

2011 EISSI Awards Winner

for University Student Project of the Year

CORS: The possibilities are endless



Various Continuously Operating Reference Stations in the CORSnet-NSW network.

Nic Gowans and Craig Roberts

Forget everything you know about surveying. Put yourself in the mind of an everyday person. You love technology, you love gadgets. Your smartphone is never out of reach. You've got more apps than phone contacts. Exploring the web for the latest technologies, you learn there's a service that can provide sub-metre and even centimetre accuracy positioning. Your handheld recreational GPS unit is abruptly looking dated. But what benefit could this service give to you? And how would you use it?

Now forget you forgot everything you know about surveying.

"CORS: Who Wants It?" was an undergraduate thesis which investigated the swag of emerging Global Navigation Satellite System (GNSS) Continuously Operating Reference Station (CORS) networks across Australia. The thesis examined a range of CORS networks available and evaluated

this technology on its strengths, limitations and general applications. It sought to answer the big questions like "Who wants it?" and "Can one network service every user?"

A CORS network is used for improving GNSS positioning. It takes the place of a traditional owner-operated base station in the classical base-rover GNSS set up. Positioning based on CORS networks is being used in a variety of industries: precision agriculture, machine guidance, surveying, asset mapping, science, etc. So how do you evaluate CORS performance across so many different user groups?

Ask the users

This thesis sought a general review of CORS technology from the user groups listed earlier, i.e. those "who want it". A representative from various user groups was interviewed to determine how they used CORS networks, what benefits it brought and what the limitations or weaknesses were.

There was considerable range in requirements in terms of precision, accuracy and data rates.

Surveyors were the first to be interviewed; one in an urban area and one in a regional area. The applications were varied and this was generally due to the availability of established survey control near the job. Costs were reduced as the surveyors no longer needed to own a base station or worry about its security. The increased productivity gained from not having to set up or take down a base station every day was also a great benefit of CORS networks. The urban surveyor was satisfied with the horizontal accuracy but critical of the vertical accuracy. The regional surveyor, however, would regularly use CORS-derived heights as low-order benchmarks. It was described as an essential service for rural areas and a godsend.

CORS applications in machine guidance range from autonomous haul trucks to civil earthworks (often with laser augmentation for improved height accuracy) and even into agriculture. The benefits in construction are generally increased productivity, while precision agriculture sees increased crop yields and decreased soil compaction. The concern here is reliability. There is some reluctance to depend on a service which is out of the farmer or dozer driver's control.

Underground services would benefit from CORS-derived asset mapping as *Dial Before You Dig* plans are often inadequate and difficult to interpret. This particular application has a low accuracy requirement; accurate enough to dig a hole in the right spot. However, an accurate AHD height in place of the traditional depth from the natural surface level is a great improvement. Once the natural surface changes due to road regrading or other construction, that depth is of little value.

Scientific applications include but are not limited to modern geodesy. CORS are used in geodesy to monitor the motion of tectonic plates, contribute to sea-level studies, realise Australia's reference frame and contribute to global services such as the International GNSS Service (IGS). In other areas of science, such as in water research, CORS can be used to monitor changing sand volumes along beaches and estuaries. The estuary floor level can be measured by pairing CORS with an echo sounding device.

Common concerns from all users were those of mobile phone coverage and CORS service reliability. Most interviewed thought the current annual subscription costs were reasonable, however there were some comments about the relatively high cost of mobile data plans in Australia by international standards. There was also a desire for legal traceability from surveyors and in underground service location.

Ask the service providers

After the users, the service providers were interviewed to see how they measure up. They were generally asked about where they operate, their goals, the products they offer and which user groups they aim to service.

The CORS network service providers examined were AllDayRTK, AuScope, CORSnet-NSW, GlobalCORS (Checkpoint), SmartNet Aus, and VicMap Position GPSnet. Each service provider offers similar standard products such as data for real-time and post-processing applications, while differences exist in regards to boutique products

such as Virtual RINEX generation, online processing and the selling of data by the epoch.

These service providers fall into two categories: a) Government, and b) Private Sector. Each category has different strengths and weaknesses.

Government networks are generally interested in establishing CORS networks over their entire jurisdiction, either State or Federal, but for varying reasons. Some allow third-parties to on-sell subscriptions and develop applications and services, using the raw data itself.

Private service providers are generally interested in the "bottom line" (i.e. profit) and tended to prefer reselling data from other people's infrastructure. Some may (partially) own their infrastructure while others, acting as Value Added Resellers (VARs), will take feeds from large established CORS networks or base stations operated by independent owners to on-sell to their clients.

During the thesis project, a major issue and recurring message for service providers was duplication of CORS infrastructure. This refers to competing CORS in close proximity servicing the same geographical area. Now this issue has eased somewhat as some service providers are beginning to be able to on-sell the products of infrastructure owners and, in some cases, private service providers are allowed access to raw data streams from each CORS.

On the hunt for the Killer App

The applications described so far are very specialised. There are still many more applications to be developed that will benefit from CORS-augmented GNSS positioning. The most likely reason that CORS applications are undeveloped is that people don't know this positioning service exists. The "Killer App" refers to the elusive application of CORS positioning that's adopted by the masses. It will most likely have something to do with your next smartphone.

The thesis concluded that CORS network positioning is a highly desirable technology spanning multiple industries. CORS can reduce operating costs and increase productivity. Recommendations were made to service providers to promote sharing of CORS infrastructure by commercial arrangements (as VARs or otherwise). This coordinated effort towards rollout and availability of CORS infrastructure and data will contribute to strengthening Australia's geospatial reference frame. Secondly, a greater public promotion of the services offered was recommended, to encourage innovation from new users with clever ideas. This will in turn serve to draw attention to our profession and promote our professional services to the public. A website summary of the thesis is available at <http://www.gmat.unsw.edu.au/currentstudents/ug/projects/Gowans/Thesis/Introduction.html>.

So go on, tell that friend of yours who loves technology and their gadgets about the sub-metre positioning services available. Then ask how it could benefit them and what they would use it for. Who knows... they might just develop that killer app!

Nic Gowans <Nicholas.Gowans@ipi.nsw.gov.au> now works for the Survey Infrastructure and Geodesy branch of NSW Land and Property Information, which operates CORSnet-NSW. Dr Craig Roberts <c.roberts@unsw.edu.au> is a Senior Lecturer in GPS/Surveying at the University of New South Wales. ■