

# A paradigm shift

William Kimberley on a new company with intriguing new products

MagCanica is hardly a name that rolls off the tongue easily, nor is it particularly easy to remember, but to Sami Bitar, its founder and president, it signifies just what he wants it to mean. It refers to magnetomechanics with the Canica bit implying its Italian heritage. In fact, the company is based in La Jolla in California, the Italian connection being Bitar himself who was born in that country.

MagCanica, a hi-tech startup company formed two years ago, is developing a number of technologies for motorsport and beyond, in a number of different areas including magnetoelastic torque sensing and control, magnetoelastic force sensors, magnetoelastic actuators and mechatronic system development. The core expertise and current product development revolves around magnetomechanics and non-contact torque sensing.

Holding a master's degree in mechatronics from Stanford University, Bitar joined Ford in Detroit where he found himself initially working on "smart" headlights. Some months later he joined the electronics department of Ford Motorsport.

The goal of his motorsport assignment was to identify and develop a torque sensor technology for the Stewart Grand Prix Formula One car. After literally scouring the world for an appropriate technology and partner, Sami came across someone who was to not only help make the project happen, but also to change the course of his life. One of the world's top experts in torque measurement and magnetoelastics who at the time acted as a consultant to Ford, Ivan J. Garshelis is in fact now MagCanica's Chief Technical Officer.

Beginning in mid-1996, Bitar, Garshelis and a wider development team continued on with the project to see it finally fitted to the Stewart for the final race weekend of the season in October 1997. A successful outing, it became the talk of the Ford sensor community. Following successful revisions of the torque sensor system in 1998 and 1999 on the Stewart Grand Prix car, Sami then

joined Visteon's sensor department, working on a new application of the torque sensor technology to road car electric power steering systems.

A few years later, following a series of reorganizations at Ford and Visteon that effectively delayed the deployment of the torque sensor technology, Bitar and Garshelis concluded that the technology could most rapidly be brought to market through an independent startup venture. The result was the creation of MagCanica, which was founded in February 2000, with Bitar working to sensitize the worldwide technical community to the opportunities that the technology offers, and Garshelis leading the technical effort. In Sami's words, "Ivan is the DNA of the company; I try to spread the good word".

MagCanica's developments to date include a driveshaft torque sensor system developed specifically for Formula One, which constitutes a significant step forward with respect to prior generations of the technology. The "smart" driveshaft functions as both a load-carrying mechanical member and as a naturally wireless torque transducer. Driveshaft torque measurement is a fundamental parameter in evaluating and improving the performance of a racing car. Such information is typically very difficult to measure on the track, and heavy reliance is made on laboratory dynamometer data and lap simulation models.

Modelling the complex interactions among gearbox, final drive, and aerodynamics can be prohibitively time-consuming and costly. Thus from powertrain to chassis to aerodynamic analysis, the torque actually transmitted to the driving wheels constitutes an invaluable performance metric. Since then, newly freed-up F1 electronics regulations have only made torque measurement even more useful. Specifically, three major uses for a driveshaft torque signal can be identified:

1. Actual horsepower measurement and in-vehicle dynamometry

2. Tuning and/or real-time control of the full powertrain (engine, clutch, gearbox, differential)

3. Aerodynamic drag estimation and correlation with wind tunnel data

Under licence from Chicago-based MDI, MagCanica has now become a niche manufacturer of magnetoelastic torque sensors and associated control systems. Its initial fields of application include motor racing - engine, transmission, steering shafts, and aerospace - helicopter rotors and turboshaft engines. Remarkably, within only two years of its founding, MagCanica already has contracts in place with a number of Formula 1 teams as well as with the U.S. Navy. In an effort to build on the initial successes of its torque sensor programs, the company is about to undertake new in-house developments in such diverse areas as magnetomechanical actuators, and non-contact (magnetoelastic) load cells to be applied to suspension members such as pushrods and track rods.

It is still in its early days but Bitar feels confident that what MagCanica has is a kernel of technology that before long will be sought by companies both in motorsport as well as in other industries. With Garshelis leading the design team, and a group of several young Stanford mechatronics engineers developing and implementing his ideas, MagCanica is following a highly interdisciplinary approach and trying to blend the best of traditional and modern engineering practice.

It is a paradigm shift, but successful implementation in the racing applications ought to help accelerate torque sensor developments in mainstream automotive applications such as power-assisted steering and torque-based powertrain control. Hopefully for MagCanica, its track record with developing torque sensor technology will open the way for analogous developments of other new useful devices. ■