DOCUMENT

Bachelor Project

Task Description

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1 Introduction

Oil drilling is performed with a drillstring with a drillbit attached on the end. While drilling, mud is pumped through the drillstring and down through the drillbit in order to apply pressure at the impact point. The mud then flows back up to a mud pit where all the mud is stored. One of the muds functions, among many other things, is to apply hydrostatic pressure. In order for the well not to collapse or fracture, it's crucial to keep the right pressure. Too low pressure increases the risk of collapsing the well, while too high pressure can fracture the well and damage the reservoir.

Today, the oil drilling industry is mainly relying on manually controlling the downhole pressure while drilling. This is a viable solution, however, it proves difficult to control the downhole pressure with enough accuracy and speed, as well as it is challenging to predict when a problem occurs. If these problems are not detected, and not handeled properly, it might lead to immense consequences. This was the case in the BP catastrophy in the Mexico gulf in 2010, which was caused by a blowout and bad safety routines.

Kelda Drilling Controls focuses on a technology called Managed Pressure Drilling (MPD), a technology that relies on a back pressure pump and a choke located by the mud pit. By adjusting the back pressure pump and the choke opening, it is possible to control the downhole pressure. This ensures a quicker, more accurate and more robust pressure control.

Because of its robust pressure control, MPD will have less errors compared to manually controlled systems, which means faster drilling. Because of its accuracy, MPD can be used under challenging pressure conditions, which means that oilfields once deemed too hard to drill, now are accessible.

MPD will be a cost effiecient solution for oil drilling. This is one of today's top priorities within the oil industry, which makes MPD a technology to recon with in the future.

1.1 Terms and definitions

Term	Definition
MPD	Managed Pressure Drilling
GUI	Graphical User Interface
PI	Proportional-Integral
P&ID	Piping and Instrumentation Diagram
TDD	Test Driven Development

2 Project Tasks

A part of Kelda's work is to create simulators resembling different cases of drilling scenario, and then provide a mathematical controller for the downhole pressure in one such scenario.

In this bachelor project, the group will be provided with one of these simulators from Kelda. The task is to create a proper Graphical User Interface(GUI) for the provided simulator in order for the user to have an easy-to-use, and a good workstation to work with a simulator.

The group will also create a Proportional-Integral (PI) controller for the simulator in order to compare it to the controller Kelda developes.

2.1 Task 1: Workflow

The group will cooperate closely with Kelda in order to gain knowledge of how to work with a team of engineers in a company, and using various tools for an effective workflow.

The group will take part in meetings with the Kelda team, in order to discuss ideas and have regular updates on the status of the the project. It's important for the Kelda team that this bachelor project succeeds, and therefore believes that good cooperation will provide the best results. Kelda expects to use the GUI made in this project and because of this one of the tasks in this bachelor project is to learn how to use different tools and ways of working in order to deliver a project that lives up to Kelda's expectations.

2.1.1 Scrumwise

Scrum is a working method where the project are split into several sprints and tasks. A sprint might be a smaller milestone in the project, that is expected to take a couple of weeks. The sprint consists of several smaller tasks, which have well defined instructions for a job, with clear goals.

At the start of a sprint, the team plans the next milestone in the project, and defines the tasks needed to reach that milestone. The tasks are then divided between the team members and the team members will regulary update the sprint when they have finished their tasks.

This ensures that the group members always knows what to do and it makes it easy to keep track of the project.

Scrumwise is a web based scrum tool Kelda uses to manage tasks within their team. The group will become a part of Kelda's team during the bachelor project and that require the group members to learn how to work in scrum.

The group members will be introduced to scrumwise by an employee of Kelda, and will be expected to set up their own sprints and manage their own task during the bachelor project period, while supervised by Kelda.

2.1.2 Test Driven Development

Using Test Driven Development (TDD) while coding means that one will make several tests for all the code produced. This means that if the code pass the tests, it's safe to use in the final product. While this method of working might be more time consuming than usual, it will ensure good and stable code. It will also make it safer for people to later alter the code, because the tests will tell them if they somehow broke some original funcionality.

Kelda uses TDD while coding in order to produce a secure code with the least amount of bugs possible. The group members are expected to use this method while coding, which means they will have to study this method and gain some knowledge on how it works.

2.1.3 BitBucket and Sourcethree

BitBucket is a private code repository for remote git storage Kelda uses for their code, while SourceThree is a graphical tool used by bitbucket for local git management. The group will get access to Kelda's BitBucket account and will learn how to use this the proper way. All code produced in this project will be stored in BitBucket.

2.1.4 Automatic reporting

A part of Kelda's documentation is done through automatic generated reports from their code and the group will do the same in this project. The documentation is written in latex and the group will have learn this language prior to their coding.

2.2 Task 2: GUI

The goal for this task is to create a light weight GUI, which provides the user with an easy-to-understand simulator, demonstrationg the behaviors in a drilling scenario. This will provide Kelda with the opportunity to easily distribrute the simulator for demonstration purposes.

The GUI should display the simulator as a Piping and Instumentation Diagram(P&ID), with the possibility to change the values of key features in the simulator. When all the necessary features are set, the user should be able to run a simulation. After a simulation, the GUI will present relevant data from the simulation as properly displayed graphs.

The GUI will be developed in LabView and the group will use TDD in this development in order to make sure that simulator always run with valid values. The group will be provided with the simulator as compiled C code from Simulink which should make the implementation of the simulator into LabView an easy task.

2.3 Task 3: PI controller

The PI controller is a common implementation in the drilling industry since it often provides an easy, yet effective solution. A PI controller should always be tested in order to establish the effectiveness of an easy solution, and also makes it a natural baseline for testing of other controllers.

The group will develop a PI controller using Simulink, and compile the controller into C code in order to implement it into simulink as a part of the GUI. The controller will then be tuned using the simluator with the tuning method the group desires. An important function of the GUI will be to compare the PI controller with the controller Kelda developes. The PI controller will also be used for comparing different controllers developed by Kelda in the future.