Cyber-Physical Industrial Systems

MODULE 3 SESSION 2

DEVELOP THE CPS DATA PROCESSING SOFTWARE COMPONENTS

LECTURER NOTES

For this activity, it is presumed that each team of students succeeded to:

- connect all the hardware components of the CPS system;
- tested the connections:
- develop the software components for the analog and/or digital inputs and for the analog and/or digital outputs.

The students will be eventually asked to modify the data acquisition software for having at least a graphical representation of one measured quantity vs. time.

Regarding the graphical representation, the students will be asked to compare it with the "ideal" variation of the physical quantity as theoretically imagined before making the measurements.

They will have to discover at least some of the following aspects:

- the aspect of the graph is not "clean", there are small "shakings" and "tremblings", like in figure 4.7 from MSIE-10-L-M3S1-W01 or in the figure below;
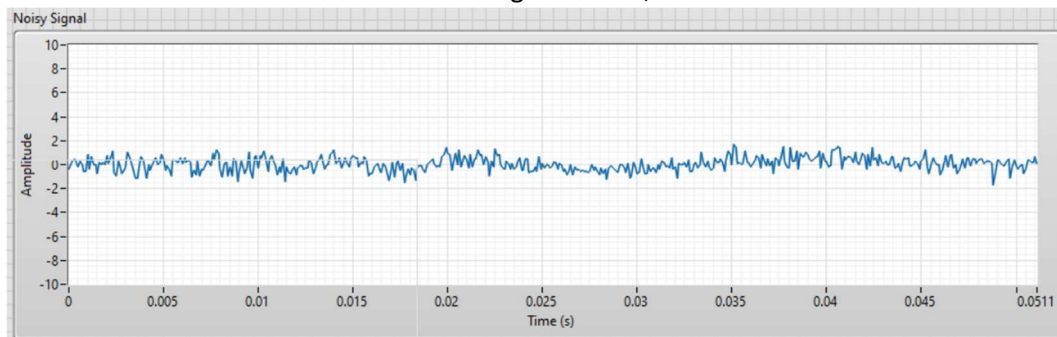
- there are clear periodic variations in the signal, like in the figure below
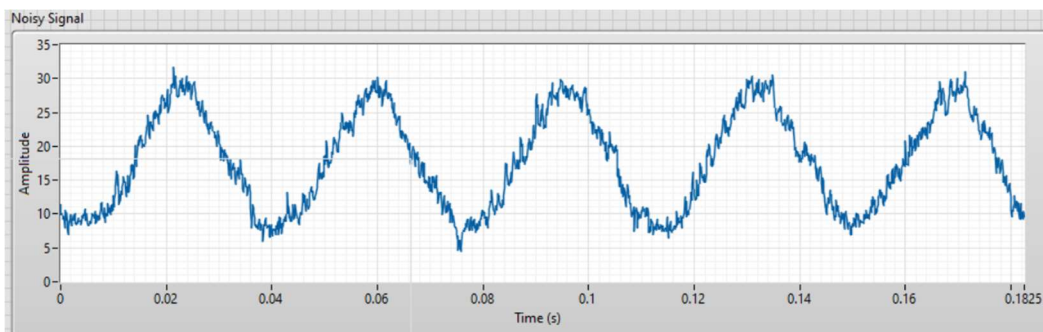
- the value of the signal is not equal to zero when this would be expected.

After discovering these errors, the students will be asked to search for "repair tools" (algorithms, methods) to reduce or eliminate them:

- applying an offset to the signal if this is not equal to zero when this would be expected;
- applying a median filter for reducing a uniform noise;
- computing the frequency of the periodic variations for trying to determine their source.

Help the students to find the appropriate signal processing functions and encourage them to try more functions, if available, and to compare their effects, for example different filters (median, Butterworth, Chebyshev) or different spectrum functions (Auto Power, Power, Cross Power etc).

After the students succeeded to obtain clean signals, ask them to repeat the measurements in different conditions (e.g. with different values of the working parameters) and save the measured results for each set of conditions.

If the measured signals are not constant during an experiment (because the signal represents a dynamic variation), students could be encouraged to use the coordinates of the points forming the signal's graph and to apply a fitting function for establishing the dynamic variation's formula.

In this case, the measured results from each set of conditions will be replaced with the fitting coefficients.