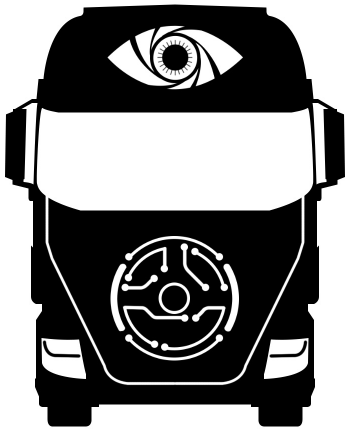
Test Plan

Autonomous Truck With a Trailer

November 20, 2020

Version 2.0



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Reviewed	Filip Jussila	2020-11-20
Approved	Carl Hynén	2020-11-21

Project Identity

Group E-mail:	vituv953@student.liu.se
Homepage:	https://tsrt10.gitlab-pages.liu.se/2020/rev_truck
Orderer:	Carl Hynén, Linköping University Phone: +46 73-562 34 34 E-mail: carl.hynen@liu.se
Supervisor:	Daniel Arnström, Linköping University Phone: +46 76-831 24 09 E-mail: daniel.arnstrom@liu.se
Customer / Course Responsible:	Daniel Axehill, Linköping University Phone: +46 13-28 40 42 E-mail: daniel.axehill@liu.se

Participants of the group

Name	Responsible	E-mail
Per Antonsson		peran080@student.liu.se
Edvin Bourelius		edvbo949@student.liu.se
Gustav Erbing		guser450@student.liu.se
Johan Gustafsson		johgu927@student.liu.se
Anton Holgersson	Information Manager (IM)	antho223@student.liu.se
Ofa Ismail	Software Architect (SW)	abdis077@student.liu.se
Filip Jussila	Document Manager (DM)	filju425@student.liu.se
Per Liljeström	Test Leader (TL)	perli397@student.liu.se
Katherine Rajala		katra756@student.liu.se
David Salomonsson	Design Manager (DeM)	davsa358@student.liu.se
Viktor Uvesten	Project Leader (PL)	vituv953@student.liu.se

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DOCUMENT HISTORY

Version	Date	Changes made	Made by	Reviewer
0.1	2020-09-30	First draft	Project Group	Viktor Uvesten
0.2	2020-10-04	Fixed comments and added content	Project Group	Viktor Uvesten
1.0	2020-10-05	Fixed comments from supervisor	Project Group	Filip Jussila
2.0	2020-11-20	Final version	Project group	Filip Jussila

1 INTRODUCTION

In this document are the multiple tests that will be performed planned to verify the requirements presented in the associated requirement specification. Not all requirements stated in the requirement specification are subject to testing. Some requirements are simply not possible to test, e.g. requirements regarding the project group's management of the other requirements.

1.1 Test status

The tests will be given a status *Passed* or *Failed*, whether or not the tested requirements was deemed fulfilled. A test that fails will result in either; further work on the related problem or a renegotiation of the tested requirement.

2 TESTS

Below are the planned tests presented according to the associated subsystem and possible requirement category. There is a high likelihood that the different tests will be performed multiple times as they are not expected to pass on the first try. When a test is performed successfully multiple times, e.g. three times is it deemed to have been passed.

2.1 Tests of controller system

Planned tests for the controller system are presented in the following subsections according to their associated tested requirements.

2.1.1 *Tests of general requirements*

The planned tests of the controller system's general requirements are listed below in Table 1.

Table 1: The planned tests of the general requirements set on the produced MPC.

Test	Tested requirements	Resources	Description
1	5	RPi	Verify that all major computation related to the MPC controller is done on the RPi.
2	8	Computer, possibly RPi	Test the MPC controller according to the functional requirements of priority 1 presented in the requirement specification.
3	9	RPi, simulation environment, Visionen & truck	Verify that the potential bias of the steering angle is successfully removed. By examining the truck's course, after calibration is done, when the truck is given the control signal corresponding to a straight path ahead. First in the simulation environment then live in Visionen.
4	11	RPi	Control that appropriate data packages can be sent from and received by the MPC controller to the other subsystems.

2.1.2 *Tests of interfaces*

Planned test of the controller system's interfaces are listed below in Table 2.

Table 2: The planned test of the controller system's interfaces.

Test	Tested Requirements	Resources	Description
5	12	RPi, simulation environment, Visionen & truck	Verify that the MPC controller is compatible with the provided motion planner: that is, it can communicate well with the motion planner first in simulation environment and then live in Visionen.
6	14	RPi & computer	Verify that changing every parameter on its own and together with other parameters works fine by using the developed method of changing parameters. Test the MPC controller in between changes to verify that everything works as intended.

2.1.3 *Tests of design requirements*

Planned tests of the controller system's design requirements are listed below in Table 3.

Table 3: The planned test of the controller system's design requirements.

Test	Tested Requirements	Resources	description
7	16	Simulation environment	Verify that the MPC controller works in real time.
8	17	Simulation environment	Verify that the MPC controller uses an integral action.
9	18	RPi, simulation environment, Visionen & truck	Verify that the MPC controller can avoid obstacles; first in simulations then live in Visionen.
10	19	RPi, simulation environment, Visionen & truck	Verify that all control signals sent to the truck will never exceed the physical constraints of the actuators; first in simulation then live in Visionen.

2.1.4 *Tests of functional requirements*

The planned tests of the controller system's functional requirements are listed below in Table 4.

Table 4: The planned tests of the controller system's functional requirements.

Test	Tested Requirements	Resources	description
11	20-22	RPi, simulation environment, Visionen & truck	Verify that the MPC controller can follow a straight path, when moving forward; first in simulation then live in Visionen.
12	23-25	RPi, simulation environment, Visionen & truck	Verify that the MPC controller can follow a straight path, when reversing; first in simulation then live in Visionen.
13	26-28	RPi, simulation environment, Visionen & truck	Verify that the MPC controller can follow a curved path, when moving forward; first in simulation then live in Visionen.
14	29-31	RPi, simulation environment, Visionen & truck	Verify that the MPC controller can follow a curved path, when reversing; first in simulation then live in Visionen.
15	32-34	RPi, simulation environment, Visionen & truck	Verify that the MPC controller can follow a arbitrary path generated by the motion planner, when moving forward; first in simulation then live in Visionen.
16	35-37	RPi, simulation environment, Visionen & truck	Verify that the MPC controller can follow a arbitrary path generated by the motion planner, when reversing; first in simulation then live in Visionen.
17	38-40	RPi, simulation environment, Visionen & truck	Verify that the MPC controller can complete an entire mission, both in forward motion and reversing; first in simulation then live in Visionen.

2.2 Tests of communications system

Planned tests for the communication system are presented in Table 5.

Table 5: The planned tests of the communications system.

Test	Tested requirements	Resources	Description
18	43	RPi	Verify that ROS can run on the RPi.
19	44	RPi	Verify that the master node is hosted on the RPi.
20	46	RPi	Verify that ROS runs automatically when booting up the RPi.
21	47	RPi, EV3	Verify that a message can be sent through the wired connection between RPi and EV3.

2.3 Tests of visualization system

Planned tests for the visualization system are presented in Table 6.

Table 6: The planned tests of the visualization system.

Test	Tested requirements	Resources	Description
22	48	Computer, RPi	Verify that there is a connection between the computer in Visionen and the RPi by sending and reading a message.
23	49	Computer	Verify that the offline path from the start position to the goal position are displayed by projecting a virtual offline path.
24	13, 50	Computer	Verify that the path from the motion planner and the MPC from the truck to the goal position are displayed by projecting a virtual planned path.
25	51	Computer	Verify that the driven path are displayed by projecting a virtual driven path.
26	52	Computer	Verify that obstacles are displayed by projecting an obstacle.

2.4 Tests of simulation environment

Planned tests for the simulation environment are presented in Table 7.

Table 7: The planned tests of the simulation environment.

Test	Tested requirements	Resources	Description
27	55	Computer	Verify that the planned path is displayed in the simulation environment.
28	57	Computer	Verify that the obstacles are displayed in the simulation environment.
29	59	Computer	Verify that the truck's movements together with the planned path are displayed in the simulation environment.

3 TEST PROTOCOL

The result of each performed test will be monitored and noted in a test protocol. In Table 8 below is the template that is used for the test protocol presented.

Table 8: Template used for the Test protocol.

Test	Requirements (Req.)	Description	Trials	Status
Test number	Requirement(-s) tested	**Test description:** **Date of execution:** **Responsible:**	Number of trials done.	The status of the performed test.