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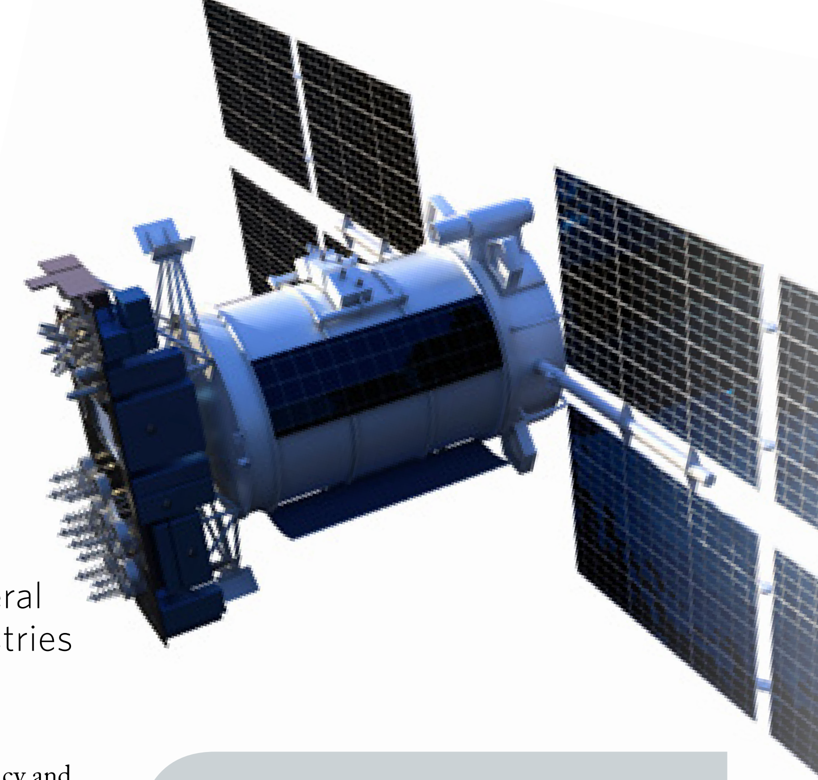
BIG DATA'S MASSIVE IMPACT

How Australian science will harness the data deluge, save lives and boost GDP by $13.7 billion

CRC Association

Perfect positioning



The CRC for Spatial Information is integrating several global navigation satellite systems to benefit industries from mining to agriculture, writes **Phillip English**.

SPATIAL SCIENCE SEEKS to answer what seems to be a very simple question: "Where am I?" If you've ever used a smartphone to find a friend's house and been sent down the wrong driveway, however, you've encountered the main challenge underpinning the spatial sciences – how to provide the most accurate positioning data for a wide variety of disciplines and users. The question of where we are in the world faces a host of technical barriers, many of which can be overcome with the aid of big data.

There are industry projects in the pipeline that will demand a far greater degree of GPS accuracy than what is currently available. These include using GPS to automate fruit picking in orchards, choreograph remote-controlled fleets of ore-transporting trucks, or control swarms of drones to selectively spray weeds. For this, GPS will need to improve to a centimetre-perfect, real-time capacity that takes advantage of big data throughput.

Spatial scientists are touting 2020 as a landmark year for positioning systems, with new and upgraded satellites going up in Russia, the USA, the EU, China, India and Japan. Australia sits snugly in the coverage range for all these systems, which has led researchers at the CRC for Spatial Information (CRCSI) to push for an integrated navigation satellite system, called multi-GNSS.

"The positioning program is driven by the vision to have instantaneous GNSS positioning anywhere, anytime, with the highest possible accuracy and integrity," says Professor Peter Teunissen, CRCSI Positioning Science Director and former ARC Federation Fellow at Curtin University.

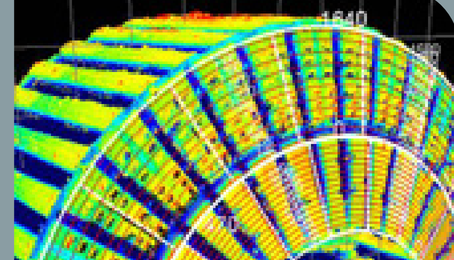
Program 1 at the CRCSI will focus on developing solutions to the very tricky problems that arise from combining data from several sources for the multi-GNSS. Priorities include reducing the effect of atmospheric delay and optimising techniques for using the signals.

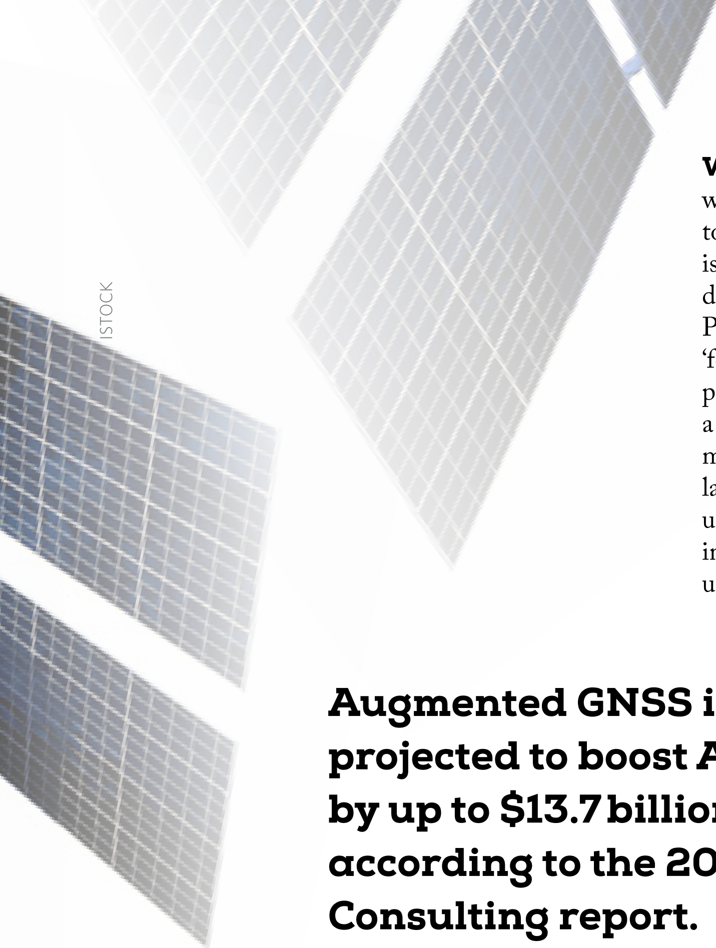
Combining GPS systems into a multi-GNSS requires huge processing power and highly sophisticated software, but the rewards are worth it. The 2013 ACIL Allen Consulting report into the value of augmented GNSS in Australia projected a boost to Australian GDP of up to $13.7 billion by 2020. The industries set to benefit most include mining, agriculture, construction and surveying.

Australia needn't wait until 2020 to take advantage of new systems, however. The Chinese BeiDou satellite program already has 14 fully operational satellites in the Asia-Pacific region. While regular GPS satellites are positioned quite low in the horizon, which means their signals can be blocked by man-made objects, such as skyscrapers, the BeiDou satellites cross at much higher angles. This means they can provide very precise location data to supplement regular GPS signals.

From data to delivery

The technology developed for use in spatial sciences can be applied in surprising places. Scanalyse Pty Ltd was started by CRCSI researchers at Curtin University with the goal to commercialise the laser scanning technology used in their measurements. Scanalyse developed a procedure called MillMapper that uses high-precision terrestrial laser scanners to accurately measure the wear on the inside of grinding mills. This allows clients to monitor and predict the optimum time to replace mill liners, reducing waste, cost and downtime. Scanalyse has since been bought by Finnish mineral processing company Outotec.





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WHILE THE MULTI-GNSS will give Australia a new and powerful tool in spatial sciences, much research is dedicated to making better use of the data and techniques we already have. Program 2 at the CRCSI focuses on 'feature extraction' – the process of producing useable information from a huge amount of data gathered through methods such as photography, terrestrial laser scanning and LiDAR (which uses laser pulses to collect 3D spatial information). For example, Google uses feature extraction to go through its massive Street View image database and blur out faces and license plates to conform to international privacy laws.

Urban development and infrastructure can also benefit from feature extraction. To prevent tedious manual measurement that can disrupt busy roads, for example, modern surveyors will often use cars bristling with laser scanners and GPS to paint a digital 3D landscape. The large amount of data collected this way can then be checked against a range of guidelines.

"Once you've recorded data for a location once, you can do many things with it," says Professor Geoff West, from the Department of Spatial Sciences at Curtin University in Perth, and project leader at the CRCSI. "You can figure out where the traffic lights are, or whether bus shelters are too close to the kerb, for example. It even has the resolution to pick up power lines behind trees to determine if any are too close."

One of the primary aims of the feature extraction project at CRCSI is to automate these kinds of information processes. Laser technology is particularly useful in this endeavour, says West. "Laser data is lovely, because every point is a 3D coordinate, which captures the geometry."

For example, CRCSI's woody vegetation project focuses on making more accurate estimates of biomass using a combination of laser scanners and aerial LiDAR. Laser scanners gather incredibly detailed 'ground truth' pictures of a forest, which researchers use to calibrate the LiDAR data. The fact that the data is collected aerially makes the process cheaper and faster.

"If they can calibrate the correspondence between the two, then they can infer what's on the ground," says West. "Something seemingly as simple as counting trees is very important thanks to initiatives such as carbon offsetting."

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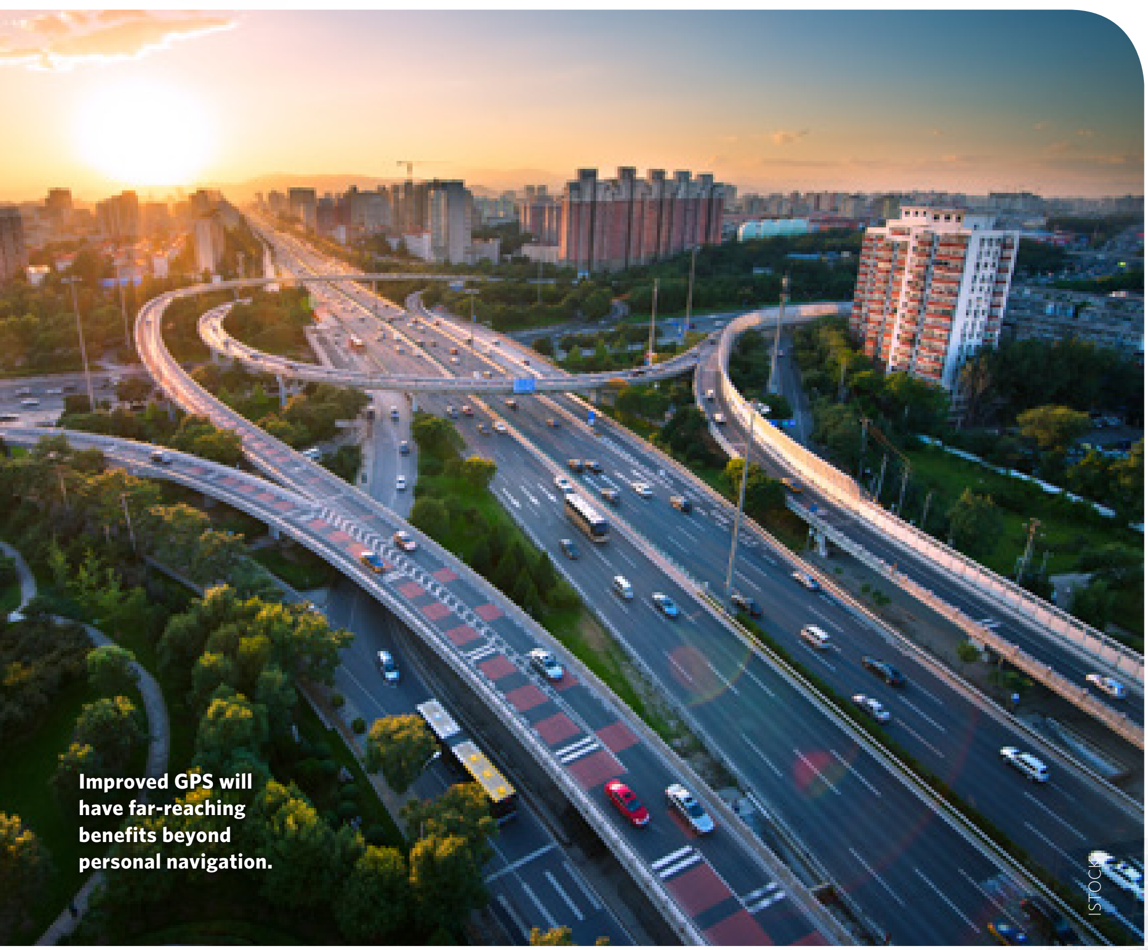

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Improved GPS will have far-reaching benefits beyond personal navigation.