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MATLAB Activities in Wind Turbine Unit

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Key Content

- **What has been changed from Water Filter to Wind Turbine?**
- **What do the new MATLAB activities look like?**
- **Are there any notes for the new activities?**

Q: What has been changed from Water Filter to Wind Turbine?

A: The order of the lessons changed.

Water Filter Lessons	Wind Turbine Lessons
2.6 Mathmatical Modeling (MATLAB)	2.6 Sketching a design
2.7 Sketching a design	2.7 Prototype Creation
2.8 Prototype Creation	2.8 Mathmatical Modeling and Test (MATLAB)

Main reason for the changes

We consulted professors in mechanical engineering and from their perspective, modeling the output power of a wind turbine is a challenge even in academia.

Therefore, we changed the order of the lessons to combine modeling (input power) and test (output power).

Q: What do the new MATLAB activities look like?

A: The new activities combine modeling and experimentation.

Wind Turbine Lessons

2.6 Sketching a design: Based on the previous research, students will sketch their 5 design plans about the blades. The differece between their plans could be the number/angle/shape/length of the blades (e.g., Plan 1 includes 3 blades and Plan 2 includes 5 blades).

2.7 Prototype Creation: Students will assemble the turbine base and create their blades based on their plans. Their design plans should be able to be tested in the next MATLAB activities.

2.8 Mathmatical Modeling and Test (MATLAB): The MATLAB activities consist of 2 parts: Part 1 (modeling) and Part 2 (test the plans).

MATLAB Activities: Part 1 (modeling) + Part 2 (test the plans)

Plan 1 - modeling the input power

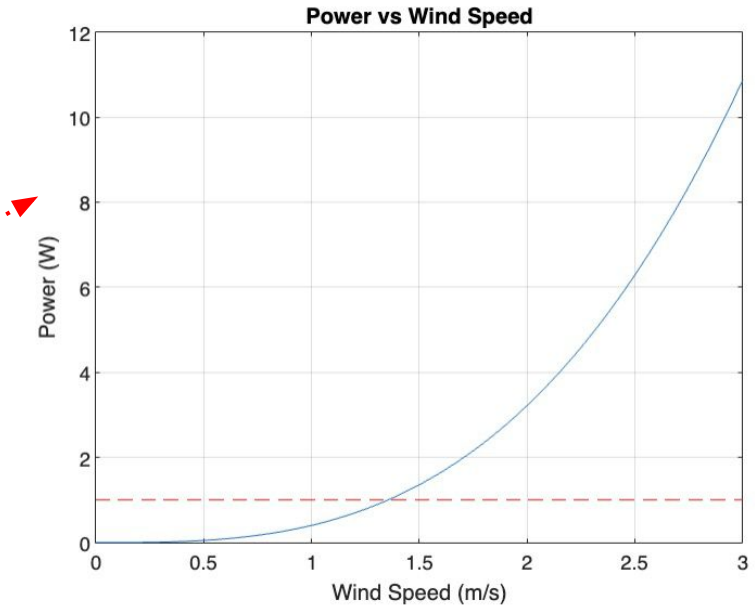
4) The input power from the wind (Pw)

The input power of the wind (Pw) in Watts is calculated using the density of air, area of the air flow, and wind speed you set. To see how this is calculated in the MATLAB code you can switch to the Output Inline View.

Plot Power vs Wind Speed

The graph below shows the Pw (W) versus the wind speed (m/s)

Note: The KidWind Advanced Wind Experiment Kit has an expected power output: 0–1 watts, thus an horizontal line in red is showing the theoretical maximum power output that can be achieved using the provided engine.



In MATLAB part 1, we will be able to input the **wind speed** of the fan and the **blades' length** for modeling the **input power**.

We only show the relationship in part 1. The input power will be calculated in part 2.

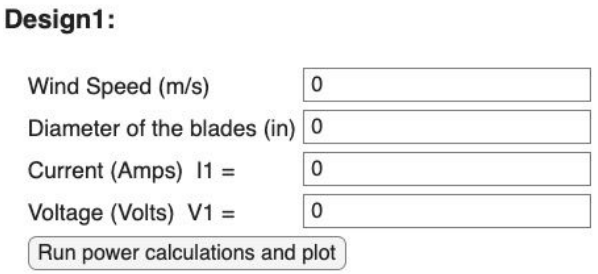
MATLAB Activities: Part 1 (modeling) + Part 2 (test the plans)

Plan 2 - test the design plans and the output power

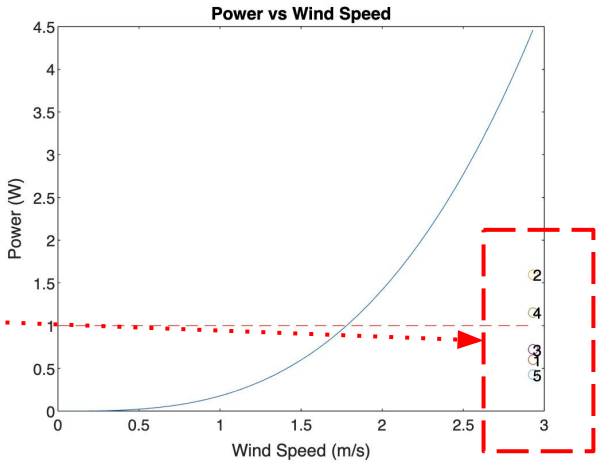
In MATLAB part 2, students would test their 5 design plans in the **test centers** by multimeters and then document the result of voltage and current. With the data, **MATLAB** will help calculate the output power, efficiency and also compare the results (e.g., MATLAB plots the result and the highest dot represents the largest output power, which is the best plan).

The classroom needs to be set up ahead with 2-3 test centers.

MATLAB provides 5 interfaces for inputting the results of 5 design plans.



MATLAB plots the result of output power.



Q: Are there any suggestions or notes for the new activities?

1. Maintaining records of experimental data will be highly valuable (e.g., wind speed, distance of the turbine from the fan, parameters of the design plans).

2. Ensure the conditions in test centers are similar before testing a new design plan.

3. Changing and testing blades' shapes and lengths will require more time than changing numbers and angles.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Thank you!
Please feel free to reach out in Slack or email.