



Wireless Communication Module To Replace Resolver Cable In Welding Robots

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Abstract:

My paper is wireless communication module to replace resolver cable in welding robots. It transmits feedback data from the seventh axis of the robot to the serial measurement board which is in the manipulator of the robot. The feedback data which is transmitted is degrees of rotation at which the welding operation is done. Xbee 802.15.4

OEM RF transmission module is used for embedded solutions providing end point connectivity to devices. This is an ideal module for robots to pc or robots to robots communication. This module can give range of 30 meters indoor and 100 meters outdoor. This xbee wireless device can be directly connected to the serial port of your micro controller. It supports data rate of upto 115 kbps.

Key words: *xbee, resolver, microcontroller*

1.Introduction

Wireless communications is the transfer of information between two or more points that are not physically connected. Distances can be short, such as a few metres for television remotecontrol, or as far as thousands or even millions of kilometres for deep-space radio communications. It encompasses various types of fixed, mobile, and portable two-way radios, cellular telephones, personal digital assistants(PDAs), and wireless networking. Other examples of wireless stechnologyinclude GPS units, Garage door openers or garage doors,wireless computer mice, keyboards and Headset(audio), headphones, radio receivers, satellite television, broadcast television and cordless telephones.

ZigBee is a specification for a suite of high level communication protocols using small, low-power digital radios based on an IEEE 802 standard for personal area networks. Zig Bee devices are often used in mesh network form to transmit data over longer distances, passing data through intermediate devices to reach more distinct ones. A resolver is a type of rotary electrical transformer used for measuring degrees of rotation. It is considered an analog device, and has a digital counterpart, the rotary (or pulse) encoder. The most common type of resolver is the brushless transmitter resolver (other types are described at the end). On the outside, this type of resolver may look like a small electrical motor having a stator and rotor. On the inside, the configuration of the wire windings makes it different. The stator portion of the resolver houses three windings: an exciter winding and two two-phase windings (usually labeled "x" and "y") (case of a brushless resolver). The exciter winding is located on the top; it is in fact a coil of a turning (rotary) transformer. This transformer induces current in the rotor without a direct electrical connection, thus there are no wires to the rotor limiting its rotation and no need for brushes. The two other windings are on the bottom, wound on a lamination. They are configured at 90 degrees from each other. The rotor houses a coil, which is the secondary winding of the turning transformer, and a separate primary winding in a lamination, and the exciting two-phase windings on the stator.

2.Related Work

The work of function generate instead of resolver will generate wave forms.It is used to generate a wide range of alternating-current (AC) signals.

Some of the most common waveforms produced by the function generator are the sine, square, triangular and saw tooth shapes. Simple function generators usually generate triangular waveform whose frequency can be controlled smoothly as well as in steps. This triangular wave is used as the basis for all of its other outputs. The triangular wave is

generated by repeatedly charging and discharging a capacitor from a constant current source. This produces a linearly ascending or descending voltage ramp. As the output voltage reaches upper and lower limits, the charging and discharging is reversed using a comparator, producing the linear triangle wave. By varying the current and the size of the capacitor, different frequencies may be obtained. Saw tooth waves can be produced by charging the capacitor slowly, using a current, but using a diode over the current source to discharge quickly - the polarity of the diode changes the polarity of the resulting saw tooth, i.e. slow rise and fast fall, or fast rise and slow fall be either repetitive or single-shot (which requires an internal or external trigger source). Integrated circuits used to generate waveforms may also be described as function generator ICs.

3.Problem Statement

A resolver is a type of rotary electrical transformer used for measuring degrees of rotation. It is considered an analog device, and has a digital counterpart, the rotary (or pulse) encoder. The robots in Ford make use of Tamagawa SmartSyn brushless resolvers. Robots consist of seven axes. Six permanent axes and the seventh axis is for application axis. Data is sent as feedback from the application axis to the serial measurement board (SMB) which is in the manipulator of the robot. Till now a resolver is used to measure degrees of rotation from a DC servo motor which is present in each axis and resolver cable is used to send that data to the SMB. The rotation angle used for welding from 7th axis is taken as feedback to the SMB through resolver cable. The use of cable in each and every axis and in application axis gets damaged. During the welding, clinching, rotating operations. Due to welding actions by robot cable gets cut frequently. Failure of the system even due to minute damage in cable. Production cost of cable is high. Maintenance cost is also high. Connector issues occur frequently. It is not reliable and stops work for several hours.

4.Proposed System

4.1.Wireless Communication Module

In this project we aim at wireless transmission of the resolver output to the controller. I have adopted the technique of converting resolver output (analog) to digital signal and transmit it using XBee transceiver module and then reconstructing the analog signal.

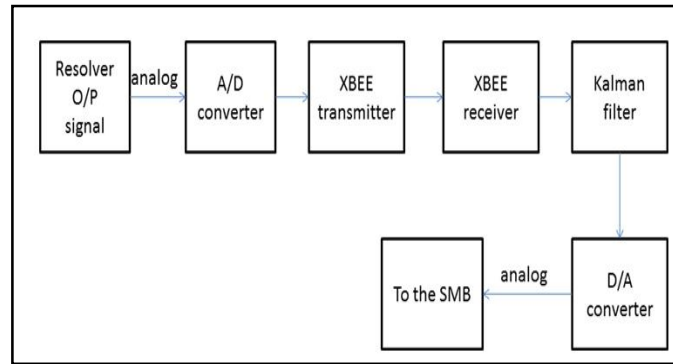


Figure 1

4.2.Resolver Output Signal

The resolver which converts the motor rotation to the analog signal which decides the degrees of rotation is the resolver output signal. It consists of one sine wave and one cosine wave with peak-peak voltage 2-3v. sine and cosine angles proportional to the rotational angle can be obtained at the phase s1-s3 and s2-s4 in the output winding when the phase r1-r2 in the exciting winding is excited by the voltage of $e_{r1-r2} = e \sin t$. A resolver used in this way is called BRX type.

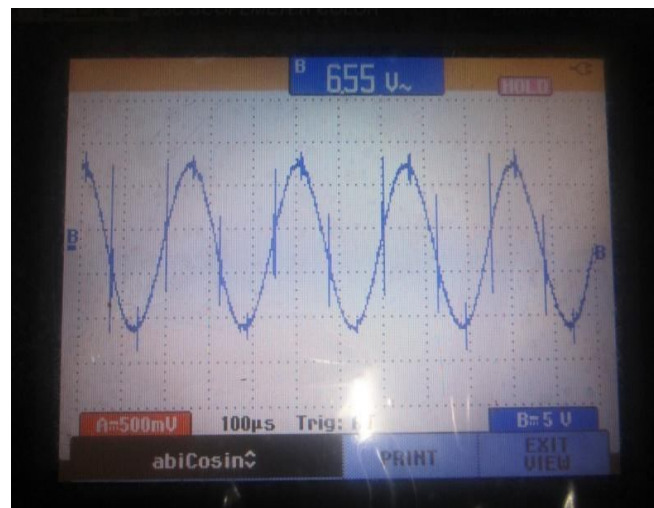


Figure 2



Figure 3

4.3. Analog To Digital Converter

Smartcoder is an ic to convert analog output signals of smart syn(rresolver) into digital position(angle)signals. It is widely used as an interface for CPU digital processing, built in controllers and drivers of robots, brushless motors, etc

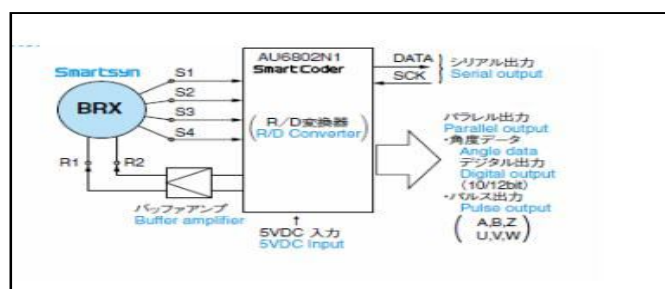


Figure 4

4.4. XBEE Transmission Module

Xbee 802.15.4 OEM RF transmission module is used for embedded solutions providing end point connectivity to devices. This is an ideal module for robots to pc or robots to robots communication. This module can give range of 30 meters indoor and 100 meters outdoor. This xbee wireless device can be directly connected to the serial port of your microcontroller. It supports data rate of upto 115 kbps. These modules use the IEEE 802.15.4 networking protocol for fast point-multi point or peer-peer networking. They are designed for high through put applications requiring low latency and predictable communication antenna. Specifications:

- model code:xb24-aci-001

- operating frequency:2.4ghz
- antenna type:chip antenna

4.5.Features

- Supported network topologies: point to point,point to multi point&peer to peer.
- Number of channels: 16 direct sequence channels
- Addressing options:pan id,channel and addresses
- Channel capacity:16 channels Addressing:65000 network address available for each channel
- AT and API command set for configuration module parameters
- Extensive command set
- Small form factor



Figure 5

4.6.Digital To Analog Converter

The AD9835 provides an exciting level of integration for the RF communications system designer. The AD9835 combines the numerical controlled oscillator (NCO), COS lookup table, frequency and phase modulators, and a digital-to-analog converter on a single integrated circuit. The internal circuitry of the AD9835 consists of three main sections. These are numerical controlled oscillator (NCO) and phase modulator, COS lookup table, digital-to-analog converter. The AD9835 is a fully integrated direct digital synthesis (DDS) chip. The chip requires one reference clock, one low precision resistor, and eight decoupling capacitors to provide digitally-created sine waves up to 25 MHz. In addition to the generation of this RF signal, the chip is fully capable of a broad range of simple and complex modulation schemes. These modulation schemes are fully implemented in the digital domain allowing accurate and simple realization of complex modulation algorithms using DSP techniques.

4.7. Kalman Filter

The Kalman filter, also known as linear quadratic estimation (LQE), is an algorithm which uses a series of measurements observed over time, containing noise (random variations) and other inaccuracies, and produces estimates of unknown variables that tend to be more precise than those that would be based on a single measurement alone. More formally, the Kalman filter operates recursively on streams of noisy input data to produce a statistically optimal estimate of the underlying system state. The filter is named for Rudolf (Rudy) E. Kálmán, one of the primary developers of its theory.

4.8. Serial Measurement Board

The serial measurement board (SMB) primarily gathers resolver data from the robot's (or additional axes) motors. This data is used to measure the speed and position of each axis. Each SMB is capable of measuring up to 7 axes. It also stores a number of data pertaining to each robot. This data is used by the controller and can be transferred between the SMB and the controller. Normally, the data is transferred automatically, but it can also be done manually.

The SMB data is affected when:

- The robot is replaced
- The SMB is replaced
- The controller (or its flash disk or mass memory unit) is replaced.
- Updating with new calibration data

The following data is stored on the SMB:

- Serial number for the mechanical unit
- Joint calibration data
- Absolute accuracy data
- SIS data (Service Information System)

Note that if the IRC5 controller is to be connected to a robot with an older SMB, not equipped with data storage capability, the SMB must be replaced.



Figure 6

5.Conclusion

Hence to overcome the disadvantages in resolver cable and to increase its efficiency and speed without any data loss and damage to the welding robots used in automobile industry wireless communication module is proposed in this paper.X-bee products NR-RF-02 and NR- RF-05 are identical in all aspects and the only difference is that NR-RF-02 has chip antenna while NR-RF-05 has wire antenna is used in this paper.

6.Acknowledgement

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