Robotics in the Forest Workshop

April 21-23, 2015

Summary of discussions and potential next steps

Introduction

The **Robotics in the Forest** workshop was organized by FPInnovations to pursue several objectives:

- Understand issues facing the forest sector relating to the timber supply chain and the changing workforce.
- Learn from what other sectors are doing to leverage advanced technologies.
- Identify promising technology pathways for future forest machines.
- Create linkages that could lead to future partnerships/alliances.

The workshop consisted of 15 different technical presentations, each one followed by questions and discussion. In addition, the workshop ended with a plenary discussion facilitated by Luc Lebel, professor, Forestry Faculty, Laval University. The goal of this final discussion was to circle back to elements of discussion brought up throughout the workshop and focus on potential next steps. This document is a summary of the key points that were raised throughout the workshop and during the final plenary session.

Plenary discussion summary

Challenges and needs

- The forest environment is extremely variable and thus presents significant automation challenges compared with agricultural and mining situations.
- There is a need to improve human-machine interactions in forest machines.
- Operators should be involved in research development.
- There is a need to increase safety in forest operations (high injury/fatality rate compared with other sectors), particularly in specific high-risk applications such as steep slope harvesting.

- One of the needs around automation and robotics is the shortening of the learning curve with new operators. This is a huge cost for the industry, especially with high turnover rates. Easier machines to operate and shorter learning curves are a must if we are to address the impending shortage of 60,000 jobs forecast by FPAC in 2020.
- Introducing more advanced technology in machines will likely increase their costs, and thus it will be critical to demonstrate value gains (productivity, comfort) that significantly outweigh the incremental costs.
- The forest sector is a relatively small market to absorb significant R&D costs. Therefore, we need to leverage technological developments from other sectors.
- Unlike in mining, the forest sector has a "triangle" of customers—the forest companies, equipment manufacturers, and forest contractors that actually buy the equipment. Often, these three sides of the triangle are not well-aligned in terms of needs and vision. This makes it hard to be "customer-focused."
- Technology needs to be robust, reliable, ready, and cost-effective to be applied in forestry.
- Technical change is easy; business changes are difficult. However, collaboration will be essential to develop step-change innovations.
- In the mining industry, automation and new technology were important during the up cycle. Enthusiasts have tended to oversell benefits. It is thus important to remain pragmatic.
- Leasing equipment can be a means of ensuring that newer, more innovative equipment is regularly introduced.
- In many countries (e.g., Brazil), silvicultural work is still largely unmechanized. Therefore, the opportunities for mechanization and automation are very large for this area of forest operations as well.

Promising technological pathways

- Advanced technologies need to free up the operators from repetitive actions that robots or automation can do more effectively. At the same time, this semi-automation will free up time that can be focused on the more strategic decisions of operations (e.g., planning the next actions, optimal navigation) that will have a greater impact on work productivity/quality.
- We need to focus on taking advantage of the mechanical capabilities of robots and the adaptability of humans. The idea is not necessarily to replace human operators but to have humans working better with the machine systems.
- Because of the variability of the forest environment, self-learning capabilities of advanced automation systems will be key.
- Developments will probably come in incremental steps, initially starting with additional automation of machine functions (e.g., John Deere's intelligent boom control [IBC]).

- Tele-operation, or operating a machine remotely, makes sense if removing the operator from a dangerous situation. It also permits machine design to no longer be focused around an onboard operator. Commercially available teleoperation systems can now be easily added on to existing machines.
- Machines would probably be completely re-designed if the engineers did not have to consider a human operator on board with all that implies in terms of safety and ergonomics.
- It was reported that 3.6 jobs are needed for every robot deployed.
- A wide range of sensors of all types, prices, and effectiveness are now available on the market. Along with greatly expanded computing power, this opens the door to automation and robotics applications that could not even be considered a few years ago.
- Providing the operator with better data, for example, location and volume of piles, allows the operator to independently make better planning decisions where computer-based decision-making systems are not yet available.
- Greater use of sensors can be used to protect machines from premature wear and assist with maintenance scheduling to prolong the life and reduce machine downtime.
- It is possible to use sensors to digitize a tremendous amount of information into data. However, a database is of little value unless the data can be translated into an environment where changes are made.

Possible next steps

- We need to integrate technologies in a coherent, deliberate way that makes sense from an economic and technical perspective. Huge investments will be required so these have to be evaluated and planned with care.
- The feasibility of implementing new technologies needs to be run through a decision-making filter to pick the early winners through a cost/benefit approach.
- There is value in describing “our problems” and letting technology industries come up with solutions.
- R&D costs are so high—witness the billions of dollars invested to meet the new engine emission standards. The sector will need to consider joining forces to share not only the risks but the benefits as well (can we find a scenario where competitors become partners?).
- The mining sector developed an initiative a few years ago called “Mine of the Future.” Many of the technologies currently implemented in the mining sector were mapped out as part of this initiative. It involved a consortium of companies that accepted to work together on this. However, we need to remember that there is a “magnitude-of-scale” difference between mining and forestry equipment in both unit costs and conversely with population (lesser, much more expensive machines versus more, less expensive machines).

- The presentations have confirmed that there is tremendous intellectual “horsepower” on these topics in universities across Canada, and much of this is accessible through the Canadian Field Robotics Network (CRFN). The forest sector, both the industry and the equipment manufacturers, need to establish alliances with this group.
- We need a group of specialists and stakeholders to map out the logical steps and a vision for advanced technology implementation in forest operations over a 5–10 year road map, especially looking beyond traditional boundaries. This will require a mixed group of visionary individuals that cover a broad range of backgrounds and expertise. FPInnovations can serve as a catalyst for setting up this working group.

Figure 1 Overall view of the workshop

Figure 2 From left to right: Moderator JF Gingras, speakers: Matthew Fordham, Philippe Giguère, Shahram Tafazoli, Robert Hall, Timo Kappi, Cameron Ower, Martin Englund, Richard Parker, Ola Lindroos (moderator)

Figure 3 From left to right: JF Gingras, speakers Stewart Baillie, Nariman Sepehri, Doug Pitt, Nathalie Renaud, Maria Hedblom, Greg Baiden