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Cable communication through the winch conductor cables for the JARE deep ice core drill - Evaluation of RS485 serial communication using an experiment and a numerical simulation-

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Data communication between the surface and the drill computer is necessary for deep ice core drilling. The contact force, inclination, and temperature of the drill are important for the drilling operation. These values were measured using the sensors in the drill and transmitted to the surface computer through the winch cable. The winch cable, which is 3000 m or more in length for enabling the deep drilling, was used for the data communication. The winch cable was also used for hanging the drill and providing the electric power supply to the motor and the drill electronics. We used the armoured which consists with outer wires and seven conductor cables. Only two of the seven conductor cables were used for data communication, because the cables were mainly used for power supply purposes. To design drill electronics, it is necessary to determine method of data communication.

We considered RS485, which is one of the serial communication interfaces, for achieving data communication, as this interface is simple and widely used in the industry. However, the maximum length of the RS485 communication is 1200 m for industrial applications. Therefore, evaluation of this interface for use in longer winch cables was performed using experiments with winch wires and a numerical simulation of the electric circuit.

In the first experiment, the string characters were transmitted from the transmitter and received by the receiver of the RS485 through a 700 m winch cable on the drum. The matching of the string characters between the transmitter and the receiver was validated by changing the communication speed, baud rate. The string characters matched up to a baud rate of 115200 bps. This baud rate limit was in accordance to that of the RS485 in the industrial applications. At higher baud rates, a non-match was observed in some of the string characters received. Therefore, the transmitted and the received waveforms were monitored using an oscilloscope. The transmitted waveform demonstrated rectangular pulses, while the received one demonstrated some metamorphose at higher baud rates. The received metamorphosed waveform could be expressed using the numerical simulation of an electric circuit with applied voltage pulses at the transmitter. The simulation was performed on the 3000 m cable to estimate the probable upper limit of baud rate to purchase a new winch cable. A new winch cable with a length of 3500 m was used to conduct the testing again. The string characters were sent and received, as the baud rates were changed, and the received waveforms were monitored. It was discovered that the upper limit of the baud rate was 19200 bps and the received waveforms agreed well with our estimation.

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