



THINK INSPIRE CREATE

Developing Tomorrow's Technology Today



**Real Time sensor performance and signal
processing in a few mouse clicks
SKF, Nieuwegein**

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(For public release: NLR)

- ▶ Who we are.
- ▶ Evaluating the real-time performance of a sensor.
 - ▶ The first steps and challenges.
 - ▶ Summary of requirements.
- ▶ The SensorPro.
- ▶ SKF case study: Measuring material stress in a wheel hub.
- ▶ Demonstration.
- ▶ Questions.

Who we are



- ▶ Established in 2006 in Enschede.
- ▶ Business focus: sensor measurement applications (automotive, industrial & audio).
- ▶ Comprised of international team of experts, specializing in:
 - ▶ DSP algorithms.
 - ▶ Analogue & digital hardware design.
 - ▶ PCB design.
 - ▶ Embedded software.
 - ▶ GUI design.

Sensor measurement: The first few steps & challenges



- ▶ What measurement accuracy is required ?
- ▶ Building hardware (amplifier, data acquisition board etc.)
- ▶ Finding a power supply (in use with another experiment).
- ▶ Filtering the data:
 - ▶ Not sure about the type of filter or specifications.
 - ▶ What algorithms do I need ?
- ▶ Writing software and designing hardware:
 - ▶ too time consuming.
 - ▶ Requires experienced designers.
 - ▶ likelihood of bugs is high.

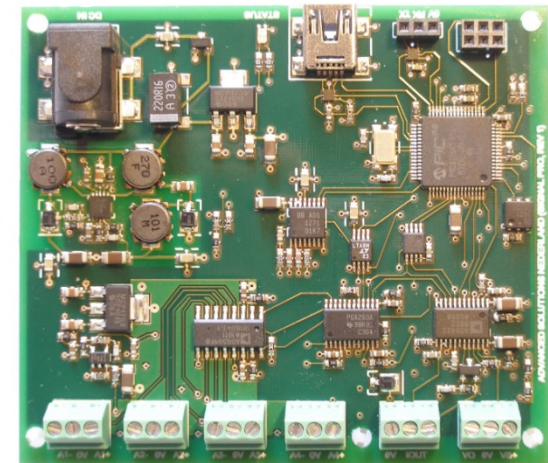


Summary of requirements

- ▶ I'm working with a new sensor.
- ▶ I want to do data acquisition.
- ▶ I don't want to worry about finding a power supply.
- ▶ I want to perform signal processing on the captured data.
 - ▶ Not sure which algorithm to use.
- ▶ I don't want to design hardware or write software.
- ▶ I want to see the sensor's performance in real-time with the algorithms.
 - ▶ Matlab not suitable for real-time analysis.
 - ▶ Simulink/real-time workshop and Labview are expensive options.

A possible solution: SensorPro

- ▶ 24-bit sigma-delta ADC.
- ▶ 100-10,000 SPS data rate.
- ▶ 4 fully differential multiplexed analogue inputs ($\pm 10\text{v}$).
- ▶ 1 analogue output:
 - ▶ Current (0-20mA) / voltage ($\pm 10\text{V}$).
 - ▶ From application.
- ▶ 0.1-10,000 software/hardware gain.
- ▶ 32-bit embedded real-time DSP functions.
- ▶ On board low noise power supply.
- ▶ USB and RS232 connectivity.
- ▶ EEPROM (standalone applications).
- ▶ Windows driver support (Matlab, C/C++).



Sensors

- ▶ Loadcells and strain gauges.
- ▶ Thermocouples, NTCs and RTDs.
- ▶ Pressure sensors.
- ▶ Capacitive and Inductive sensors.
- ▶ Level sensors.
- ▶ Humidity sensors.
- ▶ Microphones.
- ▶ Photodiodes and LDRs.

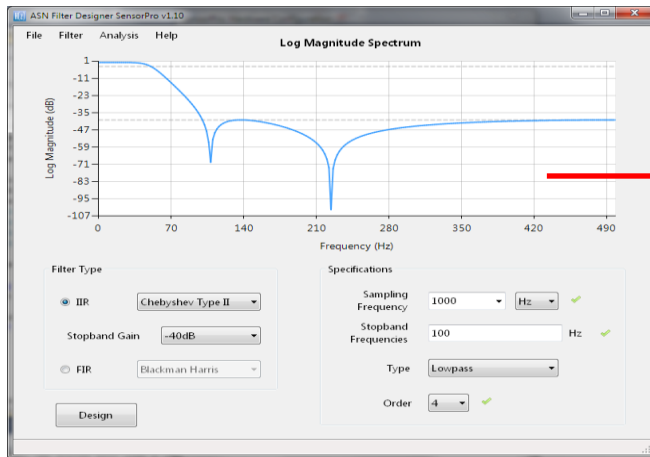
Applications

- ▶ Industrial control.
- ▶ Process control.
- ▶ Avionic instrumentation.
- ▶ Automotive transducer applications.
- ▶ Biomedical signal processing.
- ▶ Vibration analysis.

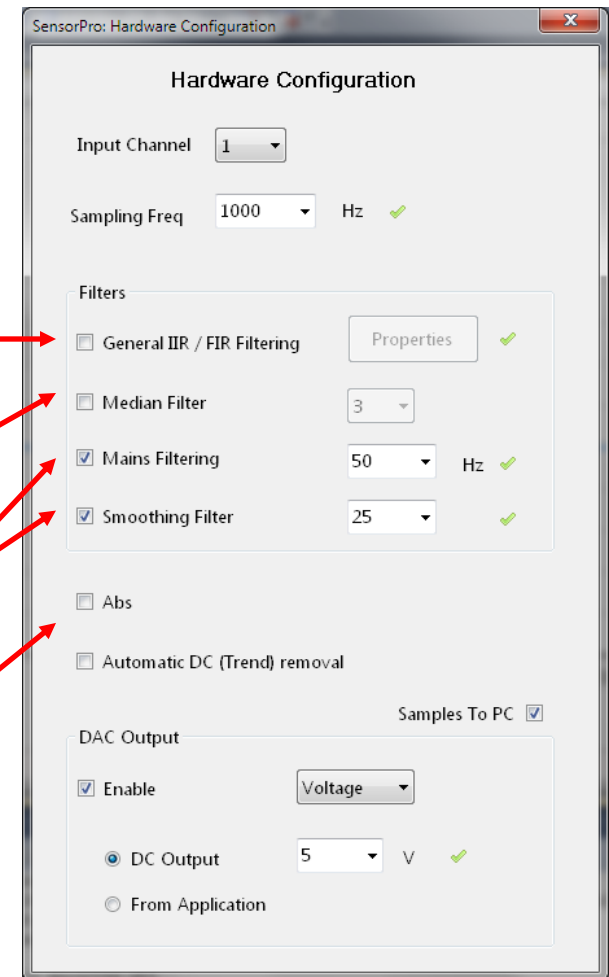
SensorPro: Real-time embedded Signal processing functions



- ▶ 2-128 tap FIR (finite impulse response) filter.
- ▶ 2nd/4th order IIR (infinite impulse response) filter.



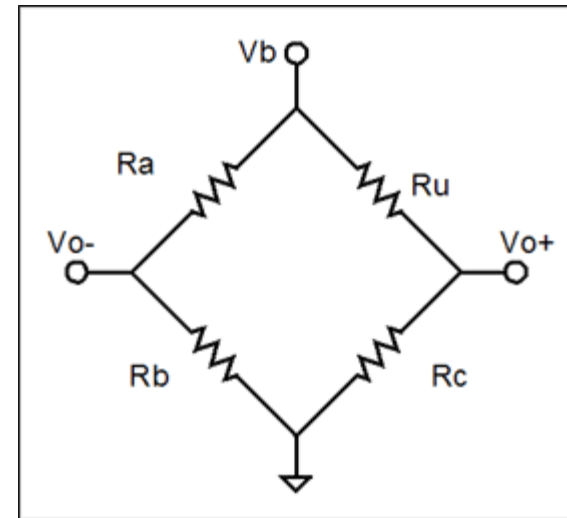
- ▶ 3rd-17th order median filter.
- ▶ power line interference cancellation filter.
- ▶ First-order smoothing filter.
- ▶ Trend removal and Absolute value.



Case Study (SKF): Measuring material stress in a wheel hub

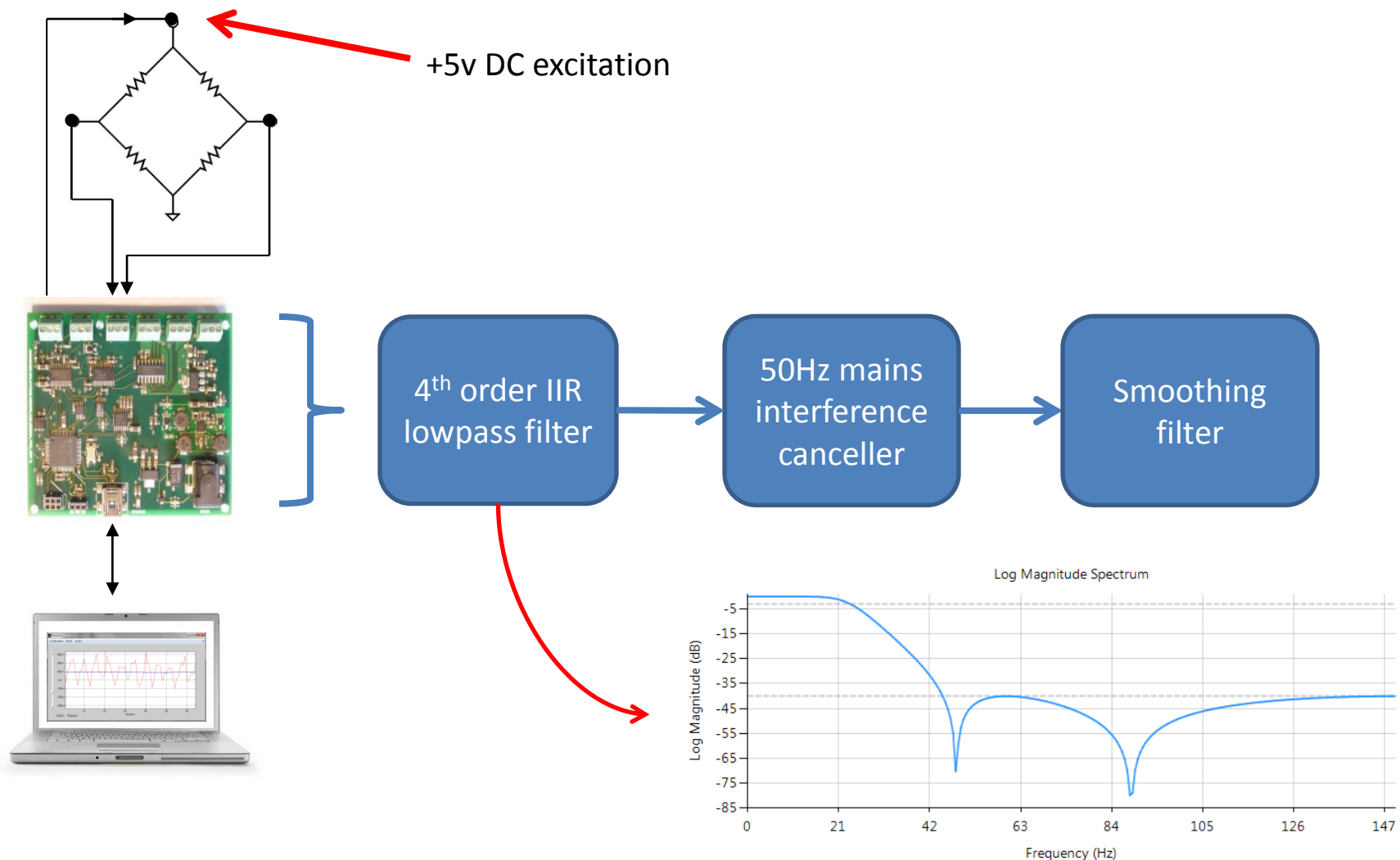


Strain gauges used to measure material stress in wheel hub when fitted to a car or tractor.

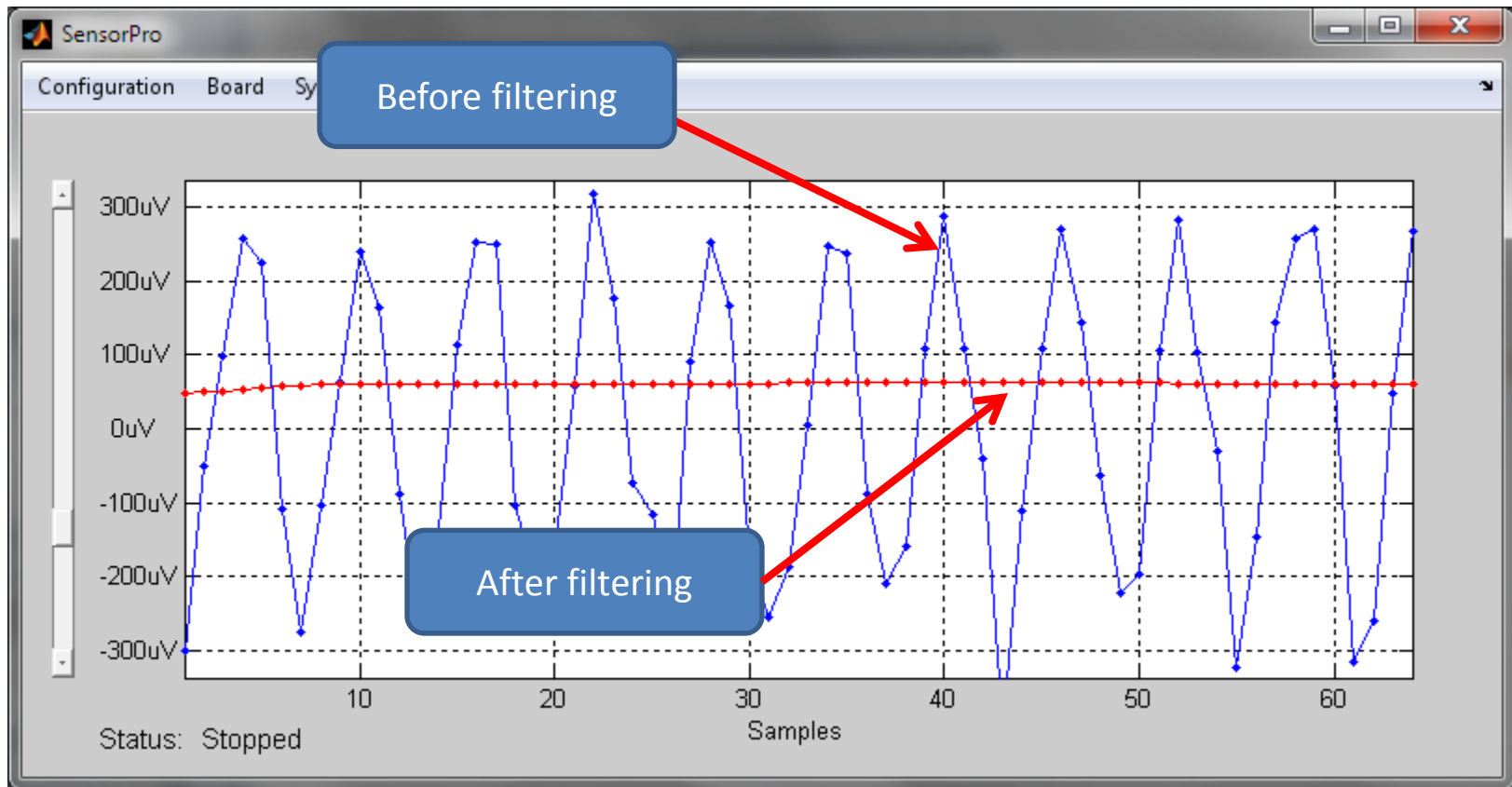


Wheatstone bridge

Case Study (SKF): Experimental setup with SensorPro



Case Study (SKF): Signal enhancement using SensorPro



Demonstration with loadcell: 50Hz and other noise elements minimization.

Contact us



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