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The review of the doctoral dissertation of Kinan Wannous „Distance Protection Design Using Digital Input Data“

The topicality of the doctoral dissertation and its relevance to the field of dissertation

The ongoing transformation from analogue to the digital era in the field of power substation automation is a key step in the development of future smart solutions in power systems. A key role in this process plays the communication infrastructure responsible for data exchange between automation's elements. Ones of the most important are intelligent electronic devices (IEDs). They provide a wide range of monitoring, control and protection functions due to the application of microprocessor technology. A very perspective feature of IEDs is their ability to work directly with digital signals. So, it would be very useful to feed them with digitalised data describing voltages and currents measured by voltage and current transformers or sensors. From this point of view, I find the topic and the content of this doctoral dissertation very actual and relevant to the field of dissertation.

The methodology used and author contribution

The doctoral dissertation is built up logically. The first part of it consists of chapters describing the state of the art in the field of distance protection relays as well as the analysis of the impact of current transformer saturation and total harmonic distortion on the correct distance protection functionality. The results of these analytical chapters are then used to design the method enabling to process a real-time stream of digitalised sampled values for distance protection functions based on the IEC6185-9-2LE standard. The method's functionality was tested through an application created in Matlab environment which successfully processed the stream of sampled values acquired from a real power substation. The application provides other functionality as well (e.g. voltage and current RMS calculation, harmonic distortion evaluation, distance protection characteristic presentation and

fault impedance calculation). The model and mainly the method itself are the main original contribution of the doctoral dissertation.

Results dissemination and candidate research activities

The PhD candidate has published the results of his research regularly on several international scientific conferences and the main parts of his dissertation were also published in an impacted journal. Unfortunately, I was not able to make a review of the candidate's other research activities, because they were not mentioned in documents provided with the dissertation.

Comments and questions

I have got several comments to the dissertation thesis and questions for the candidate:

- Literature references are usually lined according their first appearance in the text.
- Variables are not explained in the text very often.
- The links between tables and the text around them are missing in the thesis, even when the tables present important information.
- There are small formal mistakes in the text, not very often, but they are there.
- The biggest comment is aimed at chapters' summaries. They provide explanations and logical connections about what was done in the chapters as well as a motivation for it. So, they are very useful for the understanding of chapters' content on one hand, but they provide information that should have been mentioned in the chapter themselves on the other.
- What is the difference between THD filters in the used protection relay and the Matlab model? The later one shows much better accuracy than the first one (Table 5.4 vs. Table 5.3). Is it caused by the content of the Comtrade file, which was used for the Matlab model?
- How problematic it would be to implement a THD filter used in the Matlab model in a real protection relay?
- What did cause statistically unimportant cases in Fig. 6.10 and Fig. 6.11 (the values in the upper parts of the figures)?
- Why is it so difficult to identify which merging unit is sending the SMV (page 60)? There should be some addressing involved in the protocol, shouldn't it?
- Is it possible to run a created GUI (Chapter 7) even on the PC without Matlab installation? Would it be difficult to programme it in a different programming language, more suitable for stand-alone applications (C, Java, Python)?
- Is there any plan to protect the result of the dissertation thesis with a patent?

Final statement

The doctoral dissertation of Mr Kinan Wannous deals with a really actual topic, which belongs to the field of Power Electrical and Electronic Engineering. It is written in line with the defined aims and it meets the criterion for a doctoral dissertation. Acquired knowledge brings novelty to the field of

power substation automation. The results of the doctoral dissertation were satisfactorily presented to the scientific community through conferences and journal publications.

Given the above facts, it can be concluded that Mr Kinan Wannous is a candidate with sufficient scientific erudition, and therefore I recommend his doctoral dissertation for defence and after a successful defence I recommend the award of an academic degree

Philosophiae doctor (PhD.).

Yours sincerely,

doc. Ing. Peter Braciník, PhD.