A Three Climbing-Robot for Spruce

Pruning Operations

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**Abstract.** In recent years, the sustainable forest management has become a topic of great interest due to its potential to cope climate change. Indeed, forests act as a storage for CO2, which is trapped as carbon in the creation of organic material, as well as they mitigate some of the adverse effects of climate (e.g., soil erosion, flooding, etc.). In addition, if wood is used as construction material, it still keeps the CO2 trapped while, indirectly, it avoids the emission of new CO2 as no other building materials are produced (e.g. concrete, plastic, etc.). It is therefore necessary both to preserve the forest (e.g., ensuring regeneration, wildfire protection, etc.) and to promote and made more remunerative the use of its products as construction materials. In spruce forests, a proper pruning operation could contribute to the ecological health and fire prevention. It also tends to increase the quality of timbers, especially if executed on live branches, as it reduces the generation of dead knots [1]. In this work, the design and development of a climbing robot for pruning spruce trees is presented. The system consists in a circular ring frame able to close and embrace a tree trunk. From this frame, three evenly space legs, equipped at their extremities with actuated-wheels, close against the bark through the action of elastic elements. This assures a proper contact force between the wheels and the bark (i.e., the platform is stable and capable to climb along the tree), whereas it allows the adaption to different trunk diameters. On the top of the frame a cart, carrying the cutting tool, moves around the trunk guided by a circular rail. In order to guarantee a proper branch cutting, the pruning shear is maintained at the right distance from the bark and in the right orientation by a passive system. A series of sensors collect information about the external environment and the branches to be cut (i.e., localization and diameter) [2]. This allows the control system to manage autonomously the pruning operation, while the operator has only to initially fix the robot to the trunk. The system is powered through an extensible cable from a battery located at the foot of the tree.

**References**

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