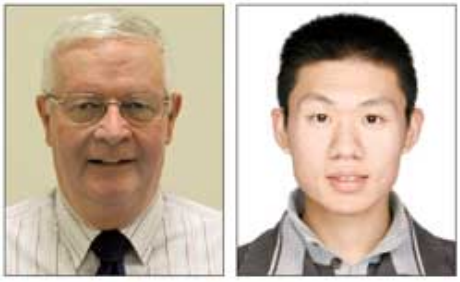
Solving the Water and Metal Problem

It’s a well-known fact that conventional electric dipole RFID label antennas will not work when placed against a metal or liquid surface. Some vendors have introduced metal- and water-friendly RFID tags, but they tend to be expensive and bulky or are designed for a particular application. At the Auto-ID Lab

at the University of Adelaide in Australia, we have been taking two approaches to develop small and inexpensive RFID label antennas that will perform well on hard-to-read products.

The first approach involves the use of a structure called a decoupler, which separates the tag from the effects of the metal or water surface. We've been working with the Sievenpiper decoupler, originally designed for use in mobile phone antennas to shield users from radiation. We identified incident, reflected and transverse waves that exist in the electromagnetic field just above its surface where the tag should be placed. We established that with correct proportions, the reflected waves can be brought in phase with the incident waves, negating the effects from metal or liquids. Now we're investigating the use of the Sievenpiper decoupler with ultrahigh-frequency RFID labels to determine what performance levels can be achieved.



Left to right: Peter Cole, Zhonghao Hu

At the same time, we're researching the effectiveness of the slotted microstrip decoupler, which has a different shape and properties. It involves the use of a simple, very thin (around 1 mm) insulating slab, with appropriately shaped metal plates above and below, that separates the tag from the effects of the metal or water surface. It's a low-cost solution, especially when the decoupler is manufactured with printed electronics using metallic inks.

Another aspect of our research is focused on fractal antennas,

designed for tagging small objects. Fractal antennas are based on intricate, repeating geometric shapes. Their smaller size makes them less expensive to manufacture than dipole antennas. Unlike dipole antennas, which generally have length but not much width, fractal antennas attempt to make good use of space in two dimensions. Our investigation is concentrated on the behavior of radiation and loss resistances. In particular, we are examining how these parameters vary with size, and how well the values can be made to match to the resistance and reactance parameters of RFID chip circuits, and at what efficiency.

Results so far suggest that good efficiency can be obtained with a significant reduction in size, and that an appropriate combination of resistance and reactance for matching to common chip circuits can be obtained. Our research also explores how fractal antennas will perform near metals and liquids, with and without a decoupler. Stay tuned.

Peter Cole is the research director of the Auto-ID Lab at the University of Adelaide in Australia. Zhonghao Hu is a research associate at the lab and a postgraduate student in the university's School of Electrical and Electronic Engineering.