

EE-206

Systemes de mesure

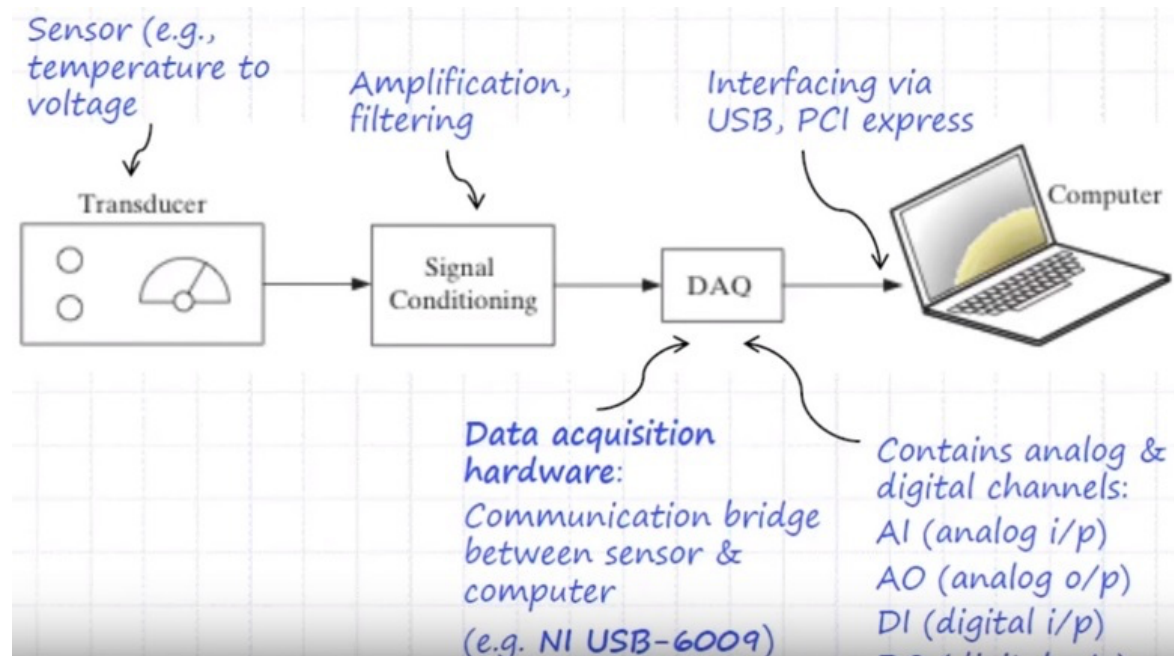
Lesson Outline

- Data acquisition
- DAQmx library
- Example

DAQ system

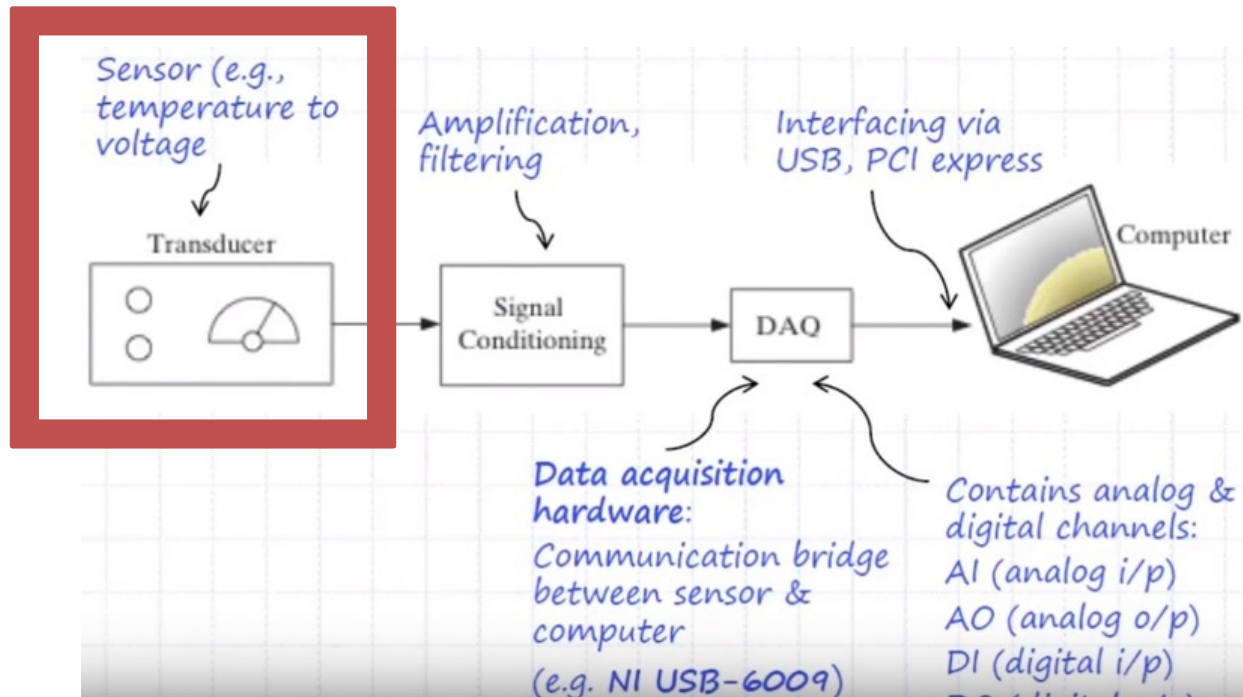
Data acquisition is a process that

1. gathers (analogue) signals from measurement sources;
2. digitizes the signals to store, analyse, and plot on PC.



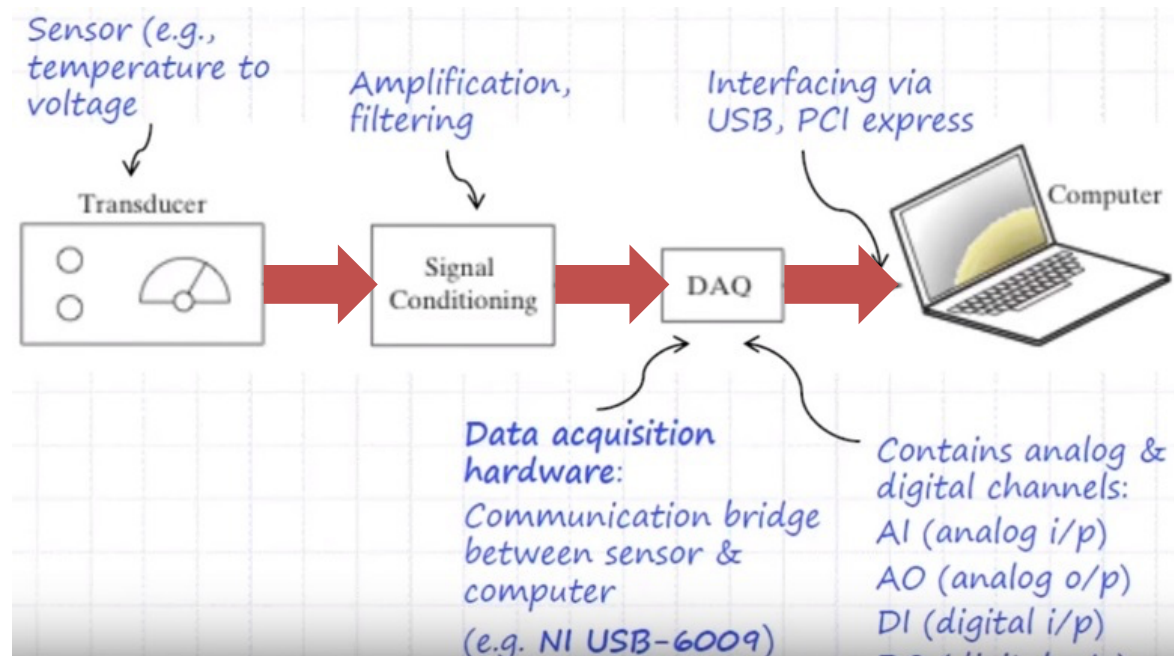
Transducer

Transducer: a device that converts a physical phenomenon into a measurable electrical signal, i.e. voltage or current.



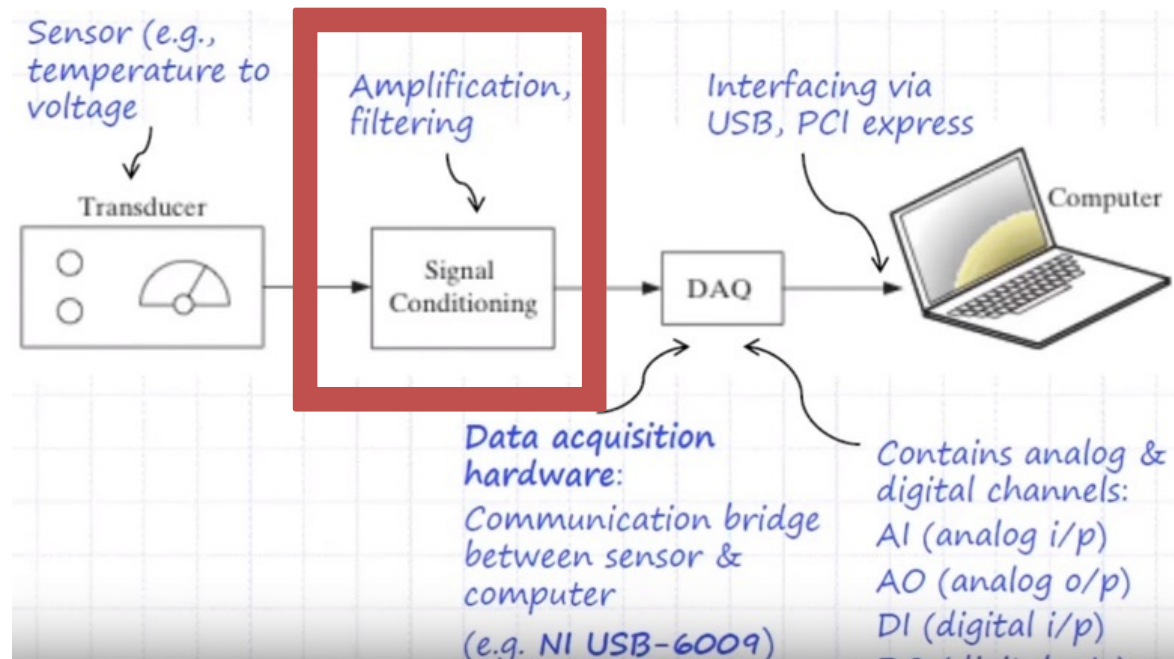
Signal

Signal: a detectable physical quantity or impulse (such as a voltage, current, or magnetic field strength) by which messages or information can be transmitted.



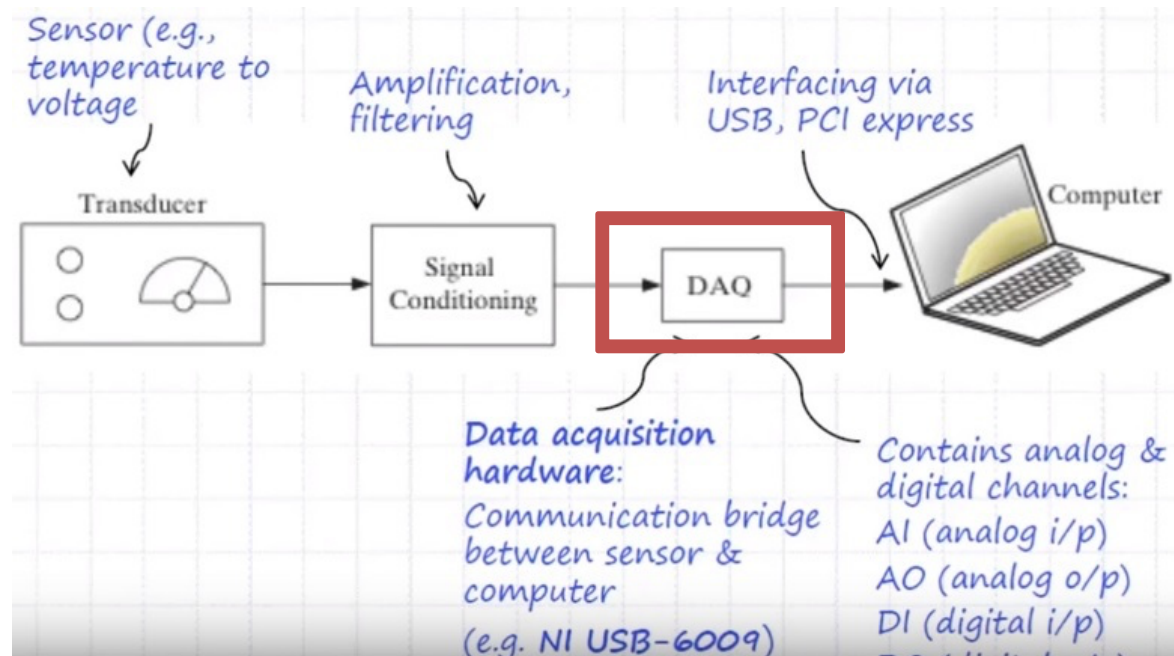
Signal conditioning

Signal conditioning: a set of operations that maximizes the accuracy of a system, allows sensors to operate properly, and guarantees safety (e.g. attenuation, isolation)



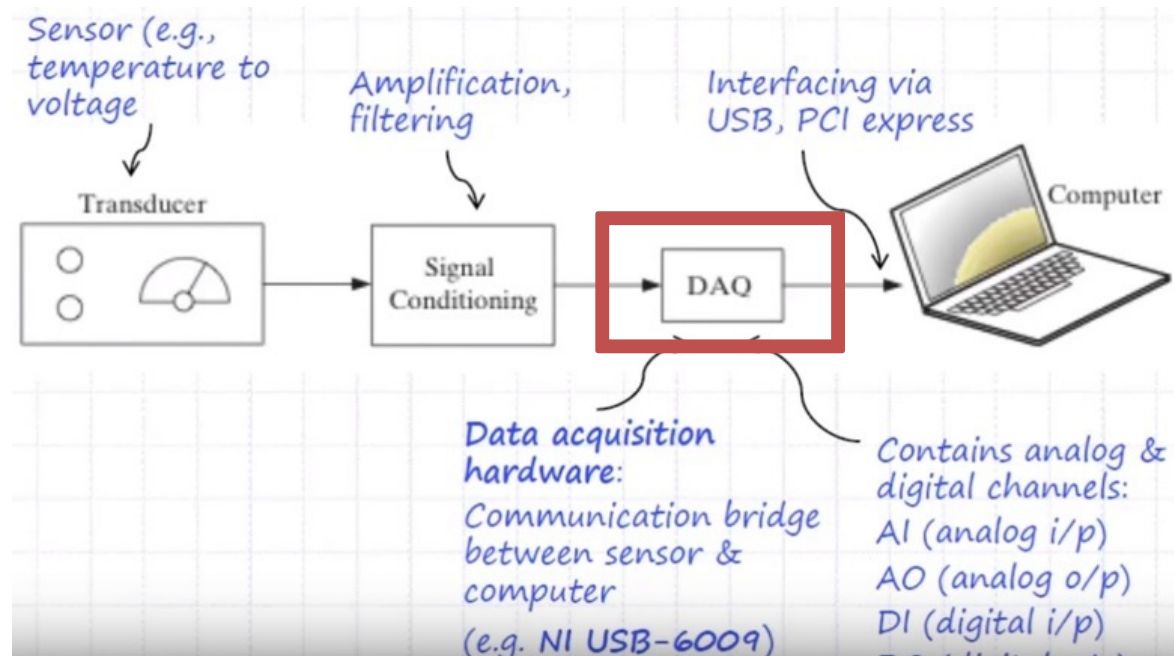
DAQ Hardware

Data acquisition hardware: a device that digitizes incoming analog signals so that the computer can interpret them.



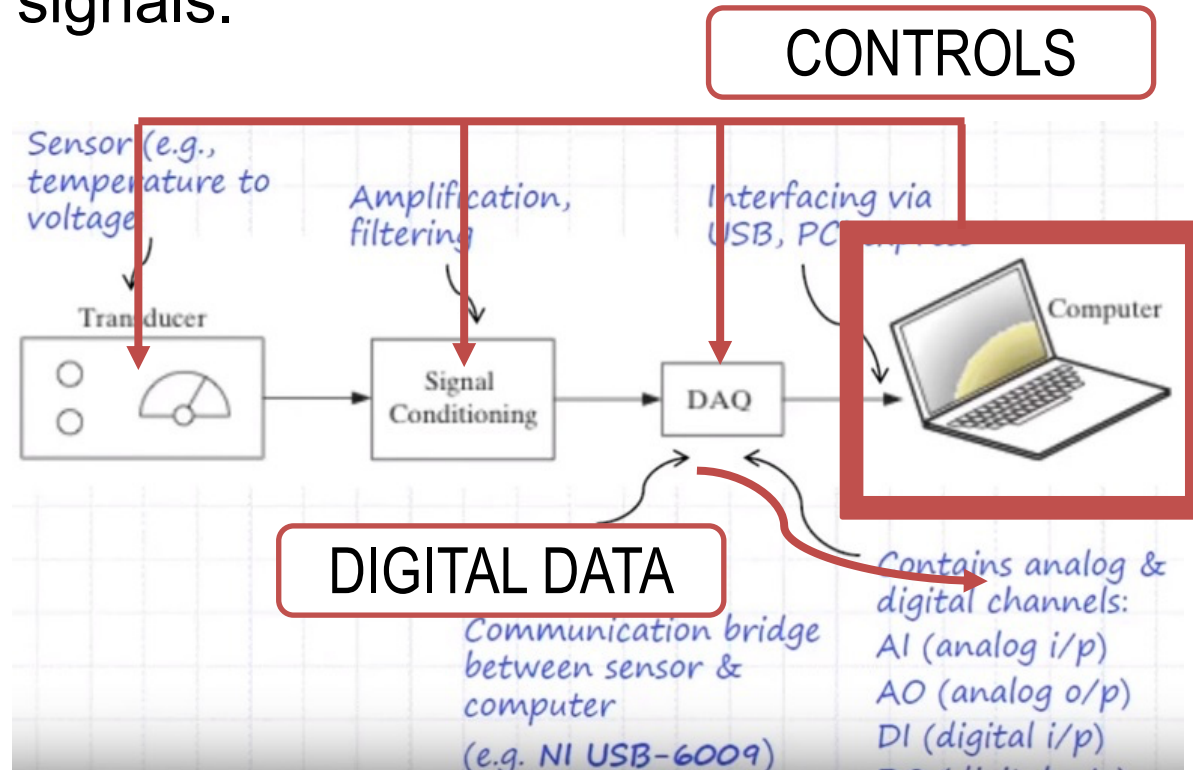
DAQ Software

Data acquisition software: transforms the PC and the data acquisition hardware into a self- tool for data acquisition, analysis, and display.



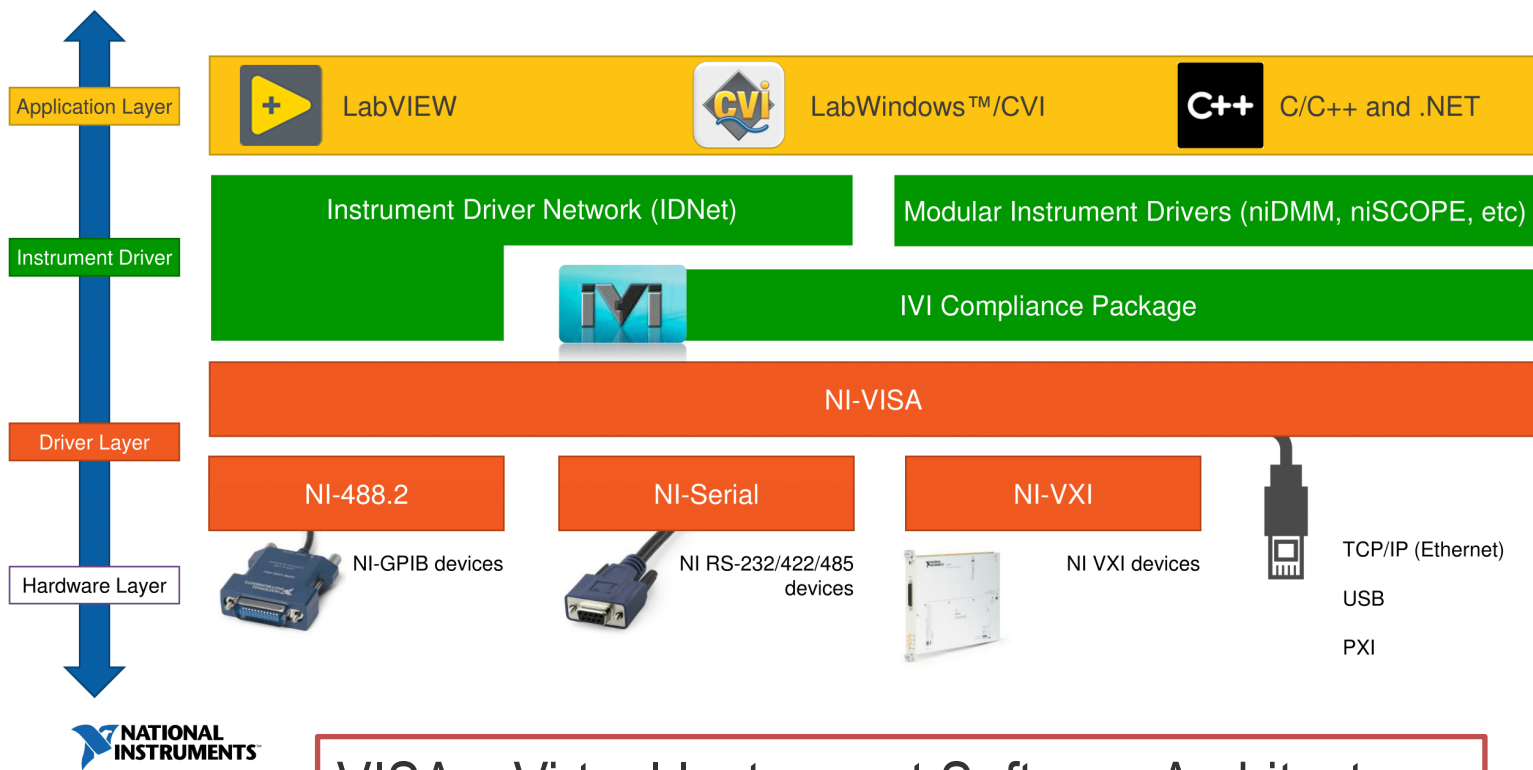
Computer Interface

Computer interface: a computer that controls and triggers the acquisition system, and stores / processes the digitally acquired signals.



Instrument control

Instrument Control Layers



VISA = Virtual Instrument Software Architecture

Drivers

- **Instrument drivers**
a library for a specific class of instruments, typically specific for a given vendor or model
EXAMPLE: Lecroy Oscilloscope HDO4034
- **Driver Layer**
acts as an interface between the application software and theDAQ hardware, and prevents a programmer from having to do register-level programming or complicated commands.
EXAMPLE: NI DAQmx

NI DAQmx

NI DAQmx is the driver software you use to communicate with and control your NI data acquisition (DAQ) devices.

NB: NI DAQmx is explicitly for NI hardware, other vendors instrumentation may require specific libraries.

It includes an extensive library of functions and VIs you can call from LabVIEW to program your devices, plus:

- Measurement & Automation eXplorer (MAX)
- DAQ Assistant

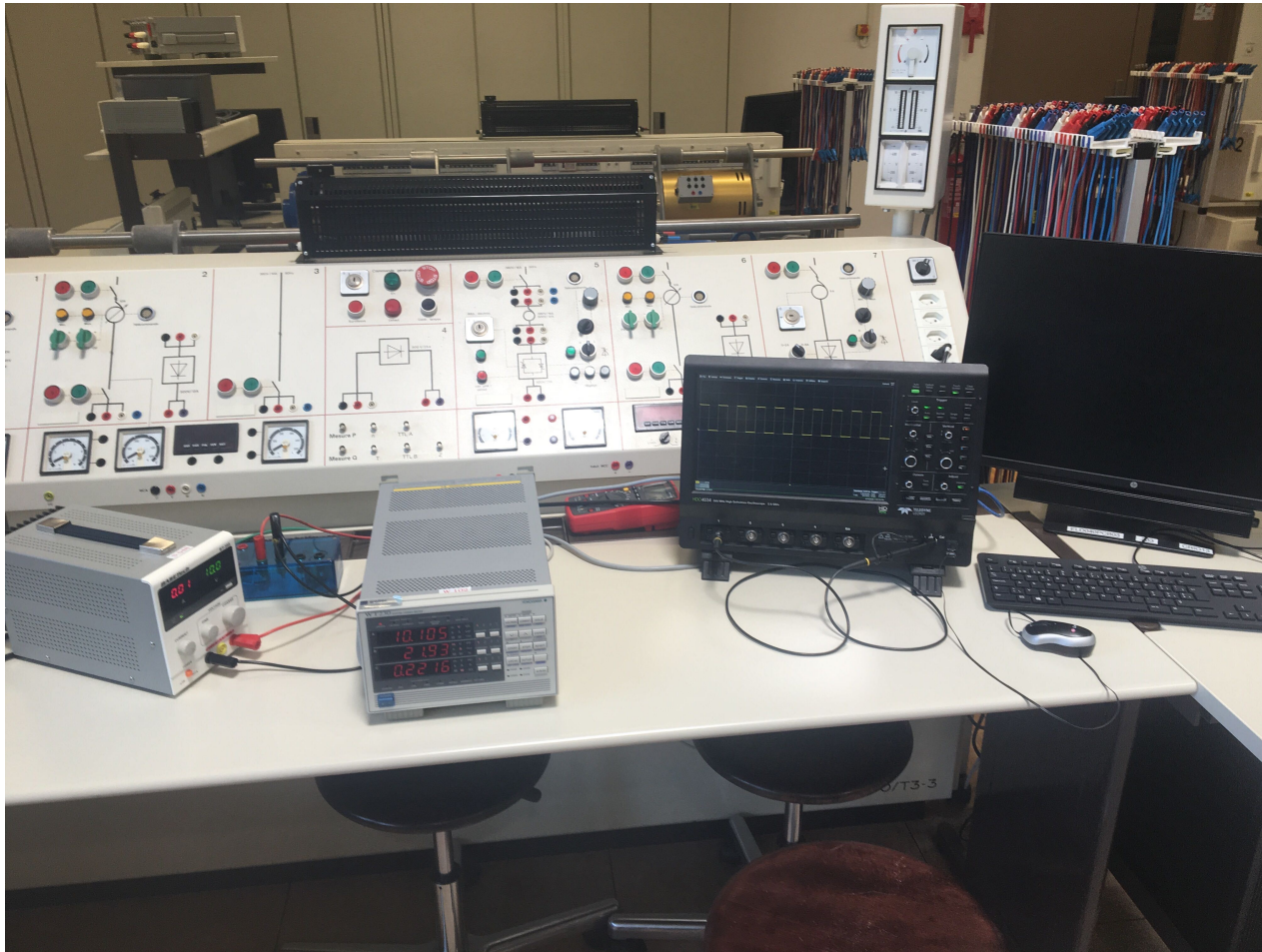
NI MAX

MAX is an application that informs other programs which devices are connected and how they are configured.

Main functionalities:

- view devices and instruments connected to your system
- configure the NI hardware and software
- create and edit channels, tasks, interfaces, scales, and virtual instruments
- execute system diagnostics
- update your National Instruments software

Example



NI MAX console

My System - Measurement & Automation Explorer

File Edit View Tools Help

Save Refresh

Network Adapters

Intel(R) Ethernet Connection (2) I219-LM

Adapter Mode	TCP/IP Network
MAC Address	84:43:09:77
Configure IPv4 Address	Static
IPv4 Address	128.178.26.68
Subnet Mask	255.255.255.0
Gateway	128.178.26.1
DNS Server	128.178.15.227

Intel(R) Ethernet Server Adapter I350-T2

Adapter Mode	TCP/IP Network
MAC Address	00:1B:21:DB:48:C8
Configure IPv4 Address	DHCP or Link Local
IPv4 Address	0.0.0.0
Subnet Mask	0.0.0.0

Intel(R) Ethernet I210-T1 GbE NIC

Adapter Mode	TCP/IP Network
MAC Address	68:05:CA:64:6C:77
Configure IPv4 Address	Static
IPv4 Address	100.100.100.10
Subnet Mask	255.255.255.0

My System

- Data Neighborhood
- Devices and Interfaces
 - ASRL1::INSTR "COM1"
 - ASRL3::INSTR "COM3"
 - Network Devices
- Scales
- Software
- Remote Systems
 - ELD040-cRIO-13
 - Devices and Interfaces
 - ASRL1::INSTR
 - ASRL2::INSTR
 - NI cRIO-9030 "RIO0"
 - Network Devices
 - Software

Network devices

HDO4034 "TCPIP0::100.100.100.100::inst0::INSTR" - Measurement & Automation Explorer

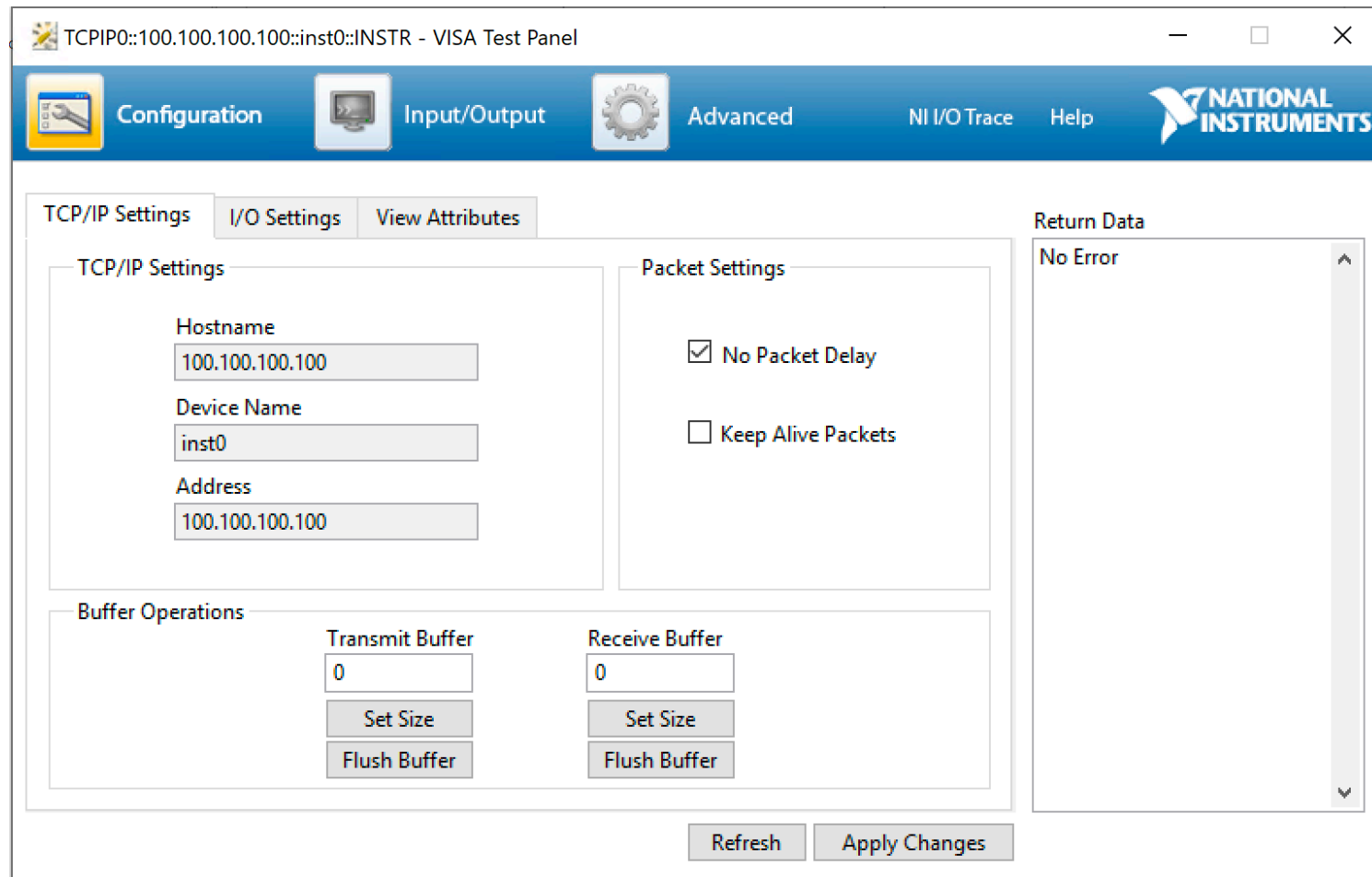
File Edit View Tools Help

Save Refresh Open VISA Test Panel

Settings

Name	<input type="text"/>
Hostname	<input type="text" value="100.100.100.100"/>
IPv4 Address	100.100.100.100
Vendor	LECROY
Model	HDO4034
Serial Number	LCRY3513N19423
Firmware Version	8.1.0
Status	Present
LAN Device Name	<input type="text" value="inst0"/>
VISA Resource Name	TCPIP0::100.100.100.100::inst0::INSTR

VISA test panel



Dedicated software

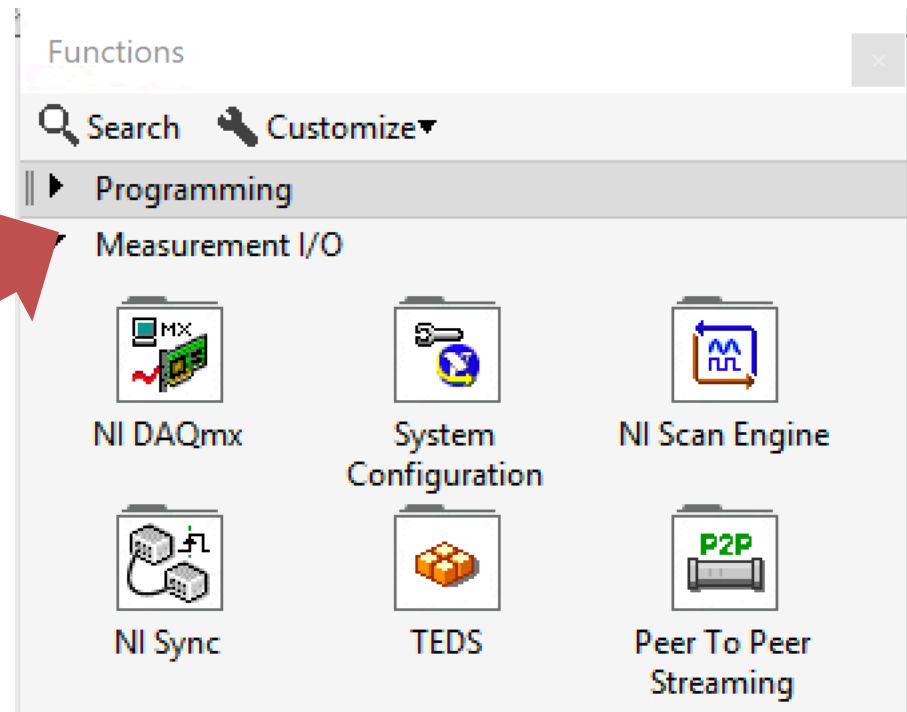
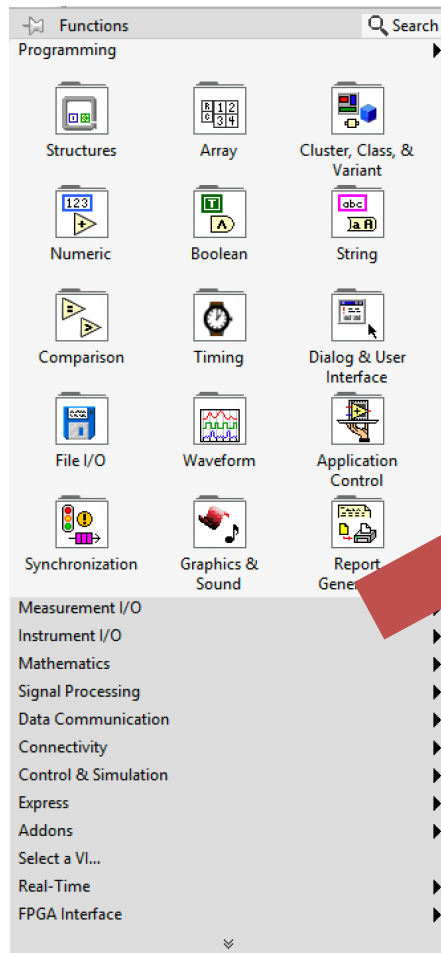


LabVIEW solution

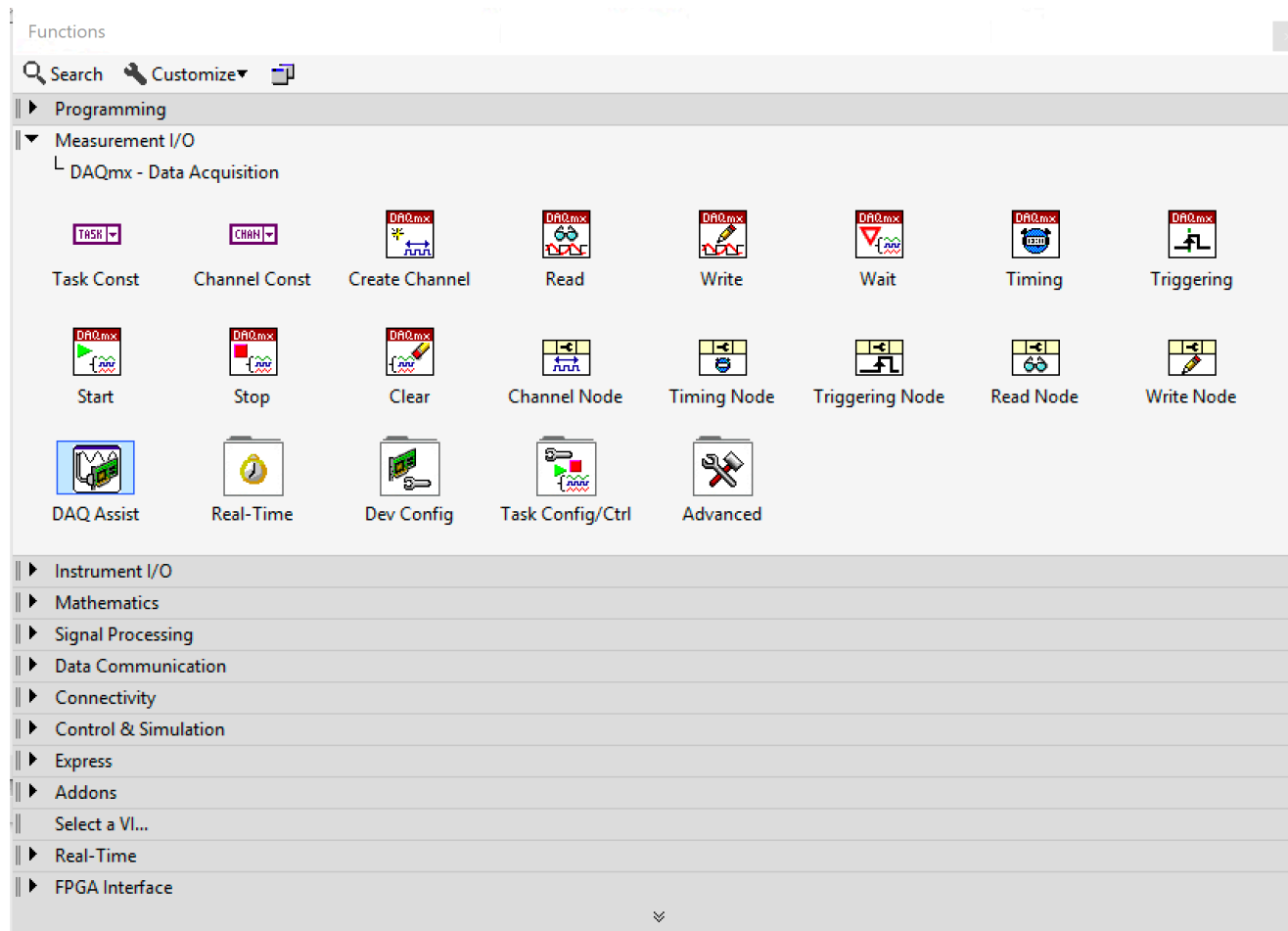
In order to control the instrument from LabVIEW, we need to check two things:

- if the instrument is supported (mostly, just NI hardware) we can use the library NI DAQmx in the palette called Measurement I/O;
- if the instrument is not supported (third part hardware) we have to install the specific library (see next lesson).

Measurement I/O

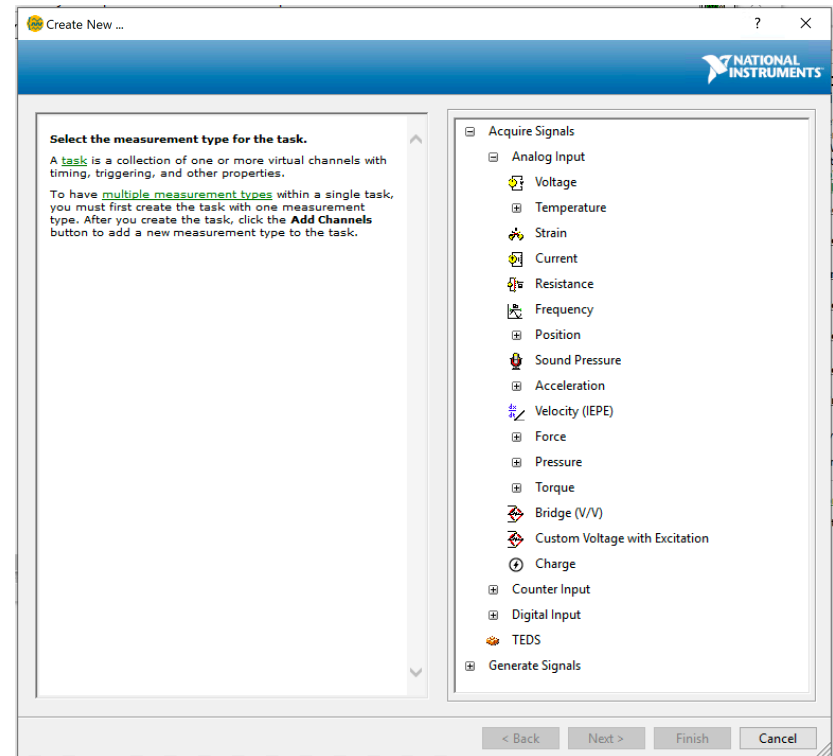
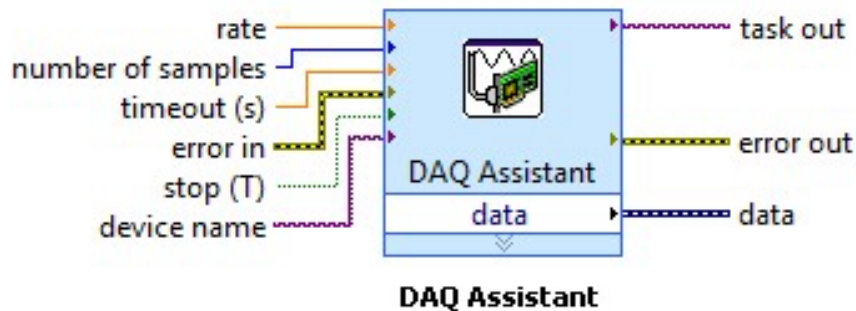


NI DAQmx library



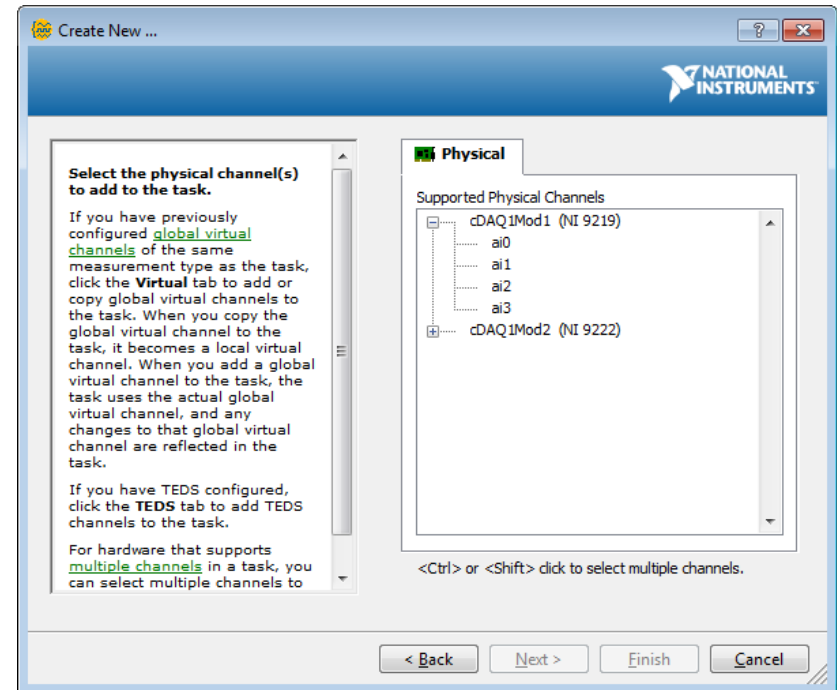
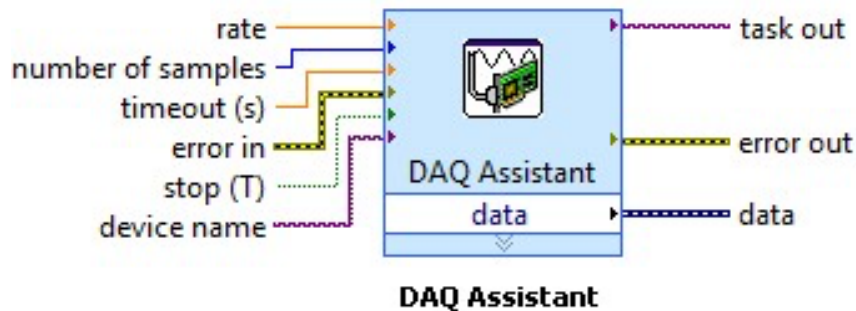
DAQ Assistant

The easiest solution is to use the DAQ assistant that can be easily customized through a multi-step procedure...



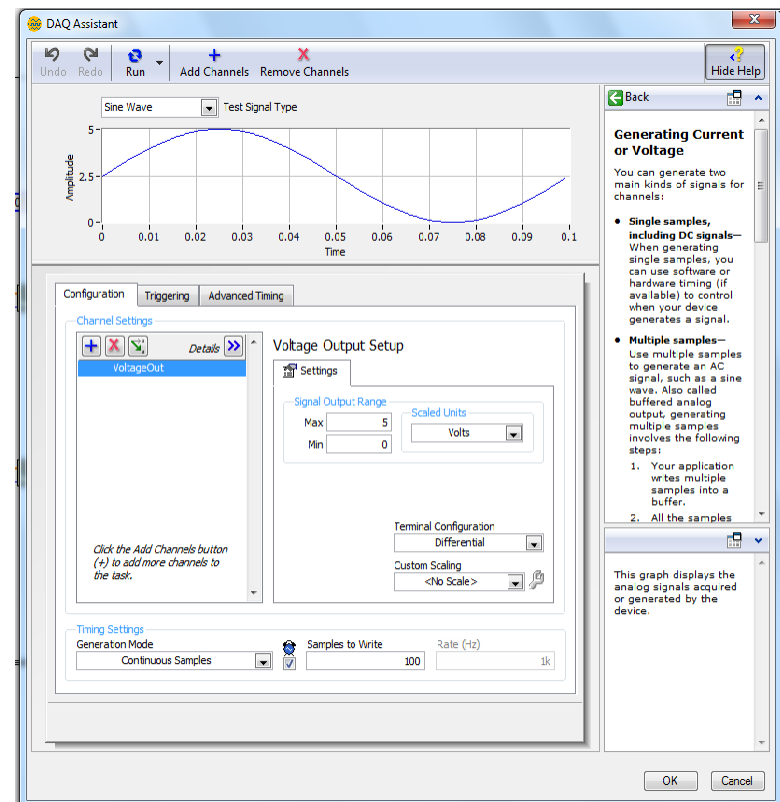
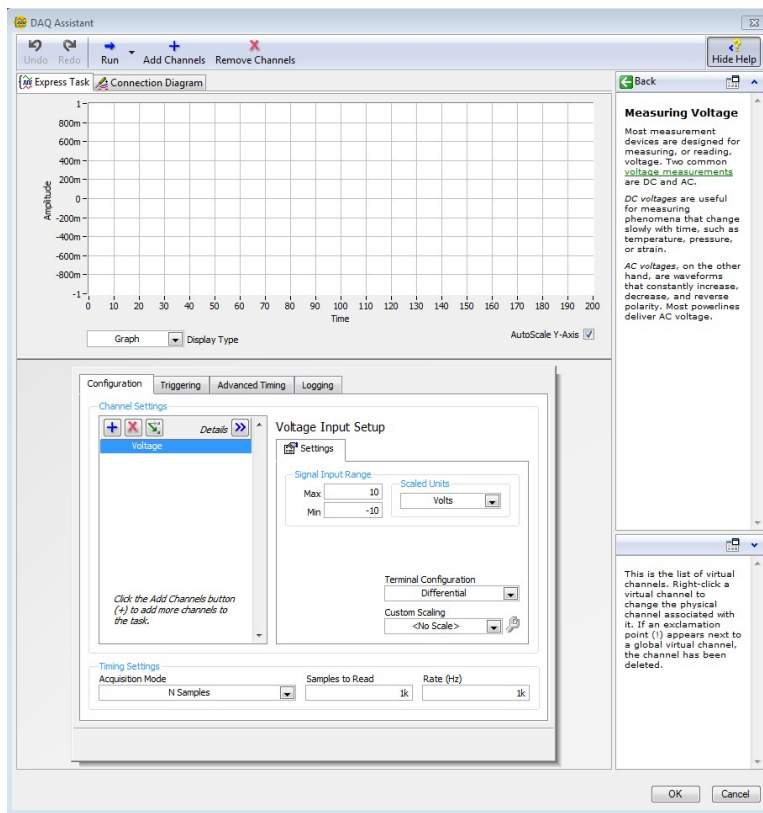
DAQ Assistant

... where Labview asks to select the instrument as well as the physical channels we want to control...



DAQ Assistant

... and, once set up, provides an intuitive GUI:



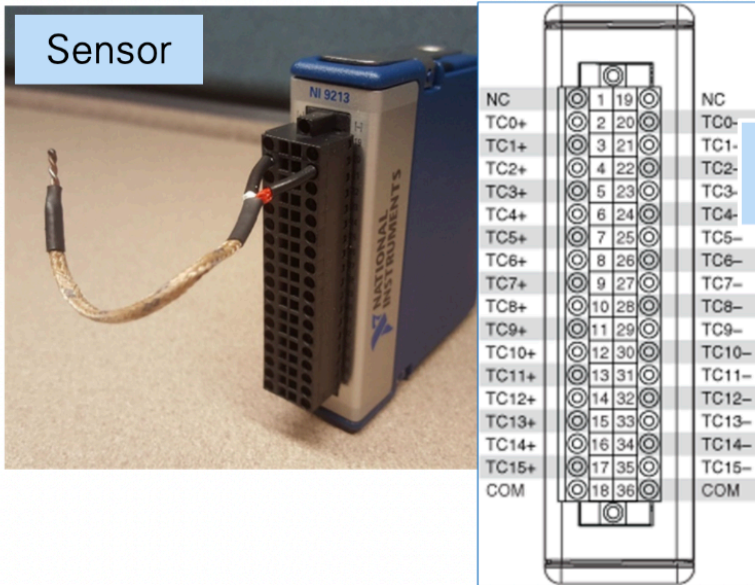
Organization of the code

But – if we don't want or can't use the DAQ assistant – we have to structure our code in a precise and repeatable way:

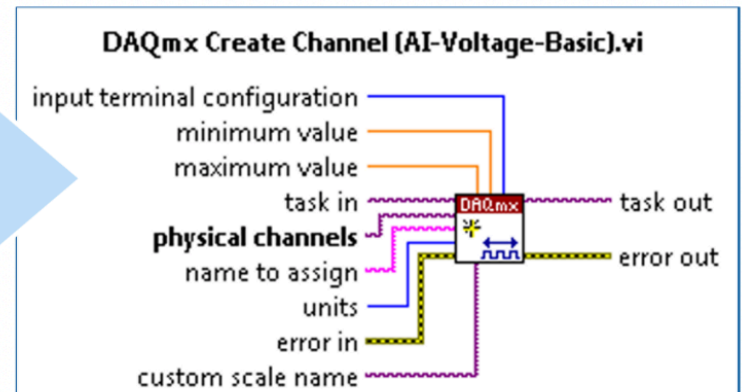
- we have to convert the instrument physical channels in Labview virtual channels;
- we define which task (experiment) we want to carry out;
- we define the specific parameters of our measurements (e.g. resolution, sampling rate, trigger) that are controlled by specific functions in the palette.

Virtual channel

Physical Channel/Pins



Virtual Channel



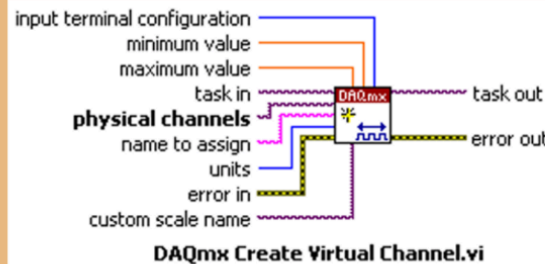
Tasks and functions

Task

Channels

Sensors,
scaling, and
data format

Channel
configuration



Timing, triggering

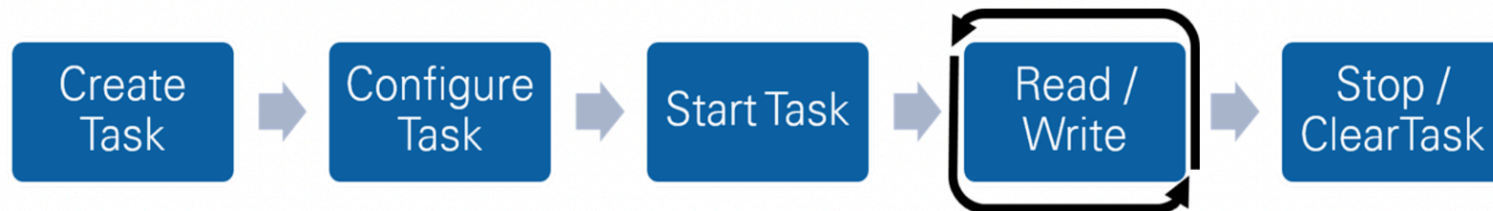
Signal routing

Buffer configuration

Hardware settings

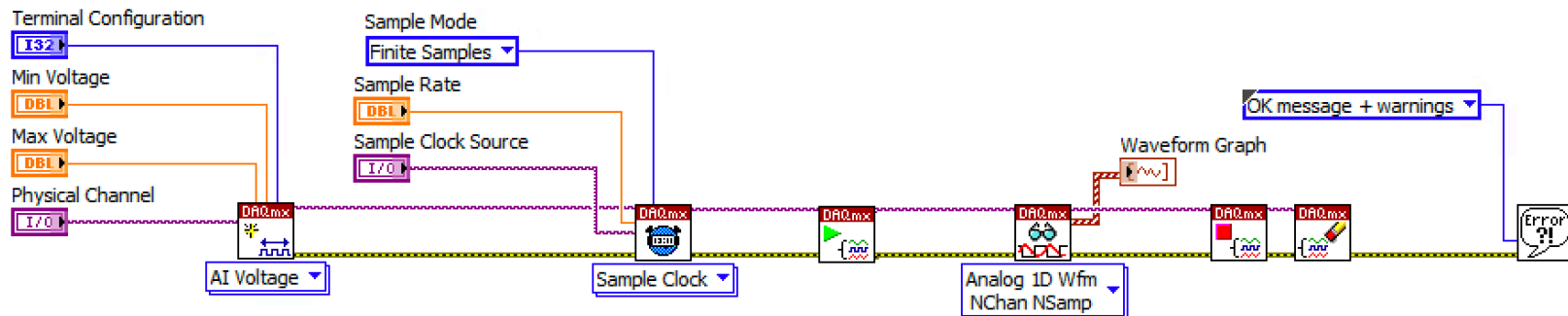
Code organization

We MUST structure the code according to this order:



1. create the task (which kind of measurement)
2. configure the task (set the instrument parameters)
3. start the task (run the experiment)
4. read/write data (acquire or generate data)
NB: it might be repeated iteratively with a for or a while loop
5. stop the task (end the experiment)
6. clear the task (set the virtual channels free for other tasks)

Coding example



Recap: was everything clear?

- What are the main components of a DAQ system?
- What does NI DAQmx enable us to do?
- Why is NI MAX important?