ITvilla

Automated measurements in building-related test-environments: common problems and some practical solutions

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Agenda

- Data Acquisition issues
  - Small signals, large disturbances
- Environment control issues
  - Stability, synchronization
- Remote management issues
  - Changes must be possible
- Data aquisition issues
  - Preview before processing
- A real-life example


Data Acquisition issues (1)

- Small signals
  - Instrumental amplifiers with high gain
    - Noise immunity
      - Screening
      - Short (analogue) cables – distributed ADC modules
    - Temperature drift
      - Special components, especially for the first stage of the amplifier
      - Calibration on multiple temperatures and interpolated zero level
  - Thermopairs everywhere
    - Avoid relays in analogue signal path
    - Avoid temperature gradients on connectors and PCB-s
  - Matching the signal with ADC range
    - Partial range usage = partial resolution = lost ADC bits
    - Use automatic gain control if possible to align the signal with range

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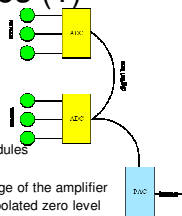
Data Acquisition issues (2)

- Various disturbances
  - Some effects are surprisingly large
    - A peak-to peak change of 0,5 degC in room temperature can cause more than 50% modulation in the signal level from heat flux sensor
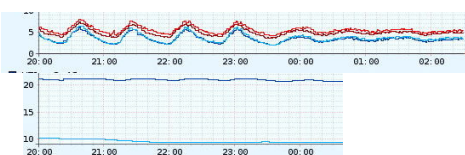
    - Also avoid direct Sun radiation on sensors

Environment control issues

- Do not try to use a domestic thermostat-controlled heater to keep the room temperature stable
  - It's too easy to get 5 degC fluctuation in temperature, modulating heavily the measured signals
  - As the heating intervals are not tied to the averaging period of the measurement results, interference effects (strange fluctuations that should not be there according to the formulas) will reveal in the averaged data
- A proper PI regulator should be used for test environment room temperature control
  - Simple on/off thermostatic switches have hysteresis
  - And they are mounted close to the heater… no precision.

Remote management issues

- A need to adjust some control parameters may occur
  - Remote control avoids a lot of traveling
- Based on the actual behavior of the test environment, some changes in the control program may be needed
  - Remote updateability is good
    - Usually from the central server

Data aquisition issues (1)

- Preview before processing
  - To make sure the data is of high enough quality to process
    - no obvious errors (false readings)
    - no holes in data flow / missing data
  - To discover possible sensor problems
    - Functional
    - Location-related
  - To have some early view
    - On the expected outcome of the ongoing experiment

Data aquisition issues (2)

- An on-site automation controller (as a lightweight local server) is able to
  - Read and digitalize sensor information
  - Control the environment conditions
    - Switching heater, humidifier, cooler, ventilation
  - Send the gathered data to the storage&visualization server
    - Various cloud services are available
    - Open source software for the server is available

A real-life example

- Nagios3 open source server software
  - with helper application PNP4Nagios
- Barix Barionet automation controller
  - equipped with tailor-made Basic-program
- A few extensions to the controller
  - high sensitivity multichannel ADC
  - digital multiplexer to read serial sensor output