DESIGN OF A MODULAR CLIMBING ROBOT WITH MACHINE VISION GUIDANCE SYSTEM

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Abstract

The design and construction of a modular climbing robot with machine vision guidance system is presented. During the ship’s construction process it’s a moment when the different blocks are welded in a dry dock. The objective of this project is to develop a versatile mobile robot to do many tasks in the dry dock, like welding and painting, to substitute the scaffolding work.

The robot is designed as a vehicle of three wheels in synchronized configuration that allows make movements in any direction without changing the orientation. A force of attraction is necessary to stick the robot to the ship’s hull. This is provided by three permanent magnets that are placed in the bottom of the robot. The use of permanent magnets is suitable for this application. When an unexpected power loss occurs the robots will not fall down, avoiding dangerous situations.

The movement commands are sent to the robot through CAN bus from a commander unit. Two or more of these robots can work together in cooperative mode to raise heavy weights or structures. In this case all the robots share information across CAN bus.

A real time machine vision system has been developed to guide the robot when it works in automatic mode. This system must be robust enough to be used in a shipyard where is no illumination control. When the blocks are built in the factory the hull panel are prepared for weld. For small plate thickness, square butt preparation is the most common joint, but for greater plate thickness V, Y, J, and U preparations are used. When two blocks are joined there is a groove between them. This groove is detected by the vision system using a multiline laser beam and a camera with an appropriated filter. The camera used for this application is a compact vision system that includes image capturing, image processing and communications capacities. The position and orientation of the groove are directly feedback to the robot. A control algorithm makes the robot follow the join for properly weld operation.