TECH NOTE : Optical strain measurement in catman

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Author: Thomas Markwitz, Product Manager Test & Measurement, HBM Germany
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Abstract

The TechNote describes how to perform optical strain measurement with HBM Fiber Sensing Interrogators type FS22SI and FS22DI in catman.

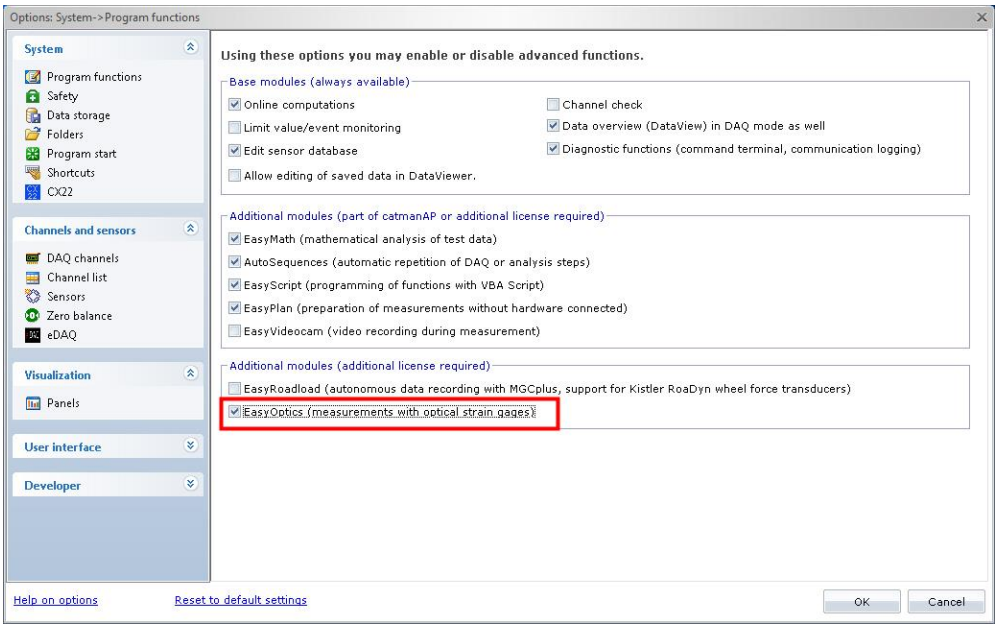
Requirements:

- catman Version 4.1 or higher
- EasyOptics module for catman
- HBM FiberSensing Interrogator type FS22SI and FS22DI

Step by Step description

Step 1: Preparation

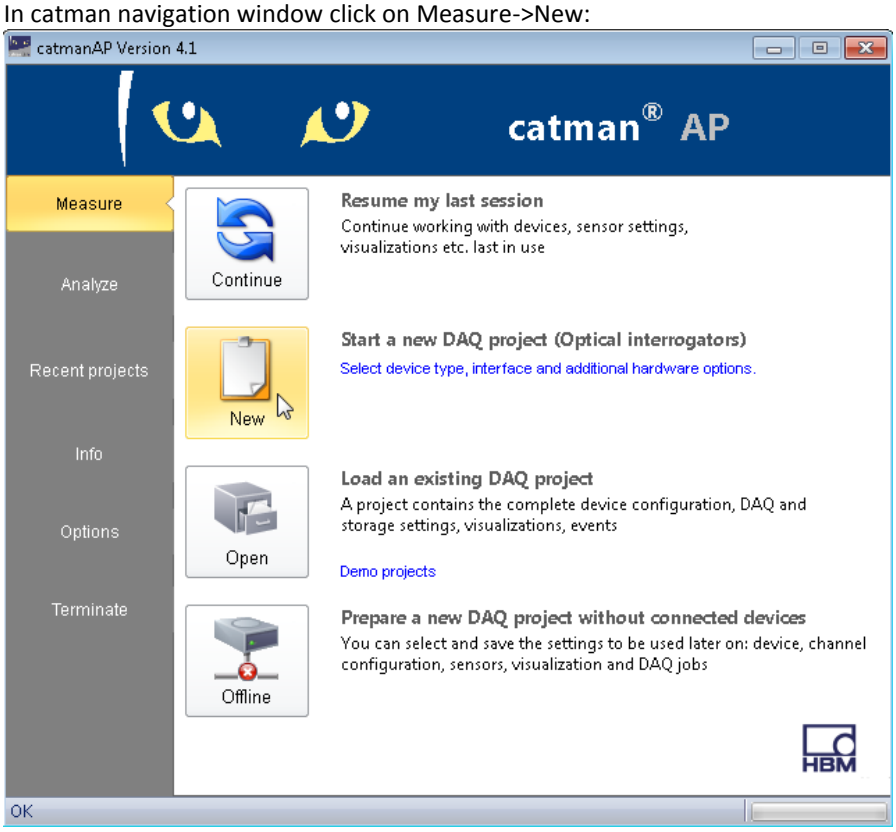
- Start catman
- Activate “EasyOptics” add on module in the general options (only first time needed)



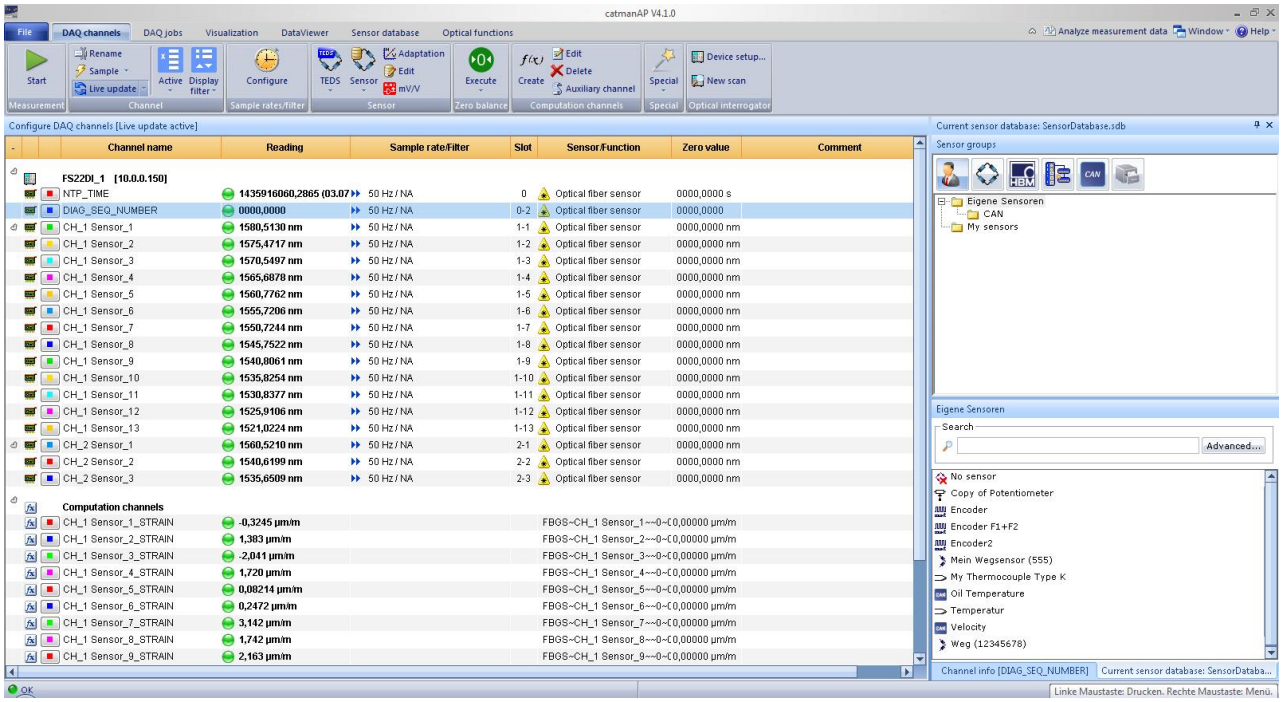
- In hardware options choose “Optical interrogators” as device type and enter IP address of your interrogator for device scan

Step 2: Setup new project

- In catman navigation window click on Measure->New:



- Result: catman connects to the interrogator, reads the configuration and automatically displays available channels and measured wavelength. Each channel corresponds to one sensor (peak). Like this you quickly get an overview how many sensors have been detected and you receive first diagnostic information.
  For each channel automatically a calculation channel is generated to convert the measured wavelength into strain:



Details on Sensor detection

During reading the configuration from the optical Interrogator catman will retrieve peak data from every device and present the gratings (sensors) found in the channel list. The number of peaks found on each fiber during this initial scan determines the number of channels appearing in the catman channel list.
This number should not change during the running DAQ process since this would obviously corrupt the sensor (grating) <-> catman channel mapping. The "Peak lock" feature will prevent a change in the mapping in case of peak dropouts. The chapter "Peak droputs and peak locking" describes this in more detail.

Hint: Do not mix up a SI/DI *connector channel* (which corresponds to a *fiber*) with a catman channel which corresponds to a *sensor* (grating). In the channel list of catman the relation fiber-sensor is indicated in the “Slot” column (e.g. 2-4 means 4th sensor on fiber number 2).

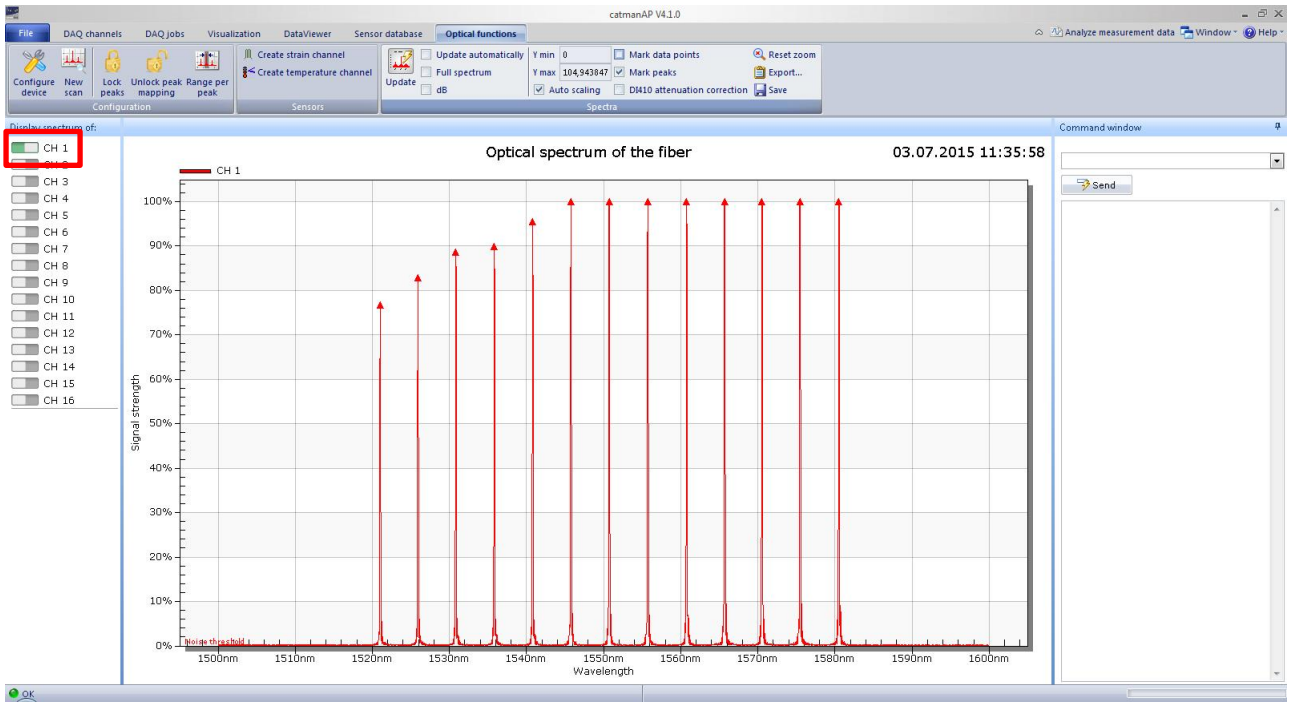
Hint: Do not mix up the *optical* sensor (a grating) with a classical sensor (e.g. a strain gage full bridge). In particular the term *sensor scan* means something completely different for optical interrogators than for other device types (like QuantumX or MGCplus): with these devices a sensor scan means looking for TEDS sensors connected to the device while with the optical interrogator it simply means detecting the peaks (i.e. number of gratings).

Peak dropouts and peak locking

As it became clear from the preceding chapter, a peak dropout (i.e. a peak vanishes or is no longer detected due to fiber damage) without further precautions would shift the channels in the catman channel list and thus corrupt your data (e.g. peak No. 3 formerly assigned to channel No. 10 would be assigned to channel No. 9 if peak No. 2 vanishes). To prevent this, catman provides the "Peak lock" mechanism. With peak locking in place each peak will be confined to a certain range (a "band") and the catman channels are coupled to this band. During measurement catman will just look if a peak in that band still exists. If not, the channel belonging to this peak gets an OVFL reading - the other channels will not be influenced any more.

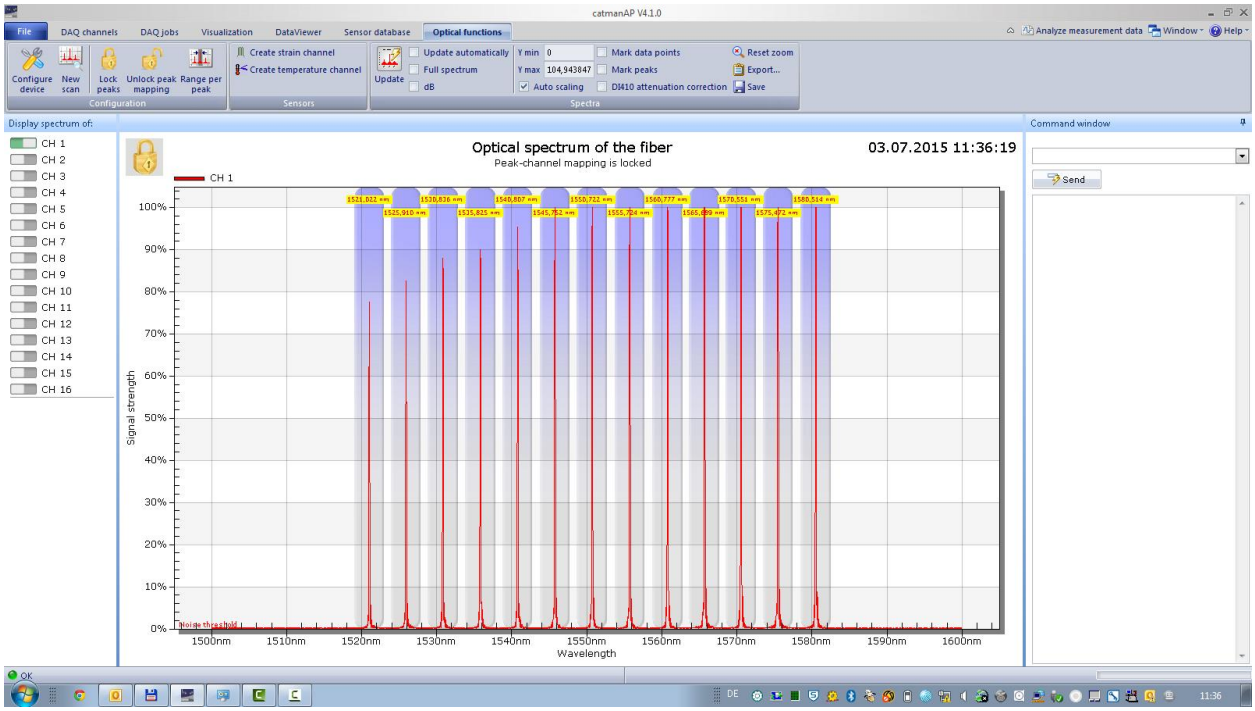
Step 3: Parameterization and Diagnostics

- Navigate to ribbon “Optical functions”. In this ribbon you can find functions to parameterize your interrogator channels and for diagnostics.
- To see all sensors the peak detection parameters usually must be adjusted
- Choose a channel and click on button “Update Spectra”.
  Result: The full spectrum of the selected channel, in this case channel 1, will be displayed:



To get continuously new spctras check option “Update automatically”. However this function is time consuming.

The following picture shows how the spectrum looks like if peak locking is enabled. Please make sure that the bands do not overlap.

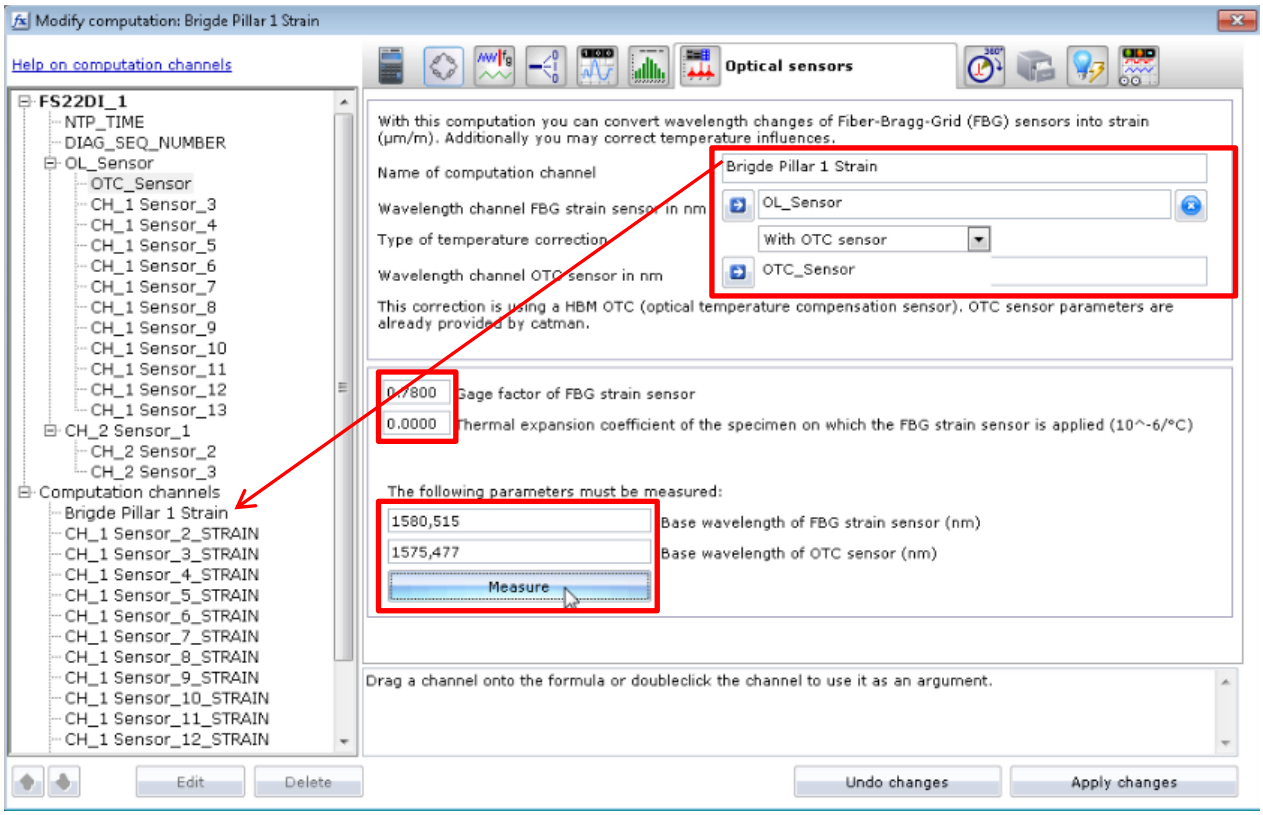


Step 4: Create temperature compensated strain channel

A strain channel can be temperature compensated with the help of a temperature sensor. Strain channels can also be created without temperature compensation.

To do so click on button “create strain channel” in tab “Optical functions” or modify an existing strain calculation channel. In the calculation dialog please specify

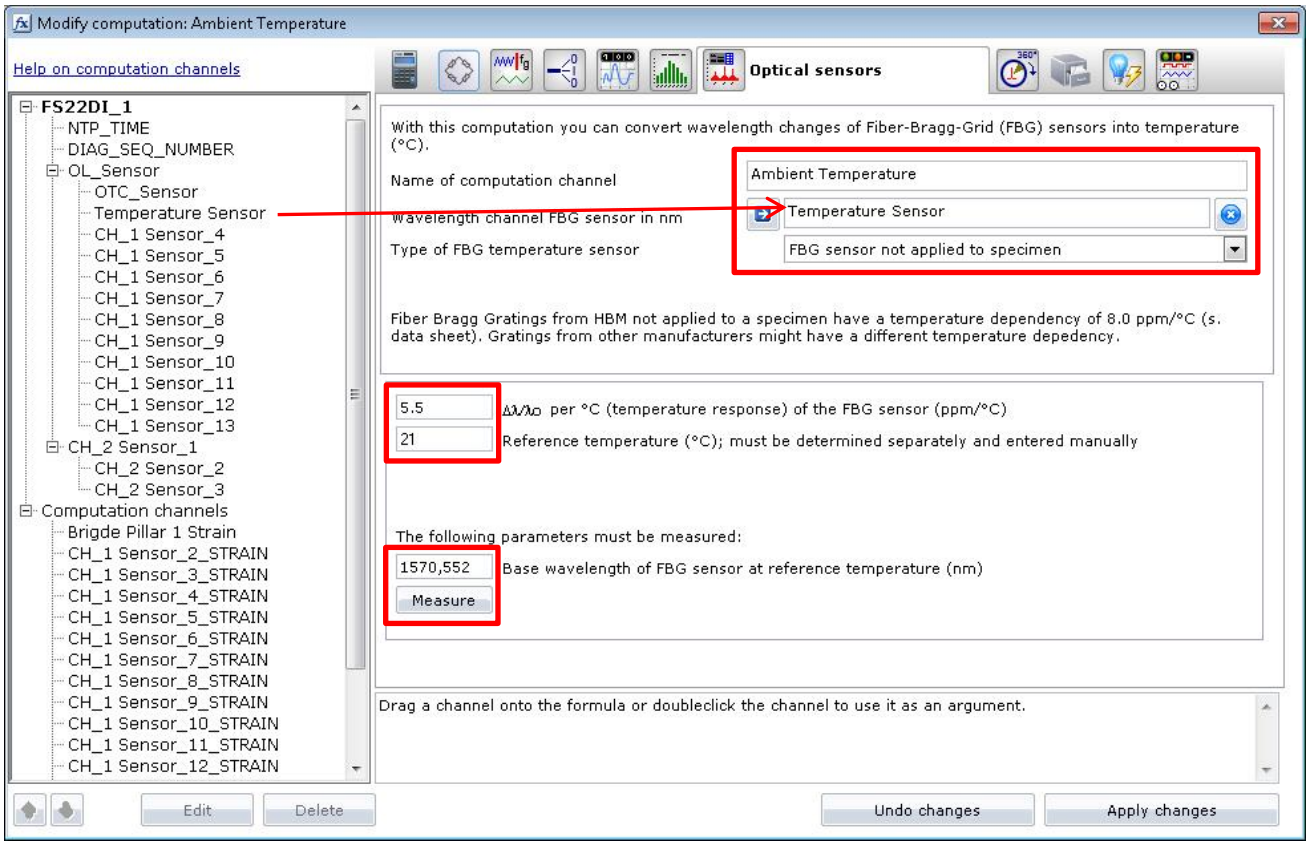
- Name of computation channel
- Wavelength measurement channel
- Type of temperature compensation and corresponding parameters
- Further parameters depend on type of temperature compensation (See catman help for details)



Step 5: Create temperature channel

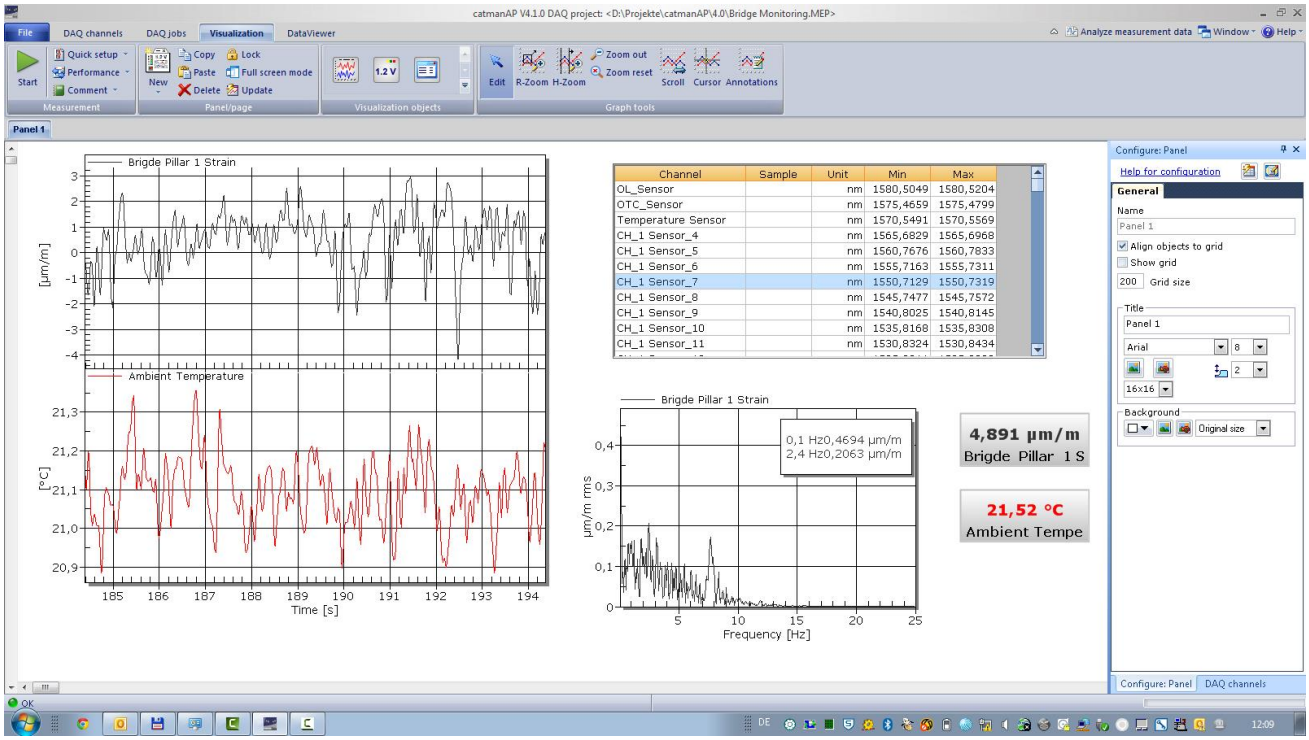
With a computation you can also convert wavelength changes of FBG sensors into temperature (°C)
To do so click on button “temperature sensor” in tab “Optical functions”. In the calculation dialog please specify

- Name of computation channel
- Wavelength measurement channel
- Type of FBG temperature sensor
- Delta ƛ/ ƛo per °C of the FBG Sensor
- Reference temperature
- Base wavelength of FBG sensor at reference temperature (can be measured)



After clicking ok the new calculation channel will be displayed in the DAQ channels list.

Step 5: Define your DAQ job parameters and start data acquisition

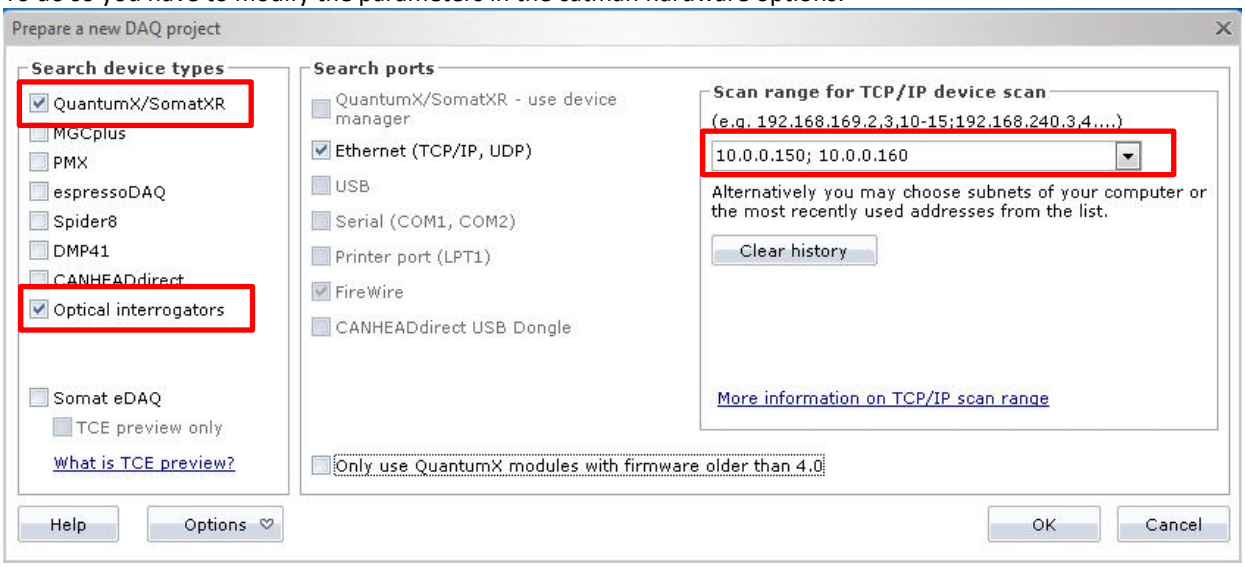


Hybrid DAQ systems to acquire optical and analog signals

It is possible to acquire optical and analog signals with hybrid DAQ systems:

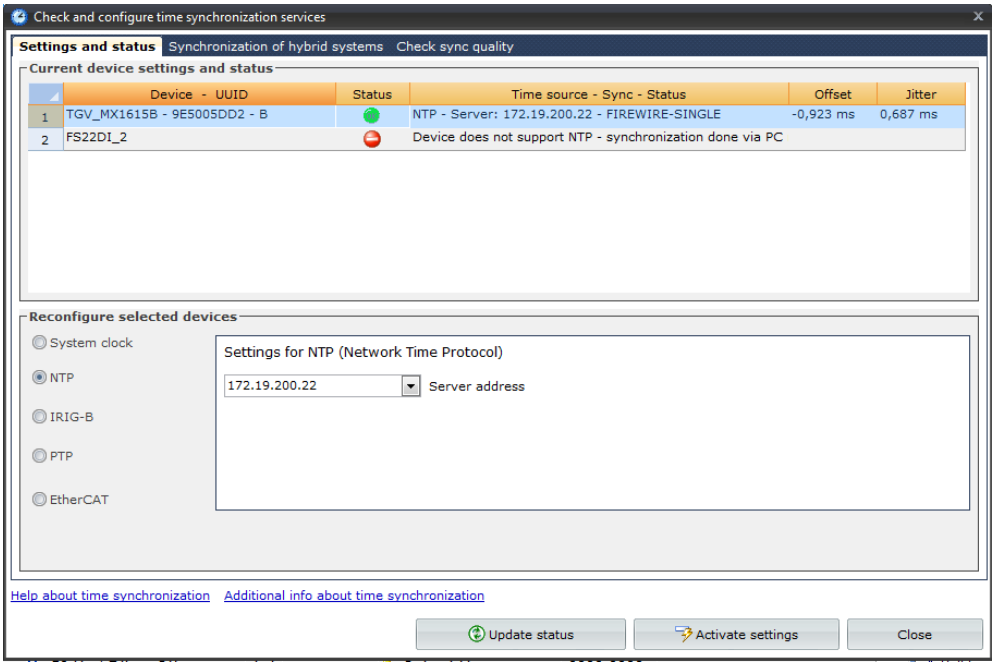
- QuantumX and optical interrogators
- MGCplus and optical interrogators

To do so you have to modify the parameters in the catman hardware options:



Please note that HBM Fiber Sensing interrogators do not support NTP synchronization so far. Nevertheless catman supports a synchronization method where

- PC and analog DAQ system (QuantumX or MGCplus) are synchronized over NTP. The NTP master in this case has to run on the PC where catman is running or catman PC and DAQ system are both synchronized with an external NTP master.
- The data received by the FS22 Interrogator is time stamped by catman



Tests showed that this synchronization method works quite good. However this depends highly on the sample rate and the network connection and traffic. We recommend to test the synchronization accuracy with mechanical force applied

to an analog and an optical sensor. The following pictures shows a measurement of a bending beam, where an optical sensor has been applied together with an electrical strain gage: