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System test plan

Propulsion system simulation

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# Aim & Hypothesis

## Aim

The aim of this test is to verify the simulation of the propulsion system of the solarboat.

## Hypothesis

The simulation will be verified according to the performed tests.

# Variables

These are the constants and variables that will be used during the test.

|  |  |
| --- | --- |
| Constants | Keep constant at... |
| Ambient temperature | Standard indoor temperature with lower and upper limits (20 ℃ ± 5℃). |
| Battery level computer | Constant power source. |
| Software Excel | Newest version. |
| All input variables | Real positive numbers & ISO-notation. |
| Testing circumstances | |
| Water wave frequency | All zero, no initial water flow |
| Water flow velocity |
| Water wave amplitude |
| Motor power source | Variable DC source from transformer |
| Setup movement | Zero, setup is fixed to make measurements as precise as possible |

## Inputs

The limits stated are the limits of the real world. If values are put in out of this range, the outputs will be unreliable.

|  |  |
| --- | --- |
| Inputs | Value |
| Motor input voltage [V] | Change value between 0 & 48 |
| Motor input current [A] | Change value between 0 & 110 |

## Outputs

These are the outputs that will be monitored and will be used to see variations or changes in the system.

|  |  |
| --- | --- |
| Outputs | Value |
| Thrust [N] | Indicator between 0 & 500 |
| Rotational speed propeller [rpm] | Indicator between 0 & 2300 |

# Tools

We divide the tools into two types. The first one is “testing tools” which are the tools requires to perform the test. The second one is “measuring tools”, which are the tools required to measure the given limits and properties.

|  |  |
| --- | --- |
| Testing tools | Demand |
| Computer | Windows 10 compatible |
| Excel | Newest version |
| Keyboard | No limit |
| Mouse | No limit |
| Calculator | Basic calculator |
| Pen & Paper | Basic pen & paper |

|  |  |  |
| --- | --- | --- |
| Measuring tools | Demand | |
| DC Voltage meter | Min. Range from 0 to 100 V | |
| Current meter | Min. Range from 0 to 200 A | |
| Rotation speed meter | Min. Range from 0 to 3000 rpm | Waterproof & High Temperature resistance |
| Flow meter | Min. Range from 0 to 100 m/s |

# Method

This section consists of actions that need to be performed during the test to conclude a result. The conditions of the constants stated in chapter “2. Variables” have to be met before executing the simulation. To execute the simulation, follow the steps stated in “4.1. Steps”.

To validate our design, we first simulate the current propulsion system and measure the real values of the prototyping setup. We then compare the measured values to the simulation outputs and improve the simulation so that the calculated values are within an error margin of the measured values. When this is the case for all the measurements, we can state that the calculation chain is validated.

In case the boat is not available for testing, we will perform the same steps and calculations, only the simulation will not be validated yet.

## Steps

1. Setup the measuring tools and the test setup to be able to perform the tests.
2. Apply a voltage to the input of the motor and measure the input current.
3. Perform a simulation the same input values and note the results.
4. Measure corresponding output values on the test setup.
5. Compare measured results with simulated results and note the difference (=error).
6. Perform simulations repeatedly and modify the motor input voltage within the range.
7. Gather the output data for the different tests.
8. Check if the error stays within or exceeds 30% of the measured output for each test.
9. Disconnect the measuring devices and power down the solarboat.

# Expected results

For the inputs into the simulation and testing setup, we expect the values to be between the stated output ranges, and between 30% of each other respectively.

This means that the output of the simulation will not deviate more than 30% of the measured value during testing, given that the inputs are the same for both the simulation and the testing setup, and within the stated range.

# Conclusion

When the outputs of the simulation stay within 30% of the measured values of the setup for the same inputs, we state that the simulation passes the test.

When the outputs of the simulation deviate more than 30% of the measured values, we state that the simulation failed the test.