HARVESTING TECHNOLOGY WATCH

Number: HTW-005
July 2010

Summary

TECHNOLOGY WATCH is a biannual report outlining research and technology developments that are occurring outside the FFR Harvesting Theme. The report is divided into the following sections:

- New Logging Technology - Showcasing new logging equipment and technology being developed around the world
- Technology Outside Forestry - Technology being utilised in other industries that could be applied in logging
- Ex-FFR Files - A review of interesting research projects carried out in other FFR research themes
- Global View – What's new in logging from around the world

This issue reviews a new technology for remote controlled logging in an unusual environment and the use of LiDAR to improve harvesting and transportation planning. In Technology Outside Forestry we review GPS-enabled gloves. One of the projects in FFR's Diverse Species theme is using a multi-value approach to plantation forestry. The Global View provides a brief overview of forestry research at Virginia Tech in the U.S.

Dzhamal Amishev, Scion

NEW LOGGING TECHNOLOGY

Remotely Operated Vehicle (ROV) LOGGING:

For several hundred years in North America, lumber companies have lost valuable waterlogged tree trunks to the depths of the rivers used to transport freshly harvested timber.

Relatively recently, modern technology has allowed companies to more efficiently recover these logs that have spent decades under water. A newer, and potentially more promising, area of the industry is underwater logging of trees submerged due to flooding of forest areas for construction of hydroelectric dams. The forests still represent valuable timber, just timber that's harder to get to. Underwater logging is a tough business, with divers descending dozens of metres with hydraulic saws and equipment to harvest trees, or with companies using heavy equipment to pull trees out of lakebeds, roots and all.

Figure 1. Sawfish takes to the water to begin work.

As with most dirty and dangerous—and in this case, wet—jobs, unmanned systems have a role to play. The most advanced technology for underwater logging—an unmanned remotely operated vehicle called the Sawfish™ Underwater Harvester—was developed by Triton Logging Inc. (Figure 1). Weighing 3180 kg, the unique Sawfish provides a competitive edge in underwater harvesting unmatched by other logging companies. Chris Godsall, founder

Future Forests Research Ltd, PO Box 1127, Rotorua. Ph: 07 921 1883 Email: info@ffr.co.nz Web: www.ffr.co.nz

and CEO of Triton Logging Inc., based in Saanichton, British Columbia, in discussing how tough it is for entrepreneurs to enter the industry, says "There have been several companies trying to duplicate what Triton does,"

Triton Logging has spent the past nine years honing techniques, training and methodologies, as well as refining the Sawfish itself. "It's not an inexpensive thing to do," Godsall says. "And, really, engineering is half the battle." The first Sawfish cut more than 10,000 trees. Able to operate at any depth, the Sawfish features eight video cameras and sonar, a 55-inch hydraulic chainsaw powered by a 75-hp electric motor. It carries 50 inflatable/reusable airbags. An operator remotely guides the robotic submarine to a tree (Figure 2) which is grabbed via the grapple saw head and felled. An airbag is then attached to the tree using a drill.

Figure 2. Remote controlled underwater harvesting operation as viewed by operator.

Once cut, the airbag is deployed, bringing the log to the surface for capture and transport. Triton experienced a few bumps in the road during development, but the Sawfish hasn't encountered what Godsall would see as major complications, saying that "surprisingly little has changed over the years". A few of the modifications surrounded the airbags. In early trials the Triton team found that the airbags were too powerful, shooting the logs up to the surface. "We didn't account for the amount of propulsion that would be generated by the airbags, and the trees were being sent up at incredible speed," he says, so an early adjustment was reducing the acceleration power of the airbags. The company also re-engineered the airbag release system.

Triton is now an underwater harvesting specialist, targeting what it sees as an untapped resource. Underwater logging could potentially harvest millions of trees around the world, from Canada to Brazil to submerged Mahogany forests in Ghana, Africa.

The Canadian firm has gained a new contract to harvest the submerged forests of Lake Volta in Ghana, the largest man-made lake in the world. Construction of the Akosombo Dam in 1964 resulted in the submergence of large tracts of forest, and forced the relocation of some 80,000 people to 52 newly-created townships on the lake's higher banks. The value of its untapped timber resource is estimated around US$2.8 billion.

The ambitious underwater logging project, seeking to harvest submerged trees and solve the problem of boat accidents on Lake Volta, whilst creating job opportunities for local Ghanaians, is expected to begin in September 2010.

Project consultants expect the harvesting of over 150,000 cubic metres of wood per year to have a 25-year lifespan for the project. The estimated volume to be harvested means timber from the Volta Lake could account for over 40 percent of the country's total timber output.

Godsall sees Triton at the forefront of the industry, "Our company has one plan. That is to lead this industry," he says. "The Sawfish is the key for us and we're going to continue to use it to open up new markets. Triton remains selective in choosing sites. The main factors are good quality wood, reasonable working conditions and favourable marketing and licensing arrangements," Godsall says.

Future Forests Research Ltd, PO Box 1127, Rotorua. Ph: 07 921 1883 Email: info@ffr.co.nz Web: www.ffr.co.nz

"The biggest challenges are finding partners in countries around the world that share our priorities, and share the priorities of a health environment and long-term opportunity," he says. Triton is also focused on refining its star vehicle, the Sawfish. It has looked into lasers for cutting but hasn't found the right match. It's also open to new applications for its underwater system.

Triton Logging Inc. was recognised as a Canadian Innovation Leader in 2009 by the National Research Council of Canada for linking scientific research to commercialisation, jobs, and economic growth.

A Canadian Innovation Leader is a small- or medium-sized enterprise that demonstrates specific advances in research and development within its industrial sector. Triton Logging was recognised for its research, development and commercialisation of its technologies to recover trees flooded by construction of hydroelectric dams around the world.

Reference:

Honeycutt, G. 2009. Watch that floating tree. Unmanned Systems Magazine, Vol. 27(3).
http://www.tritonlogging.com/home.shtml

Transportation Planning for the Wilson River Watershed in the "Tillamook Burn"

The Tillamook State Forest in Oregon, USA (formerly Tillamook burn) contains roads built for timber salvage after four wildfires that occurred between 1933 and 1951. The terrain is very steep and rocky with many existing roads located next to streams and unsuitable for skyline logging. Some roads have been improved or relocated over time, but a master transportation plan has long been desired, since many areas have either no or inadequate access. Initial transportation planning indicated that timber harvesting would not pay for road construction in some areas for a long time into the future. Additional investigation of roads, harvesting options and costs was required to produce a more comprehensive and achievable transportation plan. This plan will consider road construction costs, environmental risks, and recreation. It will also be used as a transportation planning template for the rest of Oregon's state forestlands.

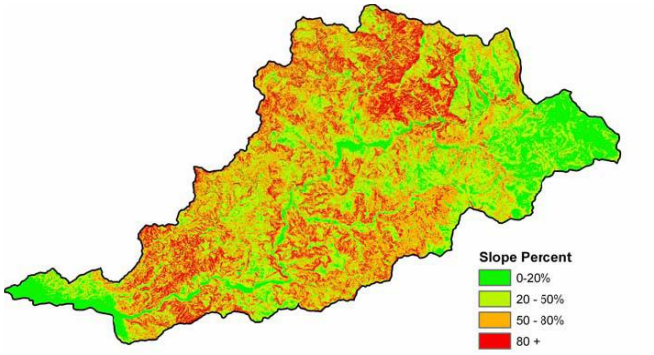

Figure 3. Slopes for road planning in the Wilson River Watershed.

During the process of acquiring data for transportation planning, the biggest data gap identified was the lack of reliable slope data. The Oregon Department of Forestry has been obtaining LiDAR for the watershed. LiDAR (Light Detection and Ranging) is an optical remote sensing technology which measures properties of scattered light to find range and/or other information of a distant target. This technology accurately determines distances to solid objects. Through post processing, pulses that reach the ground can be separated from pulses that hit vegetation. Thus the technique is also being investigated (by others) for determination of forest canopy properties such as tree height, and stand and canopy density).

The use of LiDAR data is expected to provide ground elevation data that is at least 100-1000 times more accurate than data from the current USGS topographic maps. Part of this initial transportation plan will be to compare roads planned using the USGS topographic data to those planned using the LiDAR data. A shaded relief map produced from LiDAR is for the nearby East Fork Trask River is shown in Figure 4.

Future Forests Research Ltd, PO Box 1127, Rotorua. Ph: 07 921 1883 Email: info@ffr.co.nz Web: www.ffr.co.nz

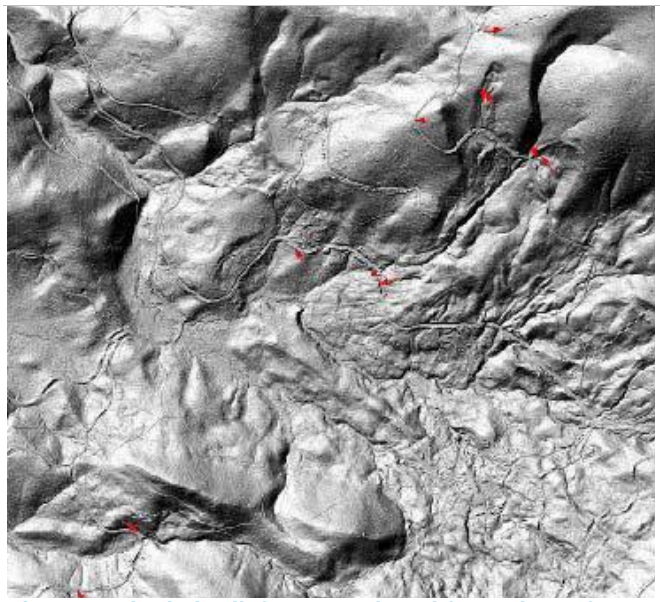

Figure 4. Shaded-relief map produced from LiDAR for a portion of the East Fork Trask River Watershed.

Maps produced from this LiDAR clearly showed roads, including long abandoned roads, old cable yarding roads toward railroad grades, stream initiation points, and deep seated landslides (including those not visible even when walking the ground). It was found that the traditional 1:24000-scale USGS topographic maps (also known as 7.5-minute quadrangle maps) were not adequate for detailed transportation planning in difficult terrain.

Planning for these slopes emphasise using favourable land features that exist on the ground but are not apparent on the 10-metre contour DEM maps. Actual road location required detailed field reconnaissance work and terrain assessment during location, and it was expected that LiDAR data would reduce this need in the future (at least for planning).

Reference:

Mills, K., Lettenmaier, B., Thoreson, R., Teran, B., Miller, G. 2007. Transportation Planning for the Wilson River Watershed in the "Tillamook Burn", *In* Proceedings of International Mountain Logging and 13th Pacific Northwest Skyline Symposium, pp. 53-61, Corvallis, OR, USA.

TECHNOLOGY OUTSIDE FORESTRY

GPS enabled X-Plore.XGX gloves keep track on the slopes

For skiers looking for a convenient way to keep track of the best runs down the mountain winter sports accessories manufacturer Zanier has announced the X-Plore.XGX – the first glove with full GPS functionality. Aside from making sure skiers won't get lost, the GPS enabled gloves also record altitude, speed, distance, duration and other route data for upload to the web once back at the ski lodge.

While on the mountain skiers can check their on-slope stats via a small, monochrome display on the glove's thumb. Then, when they return to the lodge they can connect the gloves to a PC via a USB cable and upload the data using the supplied software for displaying their route and on-slope performance on the web. The glove is controlled by buttons on the back, while power is supplied from an integrated lithium-ion battery.

Figure 5. The GPS-enabled X-Plore.XGX gloves showing the data display.

The X-Plore.XGX gloves are made with Gore-Tex X-Trafit technology to provide optimal grip, comfort and warmth and are supplied with a USB stick, USB cable and lithium-ion battery. Although the gloves are part of Zanier's 2010/11 line, there is no announcement regarding price

as yet, but it is expected they will be available later this year.

This development could be beneficial in monitoring and managing crew productivity. For example, having tree fallers, breaker-outs or equipment operators wear these gloves and download the data afterwards, could provide information to improve management and working practices. It could also be used for training new operators by monitoring and comparing their performance to that of more experienced operators.

Reference:
http://www.gizmag.com/gps-enabled-x-plorexgx-gloves/14254/

EX-FFR FILES

Developing New Production Systems for Multi-value Forests

Projects in the FFR Diverse Species research theme are focusing on building multi-value forest production. These will include breeding for high-value end products such as durable timbers, and for environmental services. The theme's projects address the question: how can we maximise high-value products and other values such as ecological services, derived from plantation forests?

1. The durability of specialty-purpose timbers (e.g. redwoods and cypresses) will be determined using Near Infra-Red technology and live culture testing of cores. Work on Leyland cypress has been completed, and further work on other cypress species and clones is underway during 2010. A work plan for redwood durability has set the agenda for durability testing of redwoods in 2010 -2011.
2. Riparian forest strips will be designed in partnership with Waiariki and Ngati Pikiao to incorporate both Maori and non-Maori values, while providing mitigation of nitrification and productive outputs to the forest or land owner. In conjunction with this, nursery systems will be improved and developed that will ensure high quality cost-effective planting stock, particularly for indigenous species. The nursery and field planting trials aimed at improving plant quality and reducing establishment costs will involve collaboration with Tane's Tree Trust and the Open Ground Indigenous Plants Incorporated Society with funding from the Sustainable Farming Fund and the Lake Taupo Protection Trust.
3. Other projects include the active management of genetic resources, necessary to facilitate new product development and mitigation of climate change. FFR Diverse Species is working with the forestry industry to ensure an up-to-date catalogue of genetic resource plantings, and a long-term plan, and also in developing partnerships with District and Regional Councils to facilitate the planting of genetic resource material on erosion-prone sites or council reserves. This is the only programme in New Zealand that actively manages these genetic resources.

GLOBAL VIEW

Forestry at Virginia Polytechnic Institute and State University (Blacksburg, Virginia, USA)

Virginia Polytechnic Institute and State University (Virginia Tech) runs a Department of Forest Resources and Environmental Conservation (FREC) which is recognised as being one of the top programmes in natural resource management in the United States. With diverse programmes, ranging from

protected areas management and economic policy to forest soil productivity, urbanization, and genomics, critical natural resource issues are approached from many disciplinary perspectives.

The Industrial Forestry Operations (IFO) programme prepares undergraduate students for an active role in ensuring that the sale, harvest, and conversion of standing timber to products is done in an efficient, economic, safe, and environmentally sound manner. Students acquire a solid background in natural resource management integrated with business, engineering, and legal courses.

Along with teaching, research is an integral part of the Virginia Tech Forest Operations team which works in four major research areas related to forest management activities:
1) Evaluating operations with regard to safety, productivity, planning, and logistics,
2) Creating tools to improve the efficiency and profitability of forest operations,
3) Analysing forest business issues such as supply chain management/biomass utilisation, and
4) Evaluating the environmental impacts of forest operations.

Recently completed and ongoing research projects that have been carried out by IFO graduate students include:

- One M.S. level project evaluated the water quality effects of four forest harvesting stream crossings (fords, pole crossings, culverts, and portable bridges). It was found that the portable bridges generally resulted in better water quality and that the stream crossing approach was more important to water quality than the actual type of crossing selected.
- One Ph.D. project examined the effect of different stream side management zones (SMZ) widths and harvests (25 feet, 50 feet, 50 feet with thinning, 100 feet) on water quality. Overall, minimal effects of streamside management zone widths on water quality were found, but findings generally supported use of the existing 50 feet SMZ width. Small areas of high erosion rates that by-passed the SMZ were more detrimental to water quality.
- One M.S. research project in early 2009 focused on an online GIS-based wood supply management system. It concluded good potential for improvements once the process was streamlined through the supply chain.
- One M.S. student is conducting a study of the potential impact of a wood-to-energy market on the U.S. South's wood supply chain. Important industry players throughout the 13 south-eastern states are being surveyed on the benefits and challenges of biomass utilization.
- One M.S. project is focusing on forest products transportation, including investigating issues such as truck scheduling. It is also conducting a pilot study on the new Blue Ox truck scheduling software.

Reference:
http://www.forestry.vt.edu/IndustrialForestryOperationsOptions.htm

Future Forests Research Ltd, PO Box 1127, Rotorua. Ph: 07 921 1883 Email: info@ffr.co.nz Web: www.ffr.co.nz