger support.

The Striker is a fully loaded turnkey simulator. The user simply plugs in the ac power and presses the starter. The software simulates hundreds of tracks and cars. **MD**

STRIKER SIMULATOR

Motorsport Simulators LLC, Valley View, Tex., and **iDT Simulations** designed and built this simulator and model on an all-aluminum welded tubular chassis. The suspended formula tub is a Pro Mazda replica. Hydraulic pedals, forced-feedback steering, detachable Momo steering wheel, shift lights, and paddle and sequential shifters duplicate the action of Indy racing. The trainer features three axes of motion, 3 × 50-in. plasma displays, 5.1 high-fidelity sound with dual bass shakers, and a liquid-cooled, rack-mounted computer.