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Calculation sub-system test plan

Propulsion system simulation

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Table of content

[1. Aim & Hypothesis 2](#_Toc54533392)

[1.1. Aim 2](#_Toc54533393)

[1.2. Hypothesis 2](#_Toc54533394)

[2. Variables 2](#_Toc54533395)

[2.1. Inputs 2](#_Toc54533396)

[2.2. Outputs 2](#_Toc54533397)

[3. Tools 3](#_Toc54533398)

[4. Method 3](#_Toc54533399)

[4.1 Steps 4](#_Toc54533400)

[4.1.2 Stage one 4](#_Toc54533401)

[4.1.2 Stage two 4](#_Toc54533402)

[5. Expected results 4](#_Toc54533403)

[6. Conclusion 4](#_Toc54533404)

# Aim & Hypothesis

## Aim

The aim of this test is to build and verify the calculation chain of the propulsion system of the Solar boat.

## Hypothesis

The calculation chain will be verified according to the performed tests.

# Variables

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

|  |  |
| --- | --- |
| Constants simulation | Keep constant at... |
| Ambient temperature | Standard indoor temperature with lower and upper limits (20 ℃ ± 5℃). |
| Battery level computer | Constant power source. |
| All input variables | Real positive numbers & ISO-notation. |

|  |  |
| --- | --- |
| Constants physical measurements | Keep constant at… |
| Water wave frequency | *Waves in harbor, will not be taken into*  *consideration.* |
| Water flow velocity |
| Water wave amplitude |
| Motor power source | Boat battery pack. |
| Test setup thrust | Nihil movements, setup is fixed to make measurements as precise as possible. |
| Test setup boat velocity | Sensor attached to boat at fixed position. |

## Inputs

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

|  |  |
| --- | --- |
| Inputs | Value |
| Motor input voltage [V] | Change value between 0 & 48 in equal steps |

## 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 |
| Boat velocity [m/s] | Indicator between 0 & 10 |
| Prompts or warnings for successful or failed simulation | Simulate successfully / unsuccessfully |

# 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 |

|  |  |  |
| --- | --- | --- |
| Prototype Measuring tools | Demand | |
| DC Voltage meter | Min. Range from 0 to 100 V | |
| Current meter | Min. Range from 0 to 200 A | |
| Hanging scale | Min. Range from 0 to 50 kg | Waterproof |
| Boat velocity meter (GPS) | Min. Range from 0 to 10 m/s |

|  |  |
| --- | --- |
| Environment Measuring tools | Demand |
| Wind speed + direction sensor | Set constant at 1 in simulation. |
| Humidity sensor |
| Temperature sensor (motor temp.) |
| Temperature sensor (ambient temp.) |

# 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”.

There are two stage of validating the design of user-interface sub-system.

The first stage is an independent part which has no relationship with calculation sub-system which will be used in the final design. We create a new calculation part with only a few simple formulas to check if user-interface sub-system can receive values from users and present data to users successfully.

The second stage is basing on the successful validation of calculation system which will be used in the final design and contains all formulas of propulsion system. On this stage, we will combine user-interface sub-system with calculation sub-system, input values to user-interface sub-system and check its output to validate design of use -interface subsystem can realize value transmission between users and calculation sub-system.

## 4.1 Steps

### 4.1.2 Stage one

1. Build a simple calculation sub-system which only has one or two formulas related to motor input voltage V. For instance, P = U \* I, is used in follow steps. Current I is set to 5 [A].
2. Combine the simple calculation sub-system with user-interface sub-system.
3. Input a random numeric voltage value.
4. Calculate the desired result with the input value on paper.
5. Check the output from user-interface sub-system.
6. Compare the output with the desired result.

### 4.1.2 Stage two

1. Combine the completed and validated calculation sub-system of final design with use-interface sub-system.
2. Input a random numeric voltage value.
3. Calculate the desired result with the input value on paper.
4. Check the output from user-interface sub-system.
5. Compare the output with desired result.
6. Input a random non-numeric voltage value, such as a letter or a symbol.
7. Check the output from user-interface sub-system.

# Expected results

The expected results of the outputs are as followed.

In ‘4.1.1 Stage one’, the output from user-interface sub-system is same as the desired result. There is also the prompt of ‘Simulate successfully’.

In ‘4.1.2 Stage two’, when a numeric value is input into user-interface sub-system, the output from user-interface sub-system is same as the desired result. There is also the prompt of ‘Simulate successfully’. When a non-numeric value is input into user-interface sub-system, there is no output from user-interface sub-system. But the warning of ‘Simulate unsuccessfully’ is presented.

# Conclusion

When a numeric value is input in user-interface sub-system, the output from user-interface sub-system is same as the desired result and there is also the prompt of ‘Simulate successfully’, we state this test is successful.

When a non-numeric value is input in user-interface sub-system, there is no output from user-interface sub-system but the warning of ‘Simulate unsuccessfully’ is presented, we state this test is successful.

When a numeric value is input in user-interface sub-system, the output from user-interface sub-system is different from the desired result or there is no prompt of ‘Simulate successfully’, we state this test is failed.

When a non-numeric value is input in user-interface sub-system, there is an output from user-interface sub-system or the warning of ‘Simulate unsuccessfully’ is not presented, we state this test is failed.