Project Plan

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December 13, 2020

Version 1.0

Status

Reviewed	Jesper Johansson	2020-09-23
Approved	Fredrik Ljungberg	2020-09-24

Project Identity

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CONTENTS

DOCUMENT HISTORY

Version	Date	Changes made	Sign	Reviewed
0.1	2020-09-21	First Draft	All	Jesper Johansson
1.0	2020-09-24	First version, comments fixed.	All	Jesper Johansson

NOTATIONS

- ROV - Remotely Operated Underwater Vehicle
- ROS - Robot Operating System
- RPi - Raspberry Pi 3
- LiU - Linköping University
- ISY - Linköping University department of electrical engineering
- GUI - Graphical User Interface
- CoG - Center of gravity
- CoB - Center of buoyancy
- DP - Decision Point
- HIL - Hardware in Loop

1 INTRODUCTION

This document is written to give project members and other interested people an overview of the work and workflow. It contains the time plan as well as a formulation of the project members' responsibilities.

2 PROJECT ROLES

The members of the project will have different roles in the project, which are specified here. The responsibilities are presented in table 1.

Table 1: Project roles.

Name	Responsibility	E-mail
Axel Malmberg	Project Manager	axema691@student.liu.se
Fabian Steen	Software	fabst898@student.liu.se
Jacob Ljungberg	Design	jaclj859@student.liu.se
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2.1 Project manager

The Project Manager is responsible for documents and reports being delivered on time. They are also responsible for communication with the customer and first contact with external partners.

2.2 Software

The Software manager is responsible for the necessary software being developed and further improved. This includes responsibility for the version management for the code. The software manager is also ultimately responsible that the new code is written according to the code standards specified in the Requirement Specification.

2.3 Design

The Design manager is responsible for the design of the ROV and that the product is developed in agreement with design aspects so that the design feels coherent and consistent.

2.4 Testing

The Testing manager is responsible for the tests that are necessary for the development of the ROV. This includes planning and communication with the rest of the project group about different tests.

2.5 Information

The Information manager is responsible for the information about the project and that it is distributed to necessary parties. This includes the web-page that will present the project.

2.6 Planning and vice Project manager

The Planning manager and vice Project manager is responsible for the planning and that the plans are produced and kept by the project group. They are also responsible for taking over the Project manager role if the current Project manager is not available.

2.7 Documentation

The Documentation manager is responsible for the documentation and that the documents are produced and proofread.

2.8 Hardware

The Hardware manager is responsible for making sure that the hardware on the ROV is integrated into the different parts of the project.

3 TASK OVERVIEW / AIMS AND GOALS

The project is, apart from documentation, divided into four major categories that are more or less dependent on each other. These are Data collection and verification, Modeling, Simulation and GUI. These categories are presented below.

3.1 Data-collection and verification

A big part of this project will be about parameter estimation and model verification. To this end we have the task of data collection and verification. At the start of the project the main point is to collect data in order to estimate the parameters of the model. The parameters are to be used in the model and should therefore be evaluated as soon as possible. Later on in the project the focus should shift to verifying the model and if necessary re-estimate some parameters.

Apart from the kinematics of the ROV the sensors should also be modeled (and simulated) during this project. For this reason, data regarding the uncertainty, response time and signal structure must be collected.

3.2 Modeling

Accurate modeling of the ROV is crucial to ensure that the simulation yields useful results. There exists a kinematic model from previous iterations of the project. However, this model is not sufficiently accurate to be used for satisfactory control, and can be improved. The previous project managed to find information about another model at the end of their project run that might be worth investigating. The task of modeling will be about building the model in Simulink and about integrating the parameters found during data collection.

The sensors were not modeled much by the previous iterations of this project so therefore the model of the sensors will have to be done more or less from scratch. For this reason the modeling of the sensors is greatly dependent on the data collection from the previous section. Among the parts that should be modeled are: what exactly the sensors measure and how the noise behaves.

3.3 Simulating

To simulate the ROV a model is needed. This task will therefor be closely linked to the modeling task, but there are also other dependencies. The simulation environment must be able to shuffle information around to different sources, like the model but also to the GUI. It should also be able to take in information from the model, the GUI and, in case HIL is implemented, from the ROV itself. To preform such operations an accurate model is not necessary and it should be possible to implement most parts of the simulation independently of the new model. The calculations should be handled in Simulink but the distribution of information might need other channels.

The simulation environment together with the sensor models should be able to produce sensor signals that can be fed either to the ROV-model or to the ROV itself in the case of HIL.

3.4 GUI

The GUI should display the information that the user needs and should allow for the user to choose different tasks. It is important that the communication interface between the simulation and the GUI is clearly established as a lot of information needs to travel between the different systems. The graphics for the simulation should be dealt with in Gazebo.

A long term goal is to have the ROV produce an image of the underwater world it is exploring. A visualization of the progress doing so would then be useful, and will be developed if possible.

4 MILESTONES

This section covers the group's milestones. The purpose of milestones is that the group has clear and verifiable goals to work towards. The milestones are presented in table 2.

Table 2: Milestones.

Milestone	Description	Date
M1	Verify current functionality	2020-10-02
M2	Parameter verification	2020-10-16
M3	Implemented new model.	2020-10-23
M4	Simulator integrated with Gazebo.	2020-10-30
M5	Simulation of autonomous driving by the ROV.	2020-10-30
M6	Automatic calibration of the magnetometer.	2020-11-15
M7	HIL functionality for the ROV.	2020-11-05

5 ACTIVITIES

This section covers the groups planned activities together with estimated time for each activity.

Activity	Description	Time
Modeling	-	-
1	Analysis of previous model	21
2	Development of kinematic ROV model	20
3	Development of IMU model	10
4	Development of barometer model	10
5	Development of magnetometer model	10
6	Development of sonar model	12
7	Development of pressure sensor model	10
8	Implementation of kinematic ROV model in Simulink	17
9	Implementation of IMU model in Simulink	15
10	Implementation of barometer model in Simulink	15
11	Implementation of magnetometer model in Simulink	15
12	Implementation of sonar model in Simulink	20
13	Implementation of pressure sensor model in Simulink	15
Gui	-	-
1	Implementation/modification of GUI	20
2	Creating a visual representation of the ROV	20
3	Implementation of visual representation of ROV in GUI	15
4	Creating a visual representation of surroundings	20
5	Implement visual representation of surroundings in GUI	15
6	Create/test a way(s) to calibrate magnetometer	20
7	Calibrate magnetometer from GUI	30
8	Implement controllers in GUI	20
Simulator	-	-
1	Review and revise current simulink model(s)	20
2	Create a simulation environment	35
3	Implementation of ROV in the simulation environment	30
4	Implementation of surroundings in simulation environments	20
5	Implement HIL	20
6	Verification of the models in the simulation environment	45
Verification and testing	-	-
1	Data collection and verification of parameter values	10
2	Test of ROV model	20
3	Test of IMU model	20
4	Test of barometer model	15
5	Test of magnetometer model	10
6	Test of sonar model	15
7	Test of pressure sensor model	10
8	Test of information transfer	10
9	Test of hardware	40
10	Test of simulation	20
Misc	-	-

1	Prepare the portable pool for testing and verify the current functionality of the ROV.	20

6 RISK-ANALYSIS AND DEPENDENCIES

Table 4: Dependencies of different tasks. Parentheses in dependencies mean that the dependencies only appear in the later stages of development.

Task	Dependencies	Details
Data collection	Modeling of kinematics, Modeling of sensors	In order to collect data we need to know what data is needed. For that reason we need to know the parameters of the models for the kinematics and the sensors. However we can assume that most of the parameters from the previous model will still be needed in the new model, so we can start our data collection before the model is finished.
Modeling of kinematics	(Verification of kinematic model)	The model itself does not need any prerequisites in order to be established. After the results from the model verification it is possible that the model will be further improved through iteration until the requirements are fulfilled.
Modeling of sensors	(Verification of sensor models)	see modeling of kinematics.
Verification of kinematic model	Kinematic model, data collection	To verify that the kinematic model is responding in a reasonable way it is necessary to have both the model ready and some real world data to compare it to.
Verification of sensor models	Sensor models, data collection	See verification of kinematic model.
GUI-simulation interface	-	For the GUI and the simulation to talk to each other there need to be an interface in place where it is clear what the systems should send to one another.
Simulation	(Modeling of kinematics, Modeling of sensors), GUI-simulation interface	To preform the simulation the models are needed, it will be a very uninteresting simulation if the models are not ready. However it is possible to create the framework of the simulation without either of the models. To select what type of simulations to run, some type of GUI would also be handy, this information need to get to the simulator from the GUI and therefore the GUI-simulation interface is needed.
GUI	Interface between GUI and simulation	The only thing that has to be established for the GUI before it can be worked on is the interface between the GUI and the simulation.
Verification of simulator	Data collection, Simulator, (GUI)	To verify that the simulator yields reasonable results it is necessary to have a simulator in place. It is also necessary to have some real world data to verify against. The GUI is a nice thing to have to be able to visualize the results.
Verification of GUI	GUI, (Simulation)	The verification of the GUI will need the GUI to make sense. The verification of displaying the ROV's movement will require the simulation but it is not necessary to begin verification as a whole. Like in any software task, verification and implementation should go hand in hand.

6.1 Risks outside of our control

- Due to the current Covid-19 pandemic much of the work has to be done on distance and depending on how the situation develops this might affect the practical work like testing.
- Previous group had problems with the sonar equipment on the ROV. This might cause issues for this group as well.
- Previous group had problems with implementing a script that could calibrate the magnetometer automatically. If this is not solved, the calibration must be done manually. This might take up a lot of time for the group.
- The modeling/implementation of the sensor models is strongly dependent on the measurements of the signals from the sensors.
- If the new model parameters (that will be estimated during this project) are poorly chosen this might cause problems with the simulator and if it is not addressed it could lead to a sub-optimal simulator.

7 RESOURCES

The different tasks need resources to be preformed in time, this section is here to give a descriptive overview of the hours and people that should be focused on which task. The project will include extensive documentation as well but the time set aside for that will not be presented in this chapter but in the time plan. The group's planned resource distribution are presented in table 5 and the group's resources are presented in table 6.

Table 5: Resource distribution.

Task	People	Hours	Week to be finished
Testing (Modeling)	Olof Mlakar + 1	100	42
Testing (Simulator)	Olof Mlakar + 1	60	45
Modeling	Jacob Ljungberg + Nibras Musa	190	43
Simulator	Fabian Steen + 1	170	44
GUI	Jakob Åslund + 1	160	44

Table 6: Resources.

Each group member must spend 240 hours on the project.
ISY will provide a small pool.
ISY will provide a maximum of 40 hours of tuition.
Combine Control Systems AB will provide a maximum of 40 hours of tuition.
ISY will provide a project room.
Combine Control Systems AB will provide access to a larger testing pool.

8 PRELIMINARY TIME PLAN

On the next page the preliminary time plan is presented. It contains information about decision points, milestones and the distribution of time over the different activities.

Basplan

Projekt:

Projektgrupp:	ROV	**Datum:**	9/9/2020	**Granskad:**	
Beställare:		**Version:**	0.2		
Kurs:	TSRT10	**Utfärdare:**	AM		

AKTIVITETER		**TID**	**VEM**	**TIDPLAN (när), veckonummer**																							
Nr	Beskrivning	timmar	Initialer	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	1	2	3	4	5	
1	Möte	192		16	16	16	16	16	16	16	16	16	16	16	16												192
2	Föreläsningar																										0
3	**Dokumentering**	563																									
4	Systemskiss	23	alla		12	11																					23
5	Kravspec	90	alla			60	30																				90
6	Tidplan	2	alla			2																					2
7	Git-guide		FS																								0
8	Projektplan	4	alla			4																					4
9	Designspecifikation	90	alla				60	30																			90
10	Testplan	36	OM						4	4			4	6	6	6	6										36
11	Testprotokoll	9	OM						1	1			1	1	1	2	2										9
12	Användarmanual	30	alla												10	10	10										30
13	Tekniskdokumentation	185	alla											15	50	90	30										185
14	Efterstudie	80	alla														50	30									80
15	Mötesprotokoll	14	alla			1	1	1	1	1	1	1	1	1	1	1	1	1	1								14
16	**PR**	210																									
17	Webbsida	80	JW, FS,														10	30	40								80
18	Youtube-film	50	två															30	20								50
19	Poster	80	tre														10	30	40								80
20	**Modellering**	190																									
21	Genomgång och revidering av tidigare modeller	21							21																		21
22	Utveckling av ROV-modell	20								20																	20
23	Utveckling av IMU-modell	10								10																	10
24	Utveckling av barometer-modell	10								10																	10
25	Utveckling av magnetometer-modell	10									10																10
26	Utveckling av sonar-modell	12									12																12
27	Utveckling av trycksensor-modell	10									10																10
28	Implementering av ROV-modell	17								5			12														17
29	Implementering av IMU-modell	15								5			10														15
30	Implementering av barometer-modell	15								5			10														15
31	Implementering av magnetometer-modell	15											10	5													15
32	Implementering av sonar-modell	20											10	10													20
33	Implementering av trycksensor-modell	15											10	5													15
34	**GUI**	160																									
35	Implementera/redigera GUI	20								5			10	5													20
36	Skapa visuell ROV-modell	20								5			10	5													20
37	Implementera visuell ROV-modell i GUI	15												15													15
38	Skapa visuell representation av omgivning	20									5			5	10												20
39	Implementera visuell omgivning i GUI	15													15												15
40	Skapa en metod för att kalibrera magnetometer	20															10	10									20
41	Start av magnetometerkalibrering från GUI	30																10	20								30
42	Implementera styrning i GUI	20													10	10											20
43	**Simulator**	170																									
44	Granskning av nuvarande simulinkmodell	20							20																		20
45	Skapa en simulieringsmiljö	35								10	10		15														35
46	Implementera ROVen i simuleringsmiljön	30											15	15													30
47	Implementera omgivning i simuleringsmiljön	20												10	10												20
48	Hardware in the loop	20											5	5	5	5											20
49	Verify the models in the simulation env.	35										5	5	5	10	10											35
50	Ta emot styrdata från ROV	30								5			15	10													30
51	Få styrdata att skickas från ROVen	20								5			10	5													20
52	Få ROVen att ta emot sensordata från simuleringen	10								5			5														10
53	**Testing**	160																									
54	Datainsamling och verifiering	10							10																		10
55	Test av ROV-modell	20							2	3					15												20
56	Test av IMU-modell	10							2	3					5												10
57	Test av barometer-modell	15							2	3					10												15
58	Test av magnetometer-modell	10							2	3						5											10
59	Test av sonar-modell	15							2	3						10											15
60	Test av trycksensor-modell	10							2	3						5											10
61	Test av informationsöverföring	10															10										10
62	Test av hårdvara	40							5	5						10	10	10									40
63	Test av simulering	20								5							15										20
64	**Övrigt**	190																									0
65	Buffert	190	alla				10	10	10	10	10	10	10	20	10	10	10	10	20								150
66	**Beslutspunkter**																										

Basplan

Projekt:

Projektgrupp: ROV
Beställare:
Kurs: TSRT10

Datum: 9/9/2020
Version: 0.2
Utfärdare: AM

Granskad:

AKTIVITETER		TID	VEM	TIDPLAN (när), veckonummer																							
Nr	Beskrivning	timmar	Initialer	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	1	2	3	4	5	
67	BP2 21/9	16	alla				16																				16
68	BP3 7/10	16	alla						16																		16
69	BP4 5/11 (preliminär)	16	alla										16														16
70	BP5 3/12	16	alla														16										16
71	BP6 14/12	16	alla															16									16
72	**Milstolpar**																										
73	Sensorparametrar kan genereras																										0
74	Testning av parametrar		alla																								0
75	Modell klar för användning		alla																								0
76	Samtliga modeller implementerade i simulink		alla																								0
77	Simulator integrerad med gazebo		alla																								0
78	3D miljö renderar																										0
79																											0
80																											0
81																											0
82																											0
83																											0
84																											0
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99																											0
100																											0
101																											0
102																											0
103																											0
104																											0
	Summa antal timmar:			16	28	94	133	57	116	150	74	32	200	159	184	174	190	177	141	0	0	0	0	0	0	0	1925