ODAS4-RT Data Acquisition Software

Overview:

ODAS4-RT is a Windows based application written for PCs with a USB port. It controls all aspects of the acquisition of data from remote instruments that are connected with a 2- or 4-wire link. Sensors are typically located on a towed vehicle or a vertical profiler.

The ODAS software and hardware have been designed to maximize the flexibility of data acquisition. The software is highly configurable by the user. The list of channels to be sampled, the order of their sampling and the rate of sampling are just three of the many configurations that the user sets with a simple ASCII setup file. Additional sensors and transducers can always be added to a basic instrument, and with 255 channels, the ODAS-RT software is ready to support all imaginable instrument configurations. This extensibility and flexibility protects the user's investment in an instrument and maximizes the measurement opportunities.

Hardware Overview:

All sensors have a unique address in the range of 0-255. A data acquisition cycle starts with a request for data which is triggered by UTRANS sending an address on to the communication link (Figure 1). The remote transceivers (usually one per instrument system) turns the serial address into a parallel address word and places it on to its local bi-directional digital instrument bus. The addressed sensor decodes the address and returns a datum (single 16-bit data word) to the RTRANS. The RTRANS then transmits this datum to the UTRANS over the communication link. UTRANS buffers the received data and periodically transfers the data to the master computer over the USB2.0 cable.

There can be more than one remote instrument or RTRANS in a system. But there is only one master computer and only one UTRANS. The drivers for the serial communication link are RS485 line drivers that go into tri- (high impedance) state whenever they are idle. RS485 is a balanced differential communication method that requires a pair of conductors and can transmit information up to several kilometers, depending on the bit rate. The method of encoding is Manchester II which permits the hardware to distinguish data words from address words. Thus, a single pair of copper conductors is sufficient for high-speed bi-directional serial communication. Tri-state enabling and Manchester encoding makes it possible to have several remote instruments communicating with a single master computer. Finally, in cases of very long distance communication, it is possible to use the serial outputs from UTRANS and RTRANS with optical fiber modems and RF modems. Communication over 3.0 km has been achieved with 22-gauge copper conductors and to over 5 km with fiber optics.

Block Diagram:
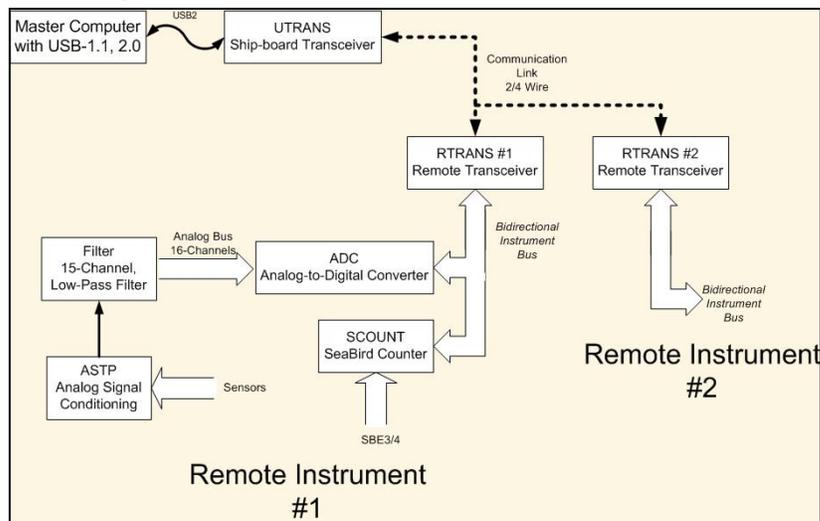
Figure 1. ODAS Hardware Diagram. The ship-based portion consists of a master computer that controls all data acquisition and a companion UTRANS. A 2 or 4 wire communication cable links the UTRANS to one or more remote instruments. The remote instruments connect to the communication link with RTRANS which passes data requests to its local, bi-directional, digital instrument bus and transmits data back to UTRANS.

Data Acquisition:

The acquisition of data is controlled by keywords and parameters in an ASCII setup file. Once data acquisition and recording has been started, ODAS4-RT will write data into a file with a name specified in the setup file. Each record written into the file consists of a 64-word header followed by a data record with a length specified in the setup file. Data are written as soon as a record length of data has been acquired. The header preceding every data record provides ancillary information such as time and date, record number and static information such as the data record size, sampling rate, etc. All information, including the header is written as 2-byte signed integers in little endian format. Matlab functions for reading the data and headers in a file are provided to the user and full data analysis packages are also available.

Figure 2. ODAS-RT Main Form. With this GUI, the user can connect with the instrument, start and stop data acquisition, calibrate selected channels and even edit the setup file.

The above screen shot shows the ODAS4-RT *Main Form* (Figure 2). This is the primary GUI to the ODAS4-RT software. The user can click

Connect [F3] to start the communication between the computer and the remote instrument(s). The information from a variety of channels is displayed in real-time and in physical units so that the user is fully informed about the disposition (depth, tilt, etc.) of the instrument. The selection of channels being displayed in real-time and the coefficients for conversion into physical units are placed in the setup file. The user can edit the coefficients whenever new calibrations warrant a change. Information that can be displayed in real time includes: pressure (depth), roll, pitch, heading (requires optional compass), transmittance, fluorescence, O_2, speed, and up to three Seabird SBE3 thermometer and SBE4 conductivity sensors. Many of these signals are from optional sensors.

To actually record data, the user simply clicks the record button and a file is created with a base name and path chosen by the user in the setup file. The numeric trailer in the name of the data file is automatically incremented by ODAS4-RT every time the user starts recording data. Thus, there is no need for the laborious entry of file names for every data file and no data files are accidentally over-written. Simultaneously, the start time, stop time, and a copy of the setup file is added to a log file to make a permanent record of the acquisition process. Upon clicking the record button, it turns into the stop button.

The user may stop recording at any time. This is usually desired when pulling a vertical profiler back to the surface because, during retrieval, the microstructure data will be meaningless and there is little need to record such data. Even while the recording is stopped, ODAS4-RT maintains communication with the remote instrument and the user can conveniently monitor the retrieval process by watching the pressure and other readings in the main form (Figure 2).

The user can also record auxiliary serial ASCII/Binary data from other instrument systems, such as a GPS receiver, via one of the serial COM Ports on the master computer. This data stream is written into a separate file with headers preceding every record that are time-stamped and cross-referenced to the records in the file containing the data received via the USB interface. The sub-box called *COM Port* (shown in Figure 2) will select which serial communications port the serial device is connected to (if any). A simple entry in the set-up file determines if COM Port data are recorded, the baud rate and the record size.

Calibration:

The Calibration form is the other major interface to the remote instrument(s). The user can choose to interrogate a single channel to verify communication and to test the "correctness" of the data from that channel. Or, the user can choose to interrogate the entire list of channels specified in the setup file (Figure 3). The user can change the *Sample Rate* and *Samples Requested*, by changing the values in the corresponding text boxes. The data displayed are the mean, minimum, maximum, and standard deviation of the raw 16-bit integer data from each channel listed in the setup file. This data is produced by an AD Converter or a frequency counter (SCOUNT) in a remote instrument.
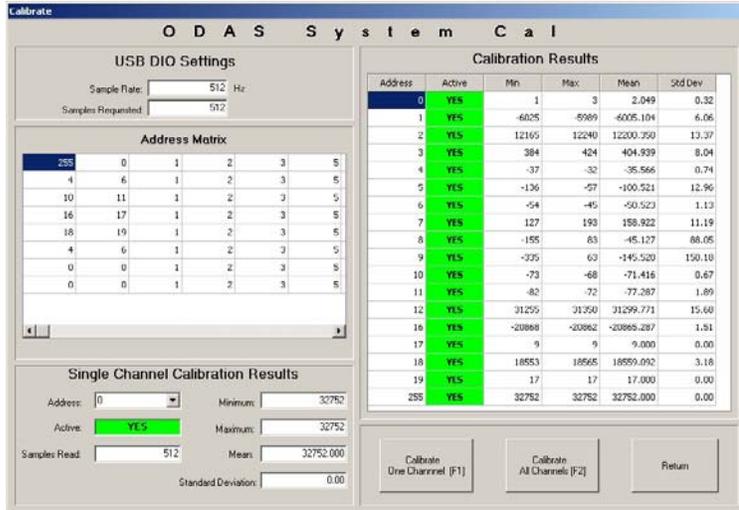
Figure 3. ODAS-RT Calibration Form. The user can choose a single channel or all channels for calibration. The sampling rate and number of samples is controlled with the appropriate box.

The *Calibration Form* is also useful for actually calibrating a sensor (which is how this form got its name). For example, to calibrate a pressure transducer, the user connects the calibration pressure source to the transducer in the instrument. The user applies a series of known pressures and notes the reading for the appropriate channel (usually number 10). These values can then be used in a regression to derive the polynomial relationship between pressure and the value produced by the data acquisition system. The regression coefficients can then be used to convert the data for the pressure channel into physical units. If the regression coefficients are listed in the setup file, then pressure will be displayed in physical units in the Main Form (Figure 2). By adjusting the *sampling rate* and the *samples requested* the user can control the averaging time of the measurements.

Graphical Display:

The real-time graphical display of the channels of data being acquired by ODAS4-RT is supported by separate software (plot_odas) which is provided with each instrument.