

Reduced-Cable Smart Motors Using DC Power Line Communication

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Abstract

A novel servomotor design that is powered and controlled through only one wire is presented in this paper. A traditional servomotor needs both a power cable and a control cable connecting the motor to a control amplifier. Cables are bulky, heavy, and expensive and, more importantly, difficult to install and maintain in many applications. Particularly for multi-axis applications, like robots and machine tools, cable harnesses become thick and long, and are difficult to run through a stack of many axes, being a major burden and bottleneck in electromechanical drives. The objective of this research is to eliminate such bulky cables by integrating and consolidating power cables and signal cables into a single wire, and transmitting control signals through the signal wire. Signals are coded by using a CDMA protocol and are superimposed on the single wire that supplies a DC voltage to each motor. In this paper first the principle of reduced-cable smart motors is described, followed by the architecture of signal transmission system using direct sequence spread spectrum. A prototype system is designed, and the signal transmission line is simulated to verify the principle.

1. Introduction

Robots, machine tools and other mechatronic systems have many axes of servomotors to control. Traditionally, as shown in Figure 1, we need numerous power cables to supply the necessary power for those servomotors and signal wires for transmitting sensor signals. Cables and wires have become a bottleneck in electromechanical devices. Especially as the degree of freedom of a machine increases they are difficult to install through a stack of many axes. Mover, Cables are bulky, heavy, expensive and difficult to assemble and maintain in high degree-of-freedom applications. The goal of this paper is to eliminate such bulky cables by integrating and consolidating power cables and signal cables into a single

wire. We will achieve this goal by combining a smart motor architecture with multi access data communication technology.

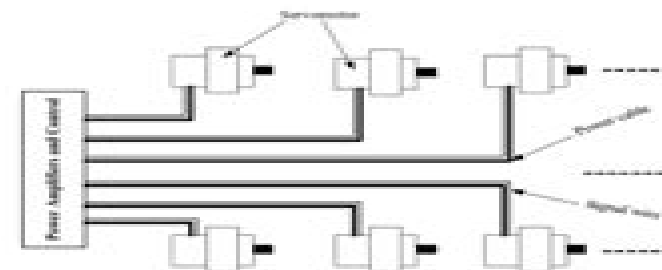


Figure 1 Need of numerous cables for a high d.o.f. electromechanical drive system.

A smart motor, also called an integrated motor, is a servomotor having a drive amplifier and a feedback controller housed inside the motor chassis. It is the type of self-contained motor packaged together with its control units, encoders and sensors, etc. Combining the motor and control allows both parts of the package to be tailored to match the performance of the other. Time saving in setting up and adjusting control system units of the motor is the benefit of this combined drive when it is replaced. Nevertheless, the most important reason to result in the motor-to-controller matching is the benefits we acquire in case of implementation and reduced electromagnetic interference (EMI) by eliminating the long lead length between motor and power amplifier, and then noise can be suppressed. Bigler proposed the prototype design of a smart motor [5], and most of smart motors presently produced have internal structures similar to his design. The most important feature in his design is that all electrical signals between the motor and controller are transmitted via pins, eliminating wiring harnesses of the

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Jin-Ying Zhang



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