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Hybrid Conveyance System with Automatic Path Planning and Power Assistance

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Abstract: The authors have developed a power-assisted system aimed at solving the following problems in a factory; i.e., a common conveyance system such as an overhead crane using push-button control can pose difficulties for the operator in positioning an object due to the object's vibration. As well, workers often suffer physically from directly moving or lifting heavy objects. In light of this, our proposed system is aimed at lessening the worker's burden while allowing highly precise positioning of an object.

We have previously developed a system for automatic path planning involving sequence control. The algorithm of automatic path planning system can be described as follows 1. An environmental map identifying objects is generated by the slide-ray projection method using laser line makers and CCD cameras. 2. The position of a spot produced by a laser pointer is measured by two cameras, and it is used as the target point of the automatic path planning system. 3. An original orbit to the target point is determined by the potential method based on the map of the environment. 4. The original orbit is reconstructed by feedforward control using inverse dynamics calculation in order to achieve sway control. Thus, our path planning system can convey an object from its initial position to a target point without creating residual vibration. However, this automatic conveyance system was found not to be sufficiently accurate to assemble the upper half of a mold on its lower half in an actual factory.

Here we propose a hybrid conveyance system which combines automatic path planning and a power-assist function for an overhead crane. The conventional system is unable to both transport an object automatically and to manipulate it directly. However, our proposed system can allow an operator to perform both of these functions. By using this hybrid conveyance system, the system first automatically transports an object, then the operator can assemble the object with a high degree of precision by direct manipulation exerting only slight force, if necessary. This manufacturing technique could be especially useful in situations that involve the movement of an object over long distances. Thus, our proposed system can increase productivity and reduce the operator's burden, as illustrated in the video.

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