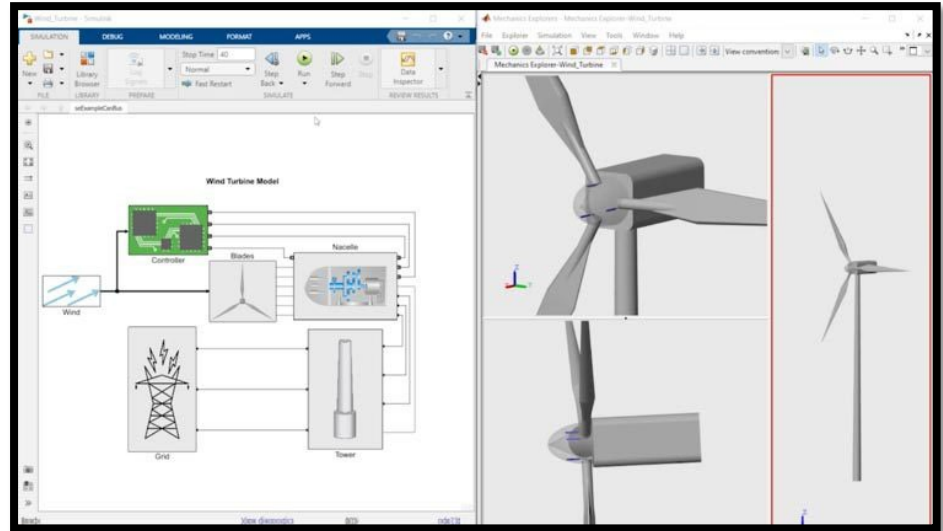


# Introducing Modeling to First-Year Engineering Students for Effective Implementation in the Engineering Design Process

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Juan Francisco Granizo



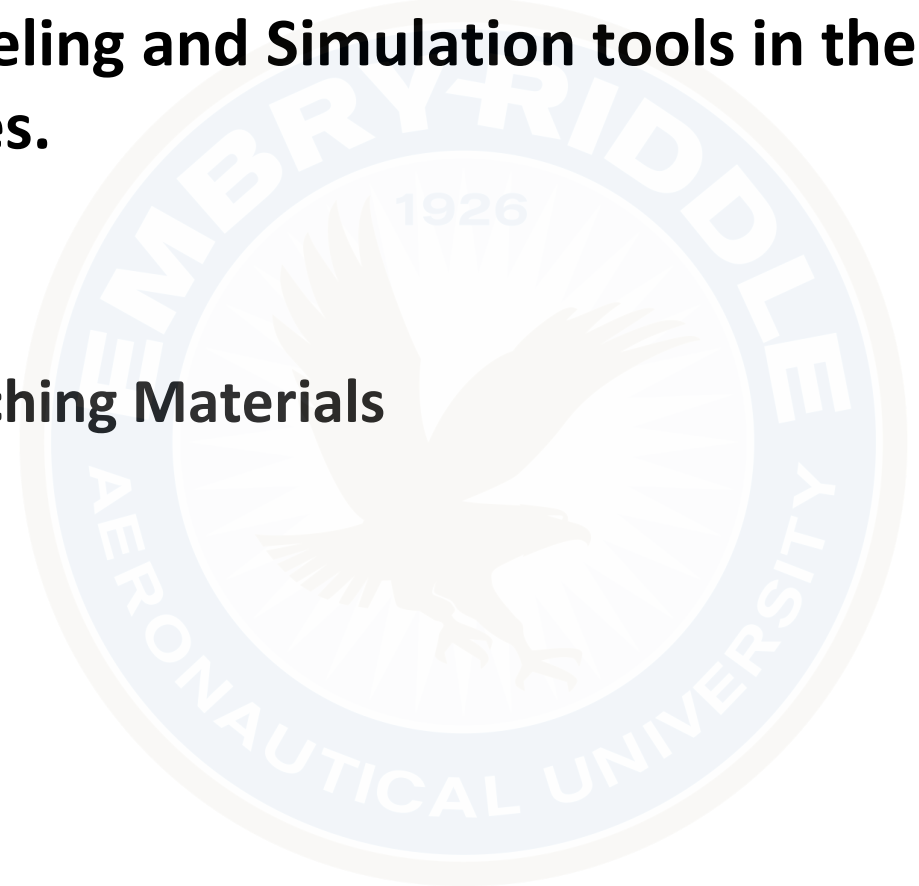
**This presentation focuses on introducing our research to familiarize students with Modeling and Simulation tools in their first year of engineering studies.**

**Learning Goals**

**Description and Sample Teaching Materials**

**Assessment**

**Ongoing Research**



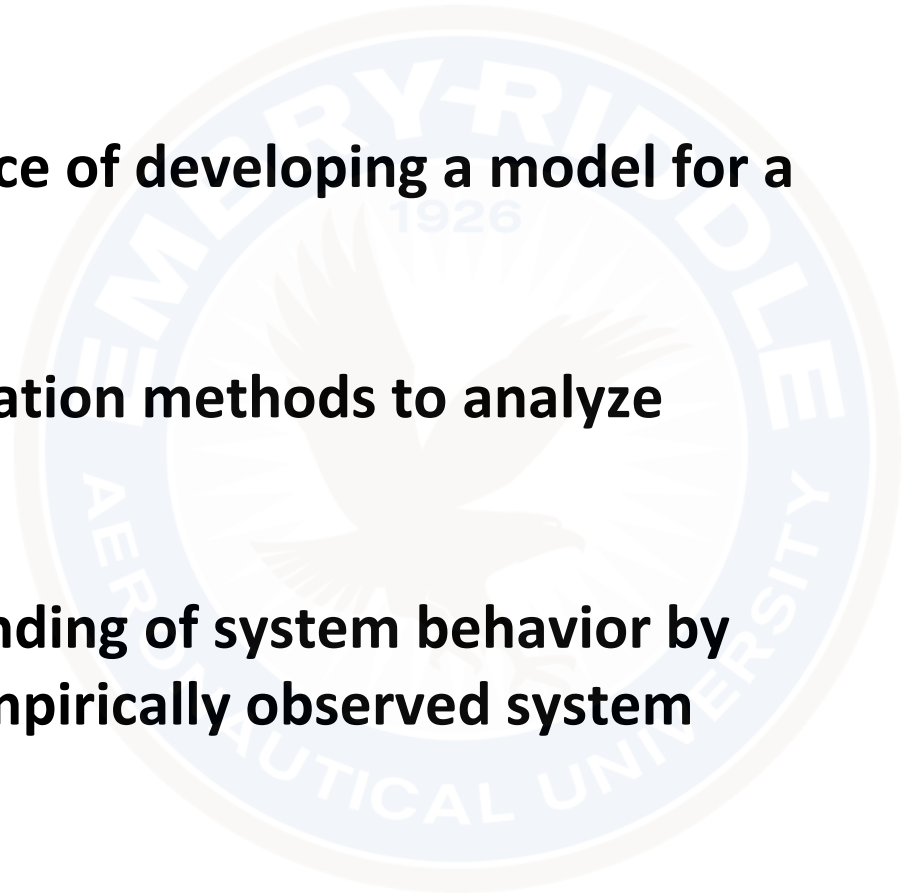
# Learning Goals

**Students will be able to...**

**understand the importance of developing a model for a given problem**

**apply basic process simulation methods to analyze model behavior**

**develop a basic understanding of system behavior by connecting model behavior to empirically observed system behavior**



# Description and Sample Teaching Materials

## Part One: Empirical Approach

### Lab Setting - Calculating Solar Power Efficiency

Groups of no more than three students.

Use a digital multimeter to measure current and voltage of small solar panel.

Calculate solar panel efficiency using measured values (simplified).



Sample Solar Panels used in the Lab



#### Calculating Efficiency

$$\epsilon = \frac{\text{useful power out}}{\text{power in}}$$

$$\epsilon = \frac{1.35 \text{ W}}{10 \text{ W}}$$

$$\epsilon = 13.5 \%$$

The **maximum** efficiency of this solar cell is 13.5%

# Description and Sample Teaching Materials

## Part Two: Model Approach: MATLAB Intro

### Matlab Example 01

How would you modify the previous code in order to be able to change the amplitude as per user input?

```
amp = input('Enter desired amplitude: ');

x = 0:0.1:2*pi;    % Generating values for x axis
y = sin(x);        % Creating sine function

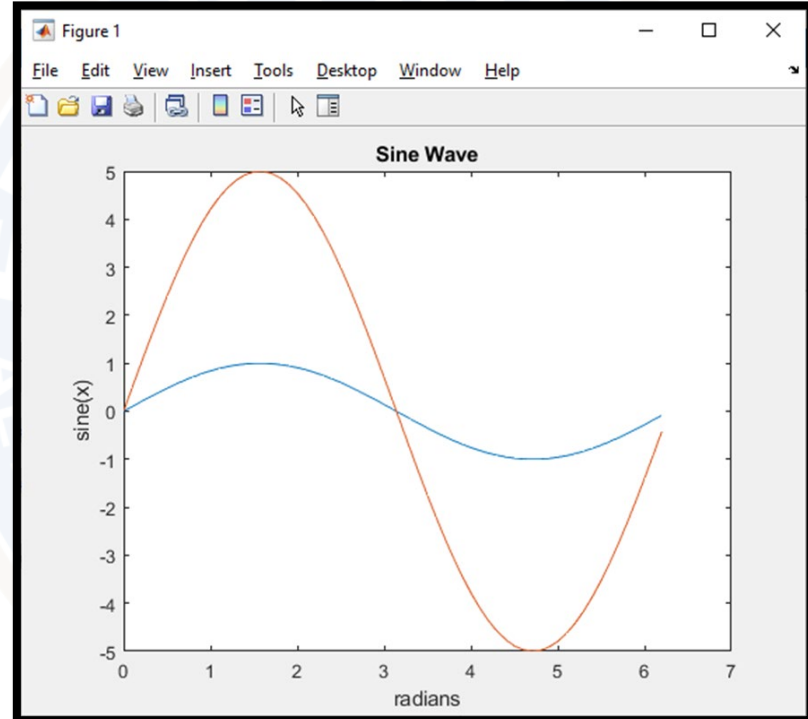
plot(x,y)          % Plotting the sine function

% Command to add another graph to same plot
hold on

plot(x, amp*y)     % Increasing amplitude by amp
title('Sine Wave') % plot title
xlabel('radians')  % x-axis label
ylabel('sine(x)') % y-axis label

% Turning off hold on command
hold off
```

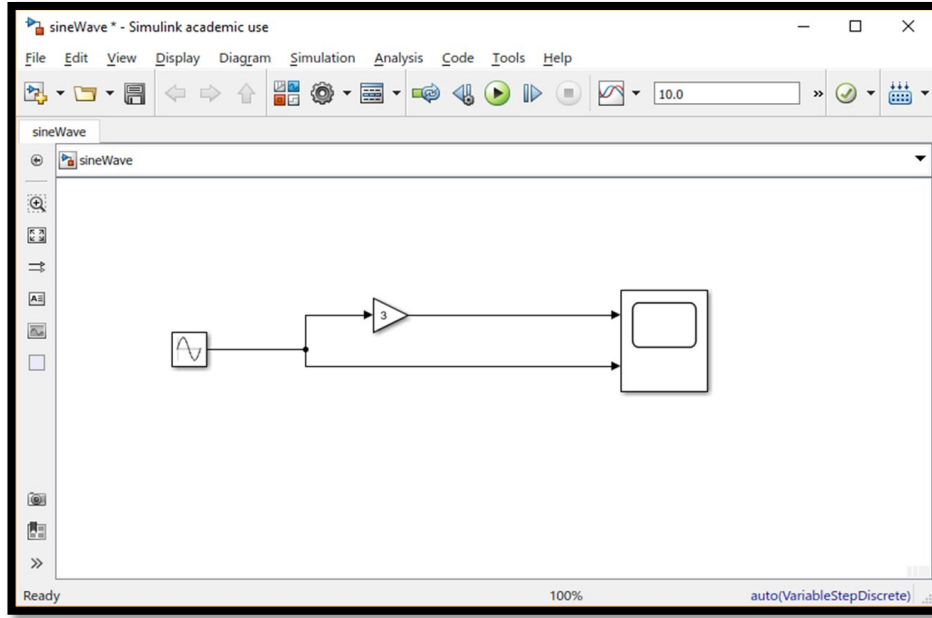
Sample Assignment Code



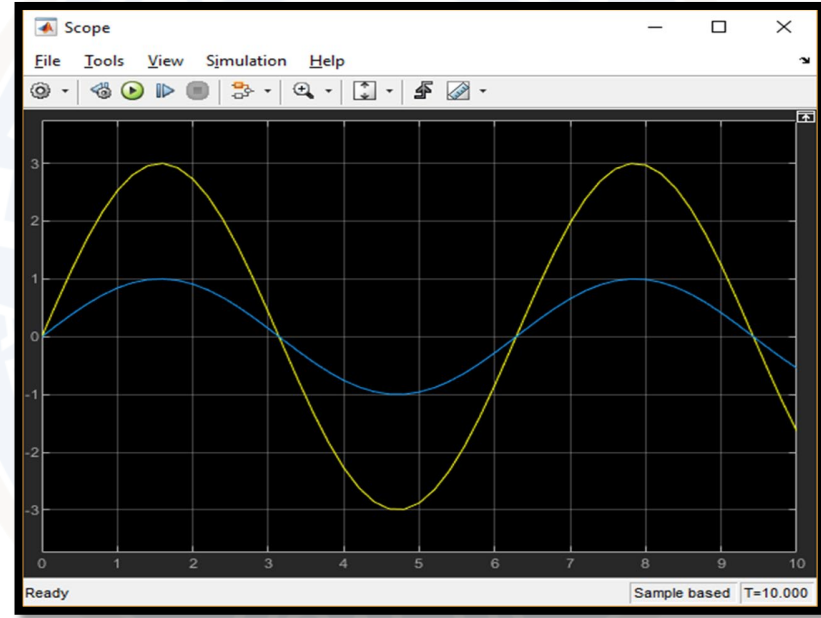
Sample Assignment Output

# Description and Sample Teaching Materials

## Part Two: Model Approach: Simulink Intro



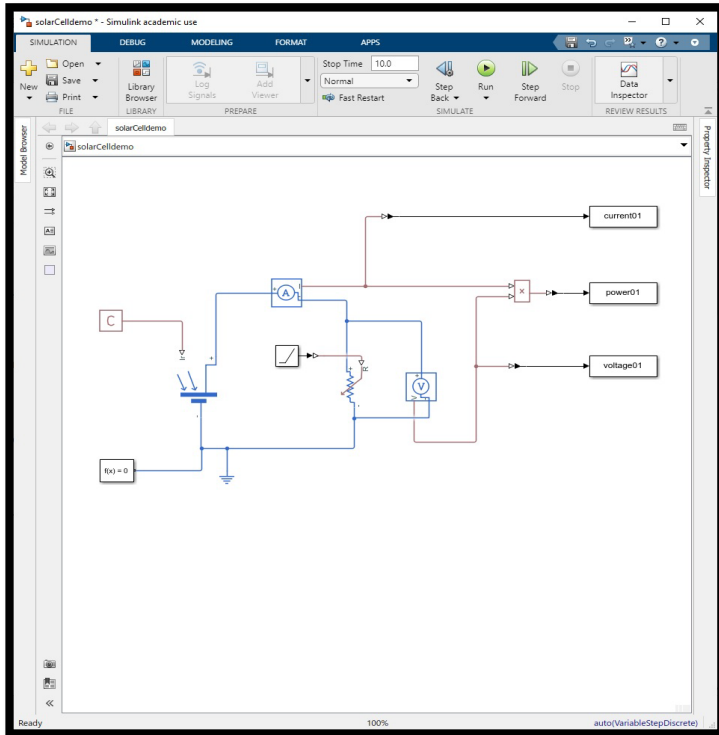
Assignment Model



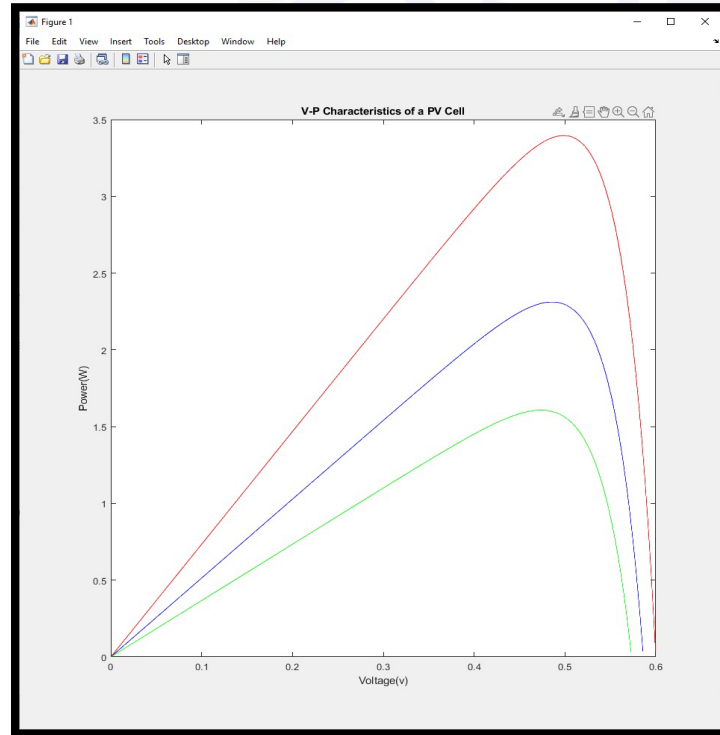
Assignment Output

# Description and Sample Teaching Materials

## Part Two: Model Approach: Simulink Model



Sample Assignment Model



Sample Assignment Output (MATLAB plot)

# Assessment

MATLAB Intro					
Criteria	Ratings				Pts
Description of criterion All required items must be present to achieve full points. Both code file (.m) and output should be submitted.	<b>5 pts Full Marks</b> All required items are present, as per instructions	<b>4 pts Good Attempt</b> Minor errors, such as: missing plot title, axis labels	<b>2.5 pts Fair Attempt</b> Minor errors; some code incomplete, such as missing second plot.	<b>0 pts No Marks</b> Unsatisfactory or missing	5 pts
Total Points: 5					

Sample Intro Assignment Rubric

Sample Model Assignment Rubric

PV Cell Model					
Criteria	Ratings				Pts
MATLAB	<b>5 pts Full Marks</b> All required items present. No errors.	<b>4 pts Good Attempt</b> Minor errors, such as missing plot labels	<b>2.5 pts Fair Attempt</b> Several errors or incomplete	<b>0 pts No Marks</b> Missing	5 pts
SIMULINK	<b>5 pts Full Marks</b> All required items present. No errors.	<b>4 pts Good Attempt</b> Minor errors, such as using incorrect values	<b>2.5 pts Fair Attempt</b> Several errors or incomplete	<b>0 pts No Marks</b> Missing	5 pts
Total Points: 10					



## Ongoing Research

CAD modeling and 3D printing concepts are also being included by having students design, model, and 3D-print a small part to be used in their design project prototype.



**In summary, by familiarizing students with Modeling and Simulation tools in their first year of engineering studies:**

**we encourage proper learning by gradually introducing fundamental concepts;**

**a project-base approach helps students connect the empirical world with modeling, solidifying understanding in an enjoyable environment.**

**Questions?**



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