Blunderjack

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Abstract

System description for the timber harvesting machine control system Blunderjack.

1 Introduction

In the field of forest harvesting, many accidents happen because of the dangerous working environment. Event though accidents will happen in the future as well, those that are the result of human error can be eliminated through computational power and computer systems. This is a description of such a system.

2 System Description

2.1 System functionality

The system shall be contained in a forest harvesting machine (in Swedish called "skördare"). Such machines are built for processing timber. The system uses sensors attached to the machine for measuring angles, extension, rotation etc.

It is important to have in mind that the forest is a rough working environment with humidity, dirt and physical demolition so the system must survive both missing sensor input and erroneous sensor input. Even though the system shall not limit the usage of the machine, it must not make faulty decisions causing material damage or, even worse, personal injury to the operator.

The system will be part of the operational system of the machine; in one end commands from the operator will be taken in from a digital joystick and in the other end signals to the hydraulic system will be sent. In addition, signals from the sensors assembled in the crane will be received and interpreted by the system.

The most important system objective is to make sure that no accidents occur. This is done by preventing the driver to make unsafe moves with the arm causing the machine to tip over, or feeding a tree through the processing aggregate in direction towards the cabin, or trying to lift more weight than the machine can handle.

The system will continuously gather information from the sensors located on the crane and in other places on the machine and will also gather information from the control panel in the cabin where the operator controls the crane and the machine.

The system shall at all times prevent so called "dangerous movements". A dangerous movement is e.g. a movement that will make a piece of timber collide with the control cabin. In order to do this, the system will perform calculations on crane movements (rotation, elevation, length and telescope movements), crane load weight, timber feed length and feed direction. If the system decides that the requested movement will cause damage to either the machine or

to the operator, the movement must be cancelled and the operator shall be notified about the action taken.

Velocities and ranges of movements depend heavily of the type of machine the system controls. Because the system shall be able to handle different brands, having different limitations on parts movements, this information must be configurable. To alleviate the installation process, the system comes with configuration parameters for the most common machines on the market, but custom configurations can be added afterwards.

Example velocities and ranges of movements are:

- Rotation: 3,4 m/s, 345 degrees
- Elevation: 2,5 m/s, -2,6 – 4,5 meters calculated from the assembly point
- Length: 3,4 m/s, 0 – 7,8 meters calculated from the assembly point
- Telescope: 2 m/s, 0 – 2 meters
- Feed: 1,7 m/s, no range limitations

2.2 Quality requirements / Goals

In order for the system to be transparent to the operator, the slack time between an input signal from the joystick and an output signal to the hydraulic system (i.e. a movement in the crane) must be less than 0,4 seconds.

Because of the rough operating environment, the system must be robust, in the sense that is shall handle the events of missing sensors and erroneous sensor data.

The safety of the operator must never be compromised.

2.3 System usage

The system will be installed on newer forest harvesting machines, which already have sensors pre-installed. After installation, the system is configured with lengths and weights of the arm, as well as with measures and weights of the machine itself.

2.4 About the description

The goal of this description is to give an introduction and a context to the system. If you find the need to add requirements or to make assumptions, please feel free to do so. Some requirements in this description are vaguely formulated on purpose - you are expected to clarify them. Note that you have to document your assumptions in order to make the reader of the report aware of the changes made.