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Analysis of human generated crane motion patterns – towards the automation of forestry manipulators

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Using techniques of robotics for upgrading forestry crane control is a concept that has attracted the attention of this industry for a long time. Increasing efficiency, easing the learning process, and reducing operators fatigue, are some of the expected benefits. From the aspect of robotics, a variety of procedures exist for generating motions that can be used to this end, but not all are suited for the complex dynamic environment of the forest work. Using human input has become a well-accepted approach for introducing automated motions that are difficult to plan otherwise. This is known as learning by demonstration and is an approach that can be adapted into forestry manipulators to provide automated functionalities that are easily adaptable according to needs. To develop this concept, we equipped a forwarder with motion sensors for capturing the patterns performed by the crane when it is being operated during normal work. The resulting visualisations of the crane work reveal large similarities in the repetitive movements, but also some differences between how operators used the crane to conduct given movements. Thus, the method enables new in-depths analysis of crane work. Moreover, based on the recorded human data we developed a standard 3D crane work procedure, via a computerized trajectory planning algorithm widely adopted in robotics. The methods used proved useful to capture, analyse and merge human, empirical crane work data into optimised movements that can be used for automation – and naturally also to improve human crane work.