

RNI: DELENG/2005/15153

Publication: 15<sup>th</sup> of every month

Posting: 19<sup>th</sup>/20<sup>th</sup> of every month at NDPSO

No: DL(E)-01/5079/11-13

Licensed to post without pre-payment U(E) 28/2011-13

Rs. 100

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ISSN 0973-2136

# Coordinates

Volume IX, Issue 9, September 2013

THE MONTHLY MAGAZINE ON POSITIONING, NAVIGATION AND BEYOND

100<sup>th</sup> Issue

**Positioning, navigation  
and beyond  
issues, priorities  
and challenges**

# Positioning, navigation and beyond

Experts share their views on issues, priorities and challenges on the occasion of 100<sup>th</sup> issue of Coordinates

## Growing realisation of the limitations of all GNSS



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Systems. Professor Emeritus, University of Bangor, Wales and Past-President of the Royal Institute of Navigation.

During the 100-issue lifetime of Coordinates magazine, new navigation satellite systems have joined GPS and there has been a growing realisation of the limitations of all GNSS. Satellite Navigation has been an outstanding technical development of the last quarter century: it has brought great benefits to mankind without polluting the environment or frightening the horses; everybody loves it! But, as with every innovation, the euphoria eventually gives way to reality and a willingness to recognise and address its limitations. Understandably, the USA has led the way here with its early recognition of the vulnerability of GPS to jamming, interference, solar weather and spoofing. In contrast, many European and Far Eastern nations, caught up in the excitement, effort and high costs of developing new satellite systems, have closed their ears to any talk of their imperfections.

The vulnerability of GNSS is seen most dramatically at sea. Shipping, in marked contrast to aviation, which has retained legacy technologies, has

come to rely almost entirely on GPS for navigation even in the busiest seaways in the lowest visibility. Multiple GPS receivers drive multiple systems on the ship, often in ways no-one aboard understands. Low-level interference causes not only loss of service, but also false positions and velocities, which appear without warning. Even the ship's radar and gyrocompass - apparently independent of satellite navigation - turn out to be linked to GPS. These are major safety concerns. Not surprisingly, nations are now turning to Enhanced Loran as a source of PNT wholly independent of satellite navigation, yet compatible with it.

Applications of GPS have expanded rapidly into those financial and legal areas in which new technology is rigorously tested in the adversarial processes of the courts. In many countries, GPS evidence in criminal prosecutions must meet the stringent standard of "beyond reasonable doubt" - when challenged by lawyers who are fully briefed on the multiple vulnerabilities of the technology. They will probe the substantial position errors due to multipath propagation in dense urban areas. Disputes over payments in GPS-based road user pricing schemes, claims of theft by delivery drivers, and the behaviour of motorists whose vehicles are

fitted with telematics insurance units are all coming into the courts. As *Coordinates* magazine enters its second hundred issues, these matters will be tested and some of them resolved. I will be paying particular attention to watching the developing use of spoofing: commandeering GNSS receivers by transmitting false signals. Once just a theoretical possibility, spoofing has now been demonstrated and effective equipment is becoming available. This provides mouth-watering opportunities for practitioners in the criminal arts of hijacking and stock-exchange fraud - on all of which *Coordinates* magazine will no doubt keep us well informed in the next 100 issues. ▽