My research methods

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1 Brief explanation of my research subject

In a factory there may be hundreds or thousands of control loops, the majority of these are using PID controllers. But even though the PID controller is quite basic and only has three parameters to tune, a lot of them are working poorly. This is usually either due to lack of time or lack of knowledge among the users. Therefore a way to tune these controllers automatically is highly beneficial, and that's where my research enters. What we try to do is to design an automatic tuning procedure of the controllers that is simple, yet good enough to get a good performance of the PID controllers.

2 My research methodology

The methodology I use is very much like the "Engineering research method" that was brought up during the course that consists of the following three steps

- Identify a problem
- Invent/build/design something
- Evaluate.

The problem that is identified is that many PID controllers work poorly, even though it should not be so hard to tune the parameters automatically. Automatic tuning of PID controllers has been done for quite a long time, but we see possible improvements and want to refine the method to get better results while keeping it simple and fast so that the users can use it in practice.

The invention is to design a good procedure of finding the PID controller parameters automatically. All the way from designing the experiment to analyzing the obtained data and use it to tune the controller. In this step we use a lot of earlier research and try to improve the method to either make it faster, better or simpler. All of which is an improvement in some sense.

The evaluation phase of my research consist of comparing the results of my method with the results of other methods, and also to compare with chosen metric limits that are considered as good for the PID controller. In the evaluation phase I also test how the method responds to different kinds of disturbances and other potential error sources and compare that to other methods as well.

3 Using other methods

Some other research method that would be interesting to use, even though I don't know if I'll have the time is to do some kind of field study. There are some different options that would be interesting, first of all it would be good to get some up-to-date facts about the current status of PID controllers running in factories and how they are tuned. Some earlier investigations exists, but to really motivate my research it would be good with more studies of that sort.

Secondly, it would be interesting to do a survey with the people using the PID controllers about user-friendliness of existing autotuners and my proposed one, and also to get a sense of what are the important features for them and what problem remains. Why would or wouldn't they use an automatic tuner. All this to make the research even more relevant to the industrial users.

4 Discussion

I think that we in our field in general, and me in particular are not reflecting that much on what research methods we use. We do usually use some version of the scientific method, but without clearly stating our hypotheses or exactly how to test it in the best way. I think that we quite often get stuck in tradition and what has been done in papers before, and mimic that but with our adjusted methods. I think that it is sometimes good to build on the research tradition of the field, since it might make it easier for others to grasp your results. But I also think that it would be good if more people actually took some time thinking about what they really want to find out and what's the best way of doing it. Maybe the methods used by everyone else is not the best for your specific question, or maybe you should even have put the question differently if you had approached the problem a bit more open-minded or from a totally different perspective.

Another thing that is sometimes lacking in our fields, and in many other research areas, are the connection to real-world problems. Sometimes it feels like we are only solving made-up problems that will have no effect in practice. That can of course be okay, but then you should be aware that that is what you are doing and not fool neither yourself nor anyone else of its immediate practical use. Therefore I think that a stronger connection to, and knowledge about, the everyday problems faced by the potential users of our "products" would be great. Something that may be achieved by more field studies or more informal visits and discussions.