Position sensors

By John Golby & Victor Zhitomirsky

Position sensors are an essential component in almost every product and industrial manufacturing process and, as they can enable significant improvements in performance and efficiency, new developments in sensor technology can help to differentiate otherwise commoditised products. With more than a decade's experience in sensor development, we have invented several position sensor technologies which combine the benefits of non-contact operation with outstanding price/performance ratio.

Our position sensors comprise three elements: a 'scale', (made from low cost printed circuit board, or PCB) which measures position; a 'target', placed on the moving part; and the signal processing electronics. To date, optimum sensor performance is obtained by combining the scale with a 'resonant' target; this target (a small piece of PCB with a printed coil and a capacitor) provides a larger signal which simplifies subsequent signal processing.

Now, using full 3D electromagnetic simulation of the scale and target, we have designed non-contact sensors capable of using metal only as the target. This allows us to measure the moving part directly rather than an additional target, which may be awkward to fix to the moving part and is always at risk of falling off or becoming damaged. In a further development, we have adapted our sensors to use magnets as targets, allowing the sensors to 'see through' metal walls.

Our improved sensor design process has also led to the development of longer 'multi-period' position sensors. Currently, the shorter the sensor the greater the accuracy, but certain applications – such as hydraulic cylinders – need accurate position sensors of several hundreds of millimetres in length. We have designed such sensors with absolute accuracies of <50um and resolutions of <10um. The compact design of these sensors, and their minimal 'dead zone' delivers additional cost savings when compared to technologies such as magnetostrictive time of flight sensors.

Signal processing algorithms have also been enhanced and we have incorporated them within a low cost Programmable System on Chip (PSoC) device. Since all the control signals are directly referenced to the PSoC master clock, the sensor can operate over a temperature range of -40°C to +150°C with an impressive stability of 2-3 parts in 12,000, making it ideal for automotive applications. The sensor itself can operate at higher temperatures with remote electronics, and we are currently developing such a system for jet aircraft engine controls.

Our new position sensor technologies remain low cost while delivering significantly improved performance, and have generated considerable interest from both sensor manufacturers and product developers. Current application areas include the aerospace industry, and medical products such as surgical robots, automatic operating equipment and injectors. In the automotive industry, licensing agreements are already in place with TT Automotive, with newer sensors available for accelerator pedals, transmissions and steering wheels. Utility meters also use our sensors, such as the Sensus ECRIII and Master Meter's Accu*Linx* water meters, and many more applications exist in industrial automation, where a licensing agreement with Novotechnik has recently been finalised (see p3).

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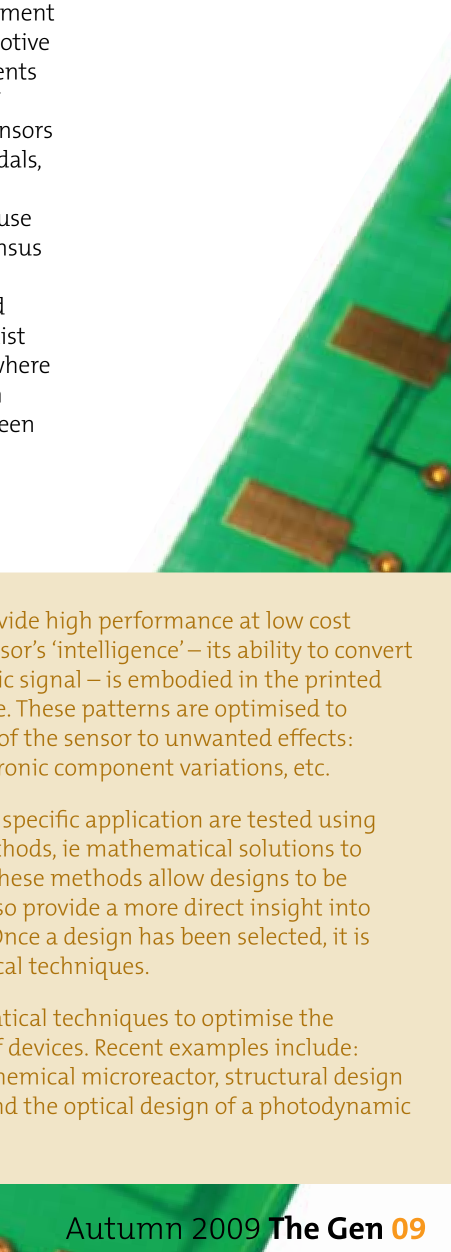

Our position sensors provide high performance at low cost because much of the sensor's 'intelligence' – its ability to convert position into an electronic signal – is embodied in the printed track pattern on the scale. These patterns are optimised to minimise the sensitivity of the sensor to unwanted effects: mechanical offsets, electronic component variations, etc.

Initial 'trial' designs for a specific application are tested using analytical modelling methods, ie mathematical solutions to the EM field equations. These methods allow designs to be evaluated rapidly, and also provide a more direct insight into the underlying physics. Once a design has been selected, it is optimised using numerical techniques.

We use similar mathematical techniques to optimise the design of a wide range of devices. Recent examples include: thermal design of a biochemical microreactor, structural design of hospital mattresses and the optical design of a photodynamic therapy system.