



Ocean Current Turbine Emulation

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Opal-RT Overview

Background

- The US Government has made a commitment to reach net zero emissions by 2050 at the latest.
- The ocean's currents store a vast amount of untapped energy which looks promising as a source of sustainable renewable energy.
- Ocean Current Turbines (OCT's) have gained a lot of attention as a reliable and viable renewable energy source to be integrated into the power grid.

02

03

04

Getting to
**NET-ZERO
EMISSIONS** by 2050



01

Opal-RT Overview

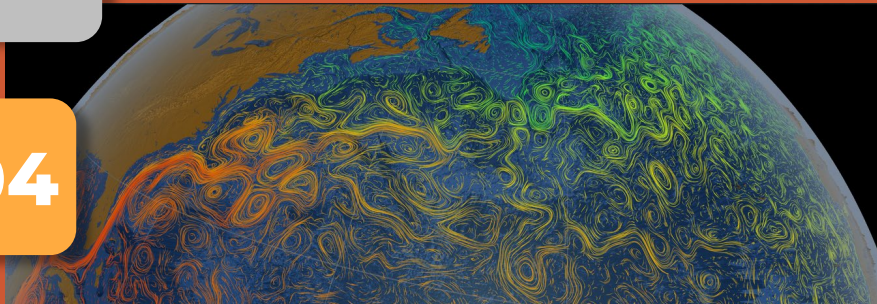


Project Impact

- **As we get closer to the zero emissions deadline there is an increasing push for research into renewable energies.**
- **This research will highlight how efficient OCT's would be for utility scale power generation.**
- **Why Opal-RT? There is an increasing demand for reliable testing and simulation, which needs to be done on real time simulation technologies.**

03

04

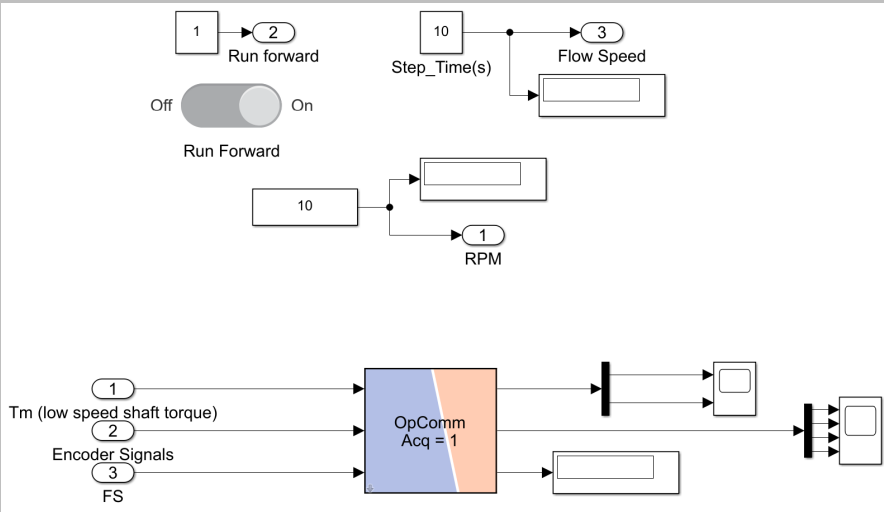


01

02 Opal-RT Overview



Real Time Simulator



04

01

02 Opal-RT Overview

03



OCT Model

OCT Simplified Model1

Block Parameters: OCT Simplified Model1

Subsystem (mask)

Parameters

Flow Speed (m/s) [values from 1-3 are realistic] 1

Rotor Diameter (m) [values from 1-30 are realistic] 20

Turbulence Intensity, TI, (%) [values from 5-20 are realistic] 10

Significant Wave Height (m) [values from 0.25-2.0 are realistic] 0.25

Rotor Depth (m) [values from 0.75-3 x Rotor Diameter are realistic] 10

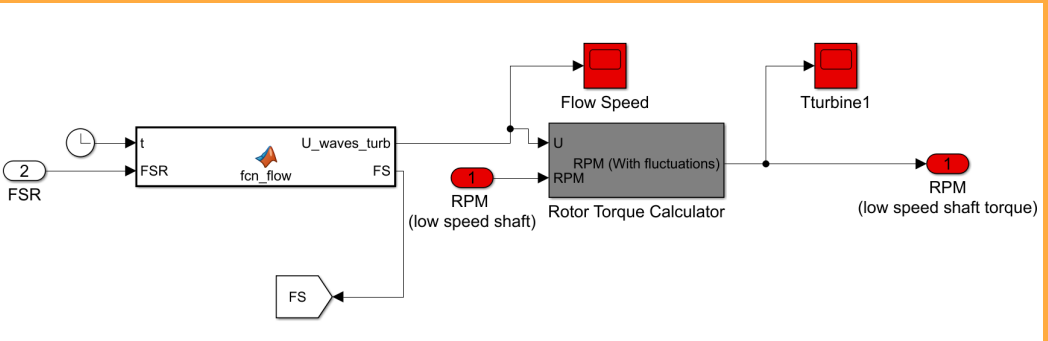
OK Cancel Help Apply

01

02 Opal-RT Overview

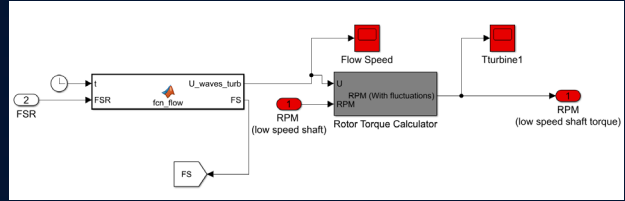
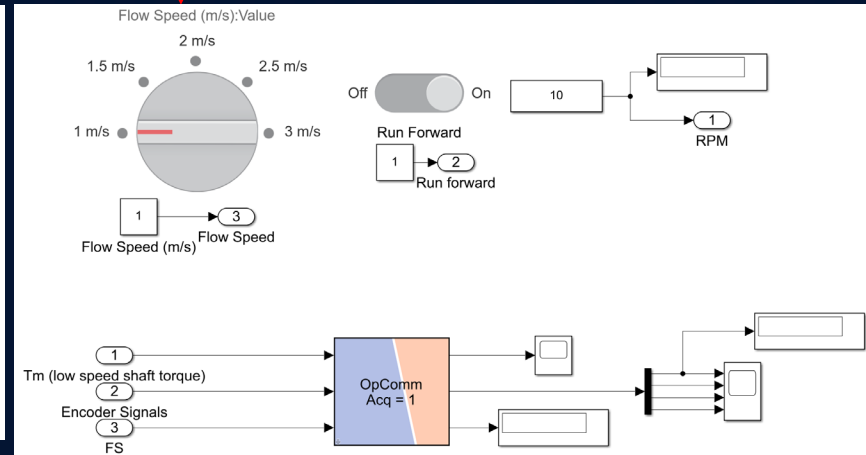
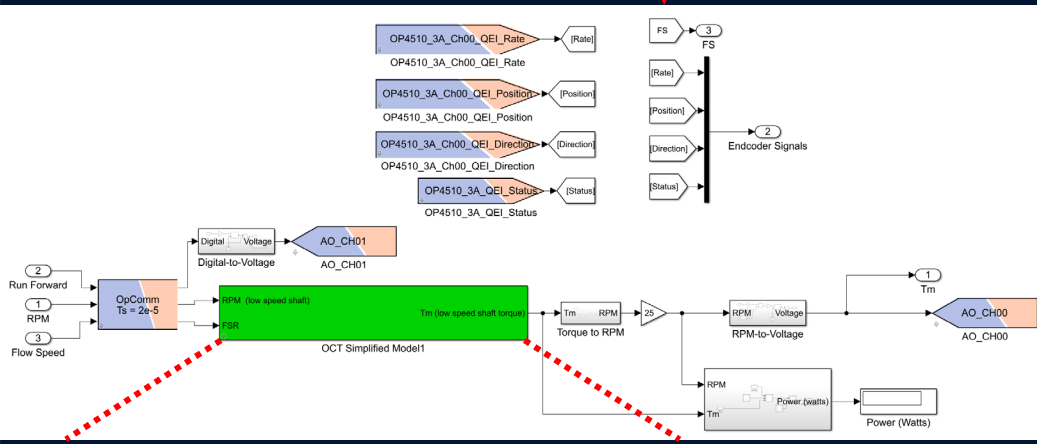
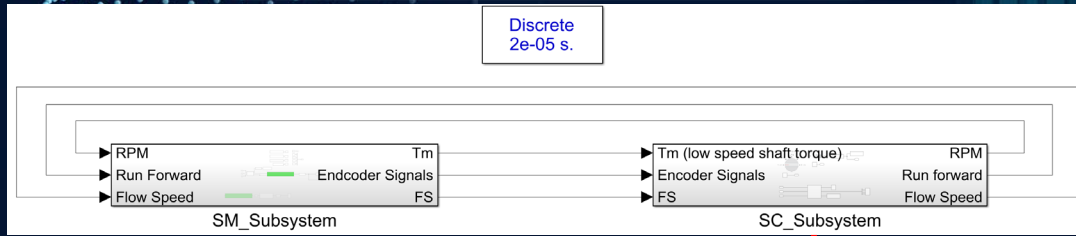
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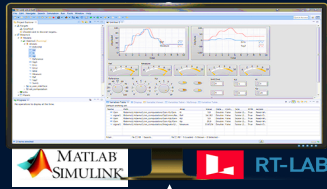
04



Main Test Model

Discrete
2e-05 s.





Computer Ethernet to Ethernet on Opal-RT



Opal-RT sends control signals to VFD and receives motor feedback

Top to Bottom Hardware-In-Loop Set up

Hardware-in-Loop (HIL) is used to integrate some form of external hardware to the Opal-RT's real-time environment.

Communication to VFD via analog and digital inputs



Speed feedback (encoder signals) to Opal-RT via RS422



VFD controls the driving motor



Torque Cell (Encoder)



Dynamometer encoder to VFD SM-Encoder breakout board



Driving Motor



1

Specs.

**AC Induction motor, 2 HP,
1800 RPM @ 60Hz, 4-Pole**

2

Control

**Motor is controlled by the
VFD through varying the flux
frequency**

Motor Under Test

**AC Induction Inverter motor,
3 HP, 1800 RPM @ 60Hz, 4-Pole**

Specs.

1

**Controlled by the driving
motor. It is coupled to the
driving motor via the torque
cell.**

Control

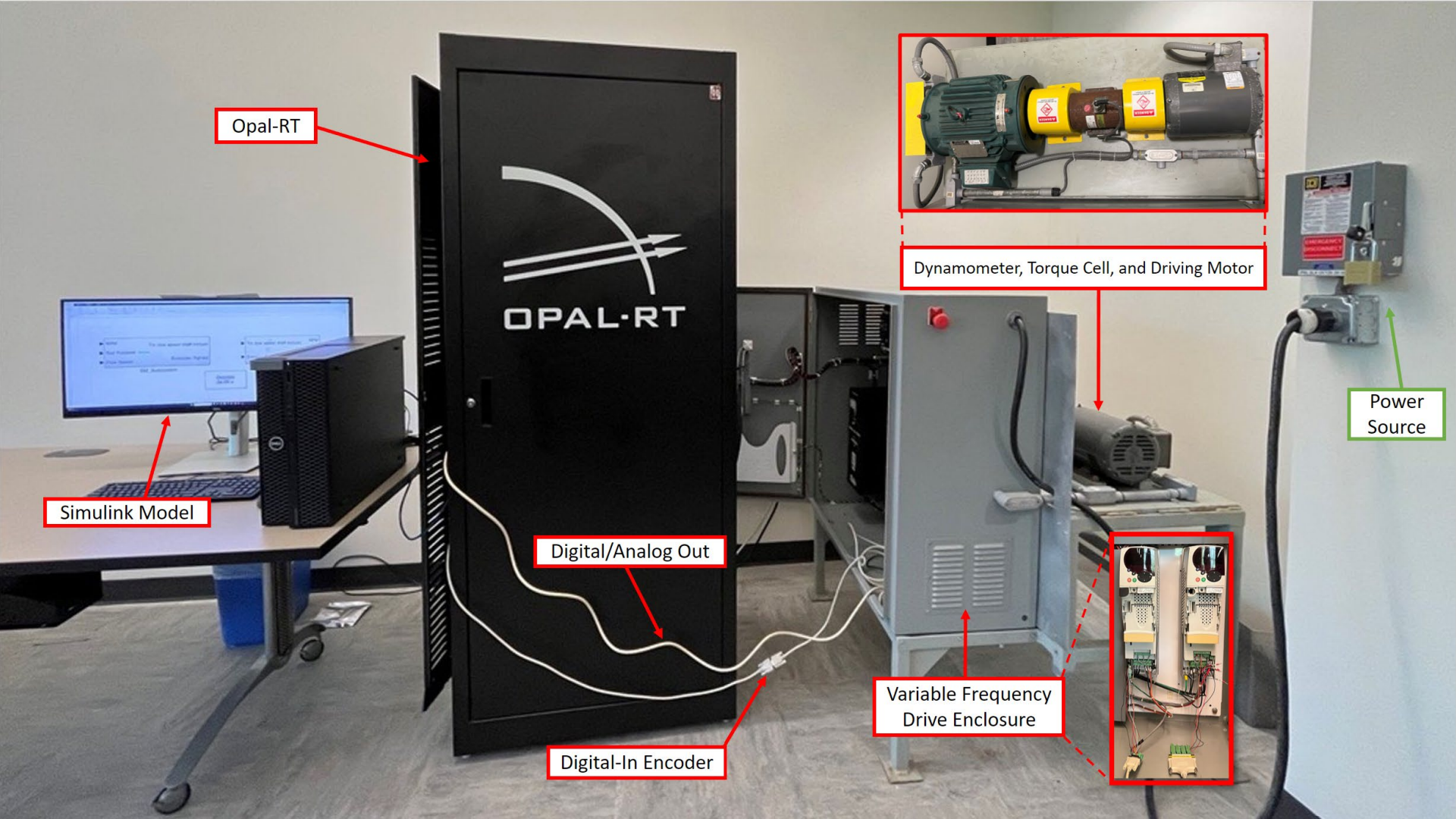
2

**Encoder is attached to the
Dynamometer. This provides
speed feedback via RS422.**

Encoder

3





Opal-RT

Simulink Model

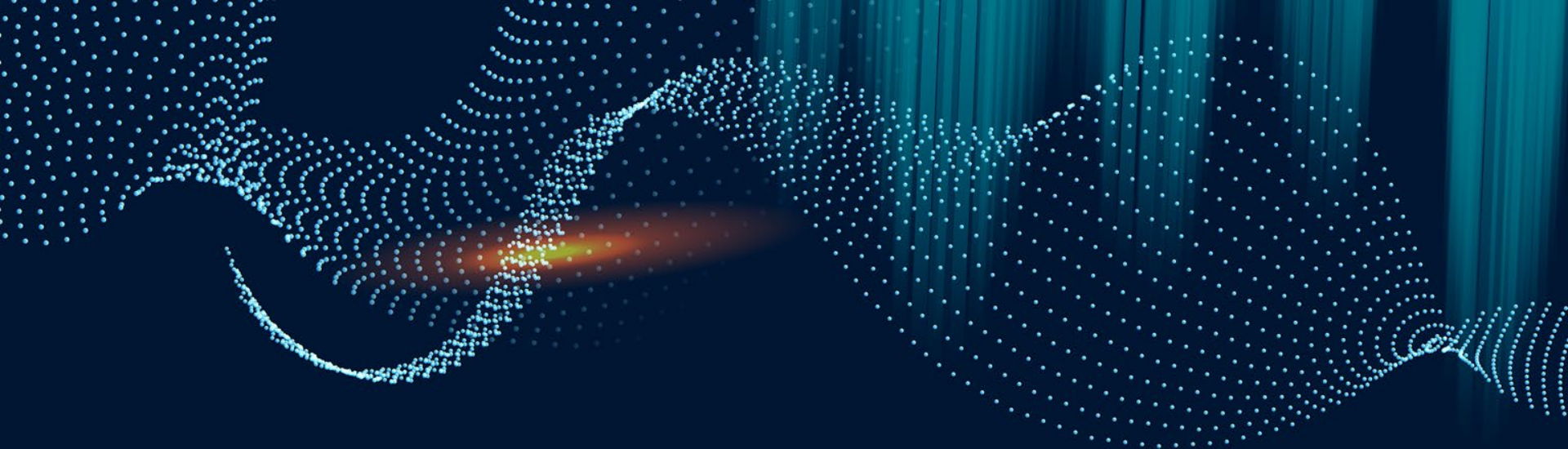
Digital/Analog Out

Digital-In Encoder

Dynamometer, Torque Cell, and Driving Motor

Variable Frequency Drive Enclosure

Power Source



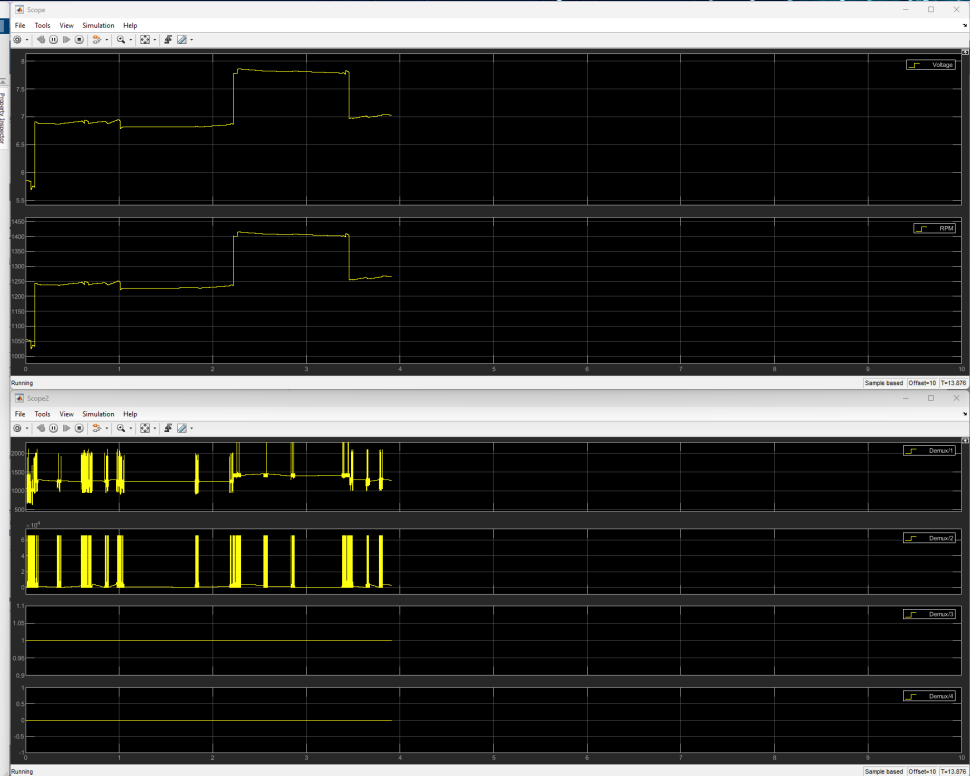
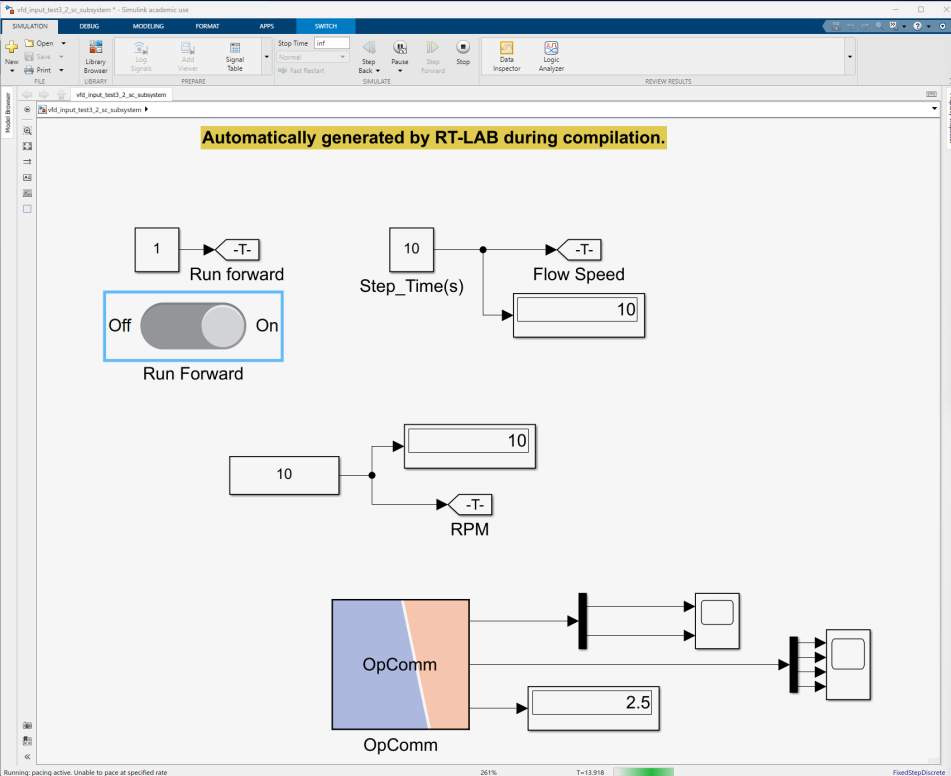
Test Run

Results

01 Timed Step-up

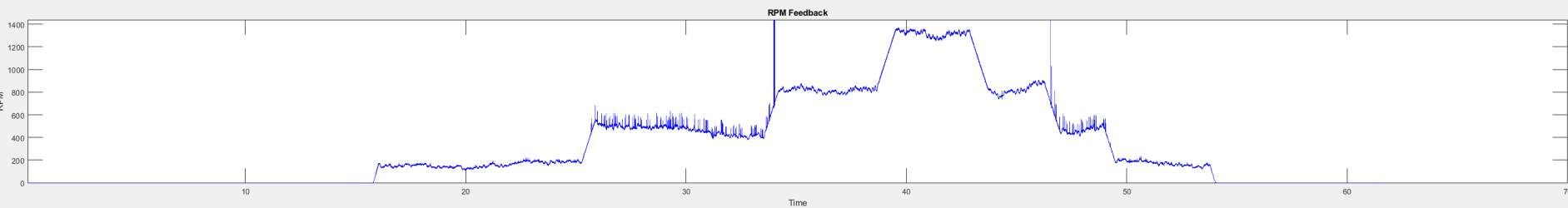
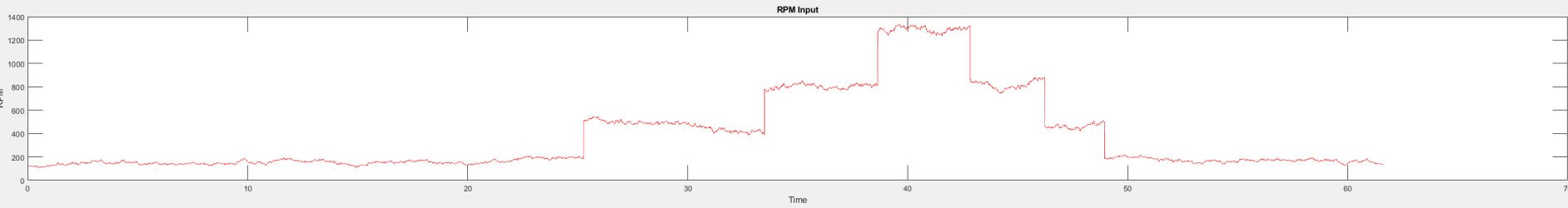
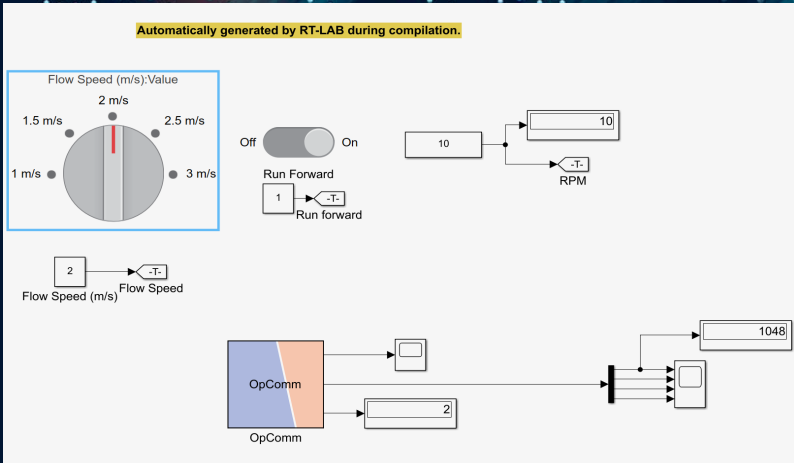
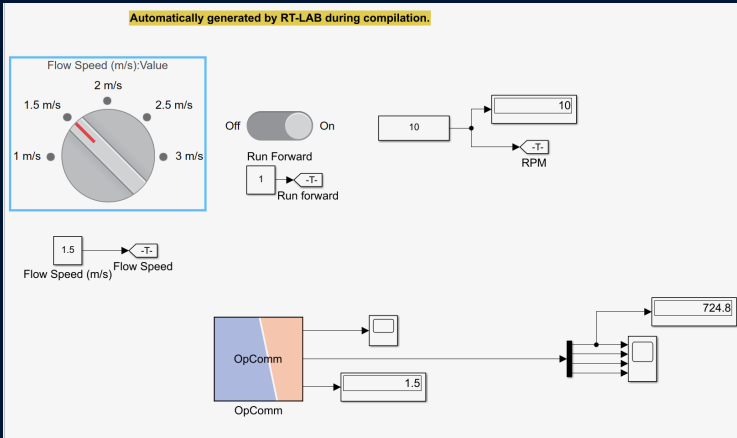
02 Main Test Model

03 Test Run Video



02 Main Test Model

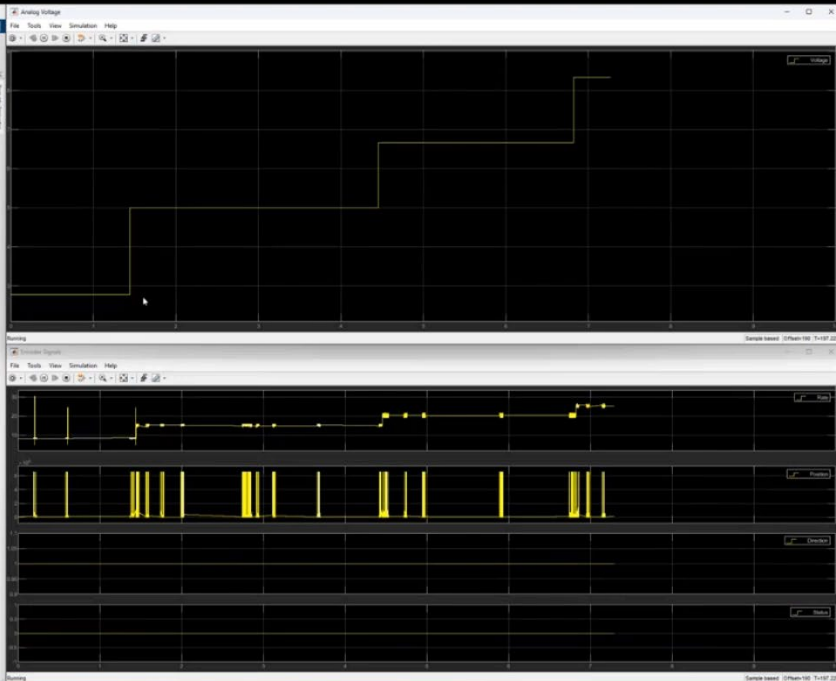
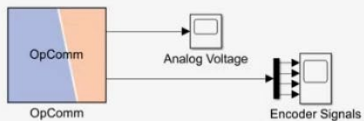
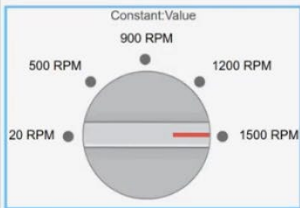
03 Test Run Video



03 Test Run Video



Automatically generated by RT-LAB during compilation.



Next Steps

Thank You!

The background features a dark blue gradient with abstract light trails. On the left, there are teal-colored wave-like patterns composed of small dots. A bright orange and yellow horizontal streak with a lens flare effect is positioned in the lower right quadrant. The overall aesthetic is modern and digital.