Field-Oriented Control of Induction Motors

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Introduction

- Induction motors are widely used in industry.
- Precise control is crucial for high-performance applications.
- Traditional scalar control methods have limitations.
- Field-Oriented Control (FOC) offers superior performance.

Advantages of FOC

- Precise Torque and Speed Control
- Improved Efficiency
- Enhanced Dynamic Response
- Reduced Motor Stress

FOC Block Diagram

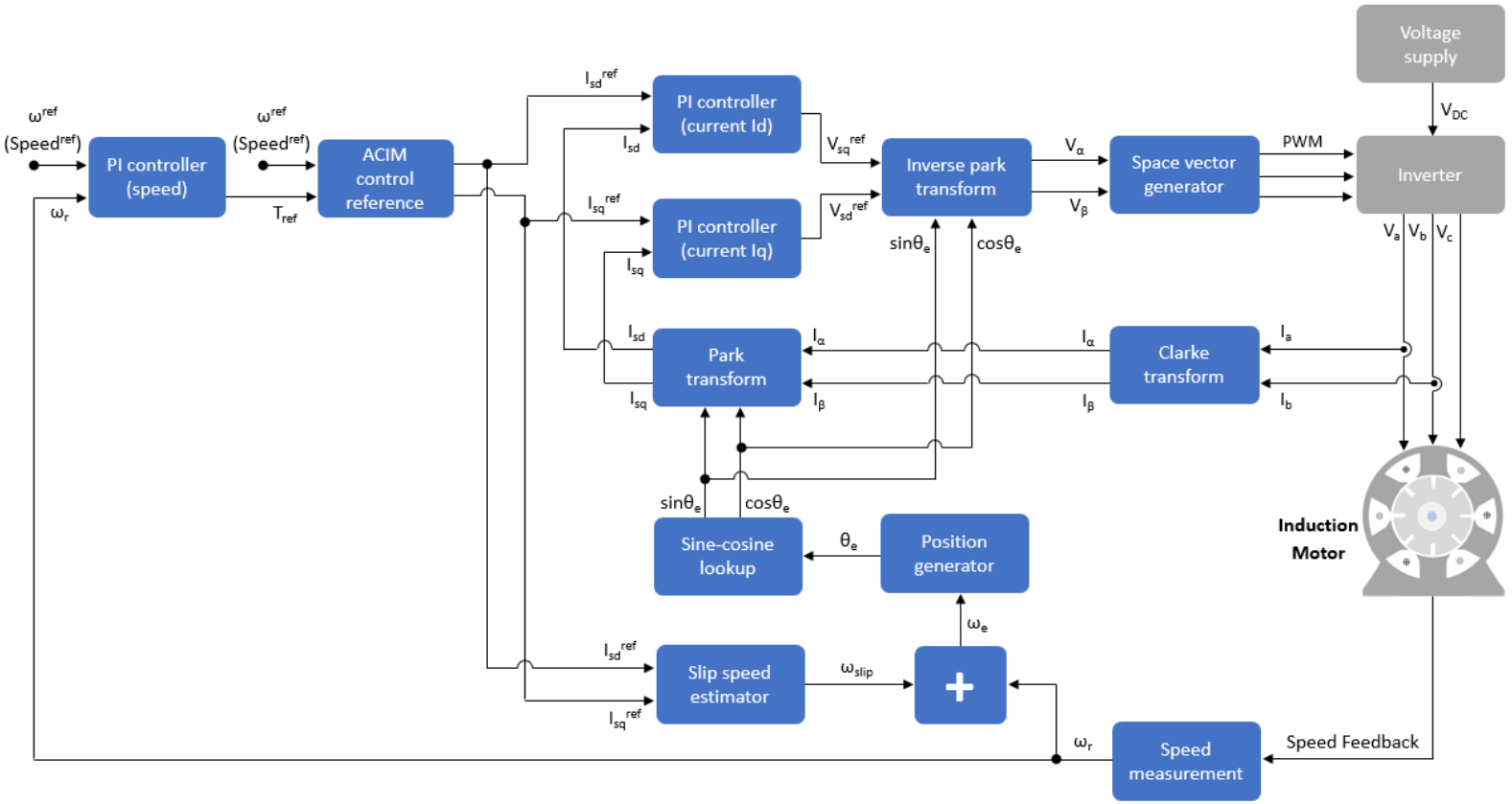

Figure: FOC Block Diagram

- Coordinate Transformations
- PI Controllers
- PWM Generation

Project Overview

- Simulation and comparison of FOC and V/f control
- Analysis of output filter (OTT filter) impact
- MATLAB/Simulink environment

MATLAB/Simulink Implementation

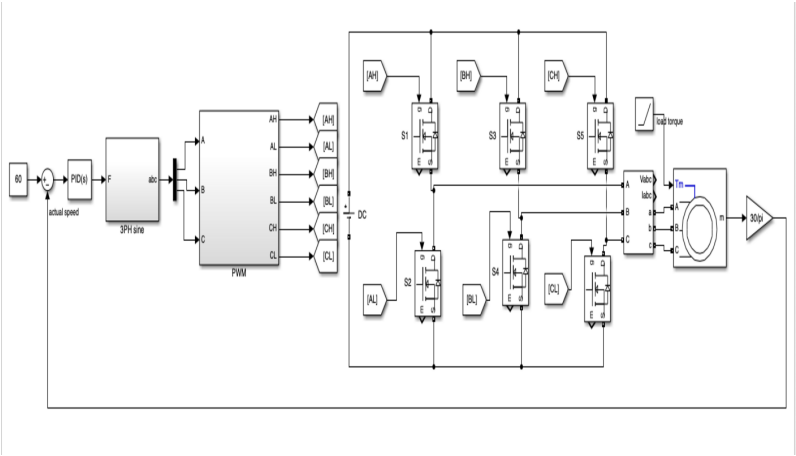

Figure: V/f Control Simulink Diagram

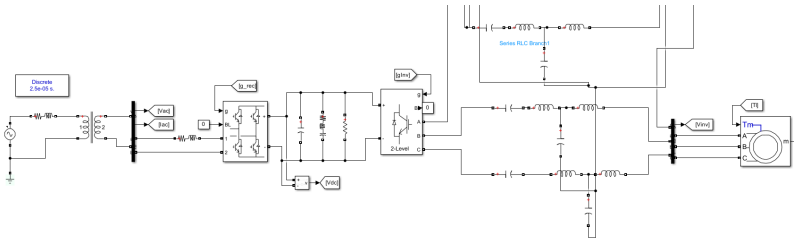

Figure: FOC with OTT Filter Simulink Diagram

Performance Comparison: Torque Response

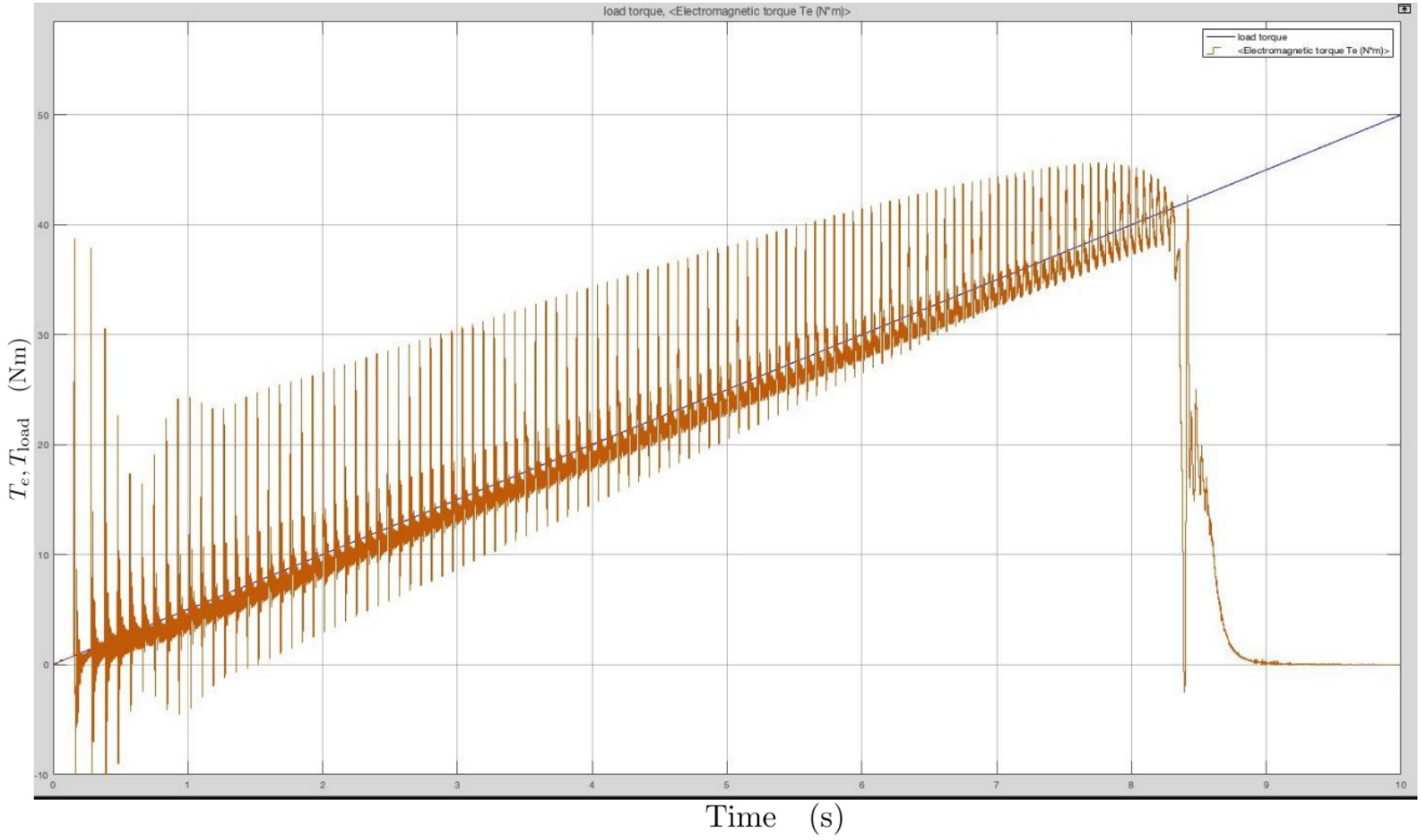

Figure: Torque Response of V/F with ramp input

Performance Comparison: Torque Response

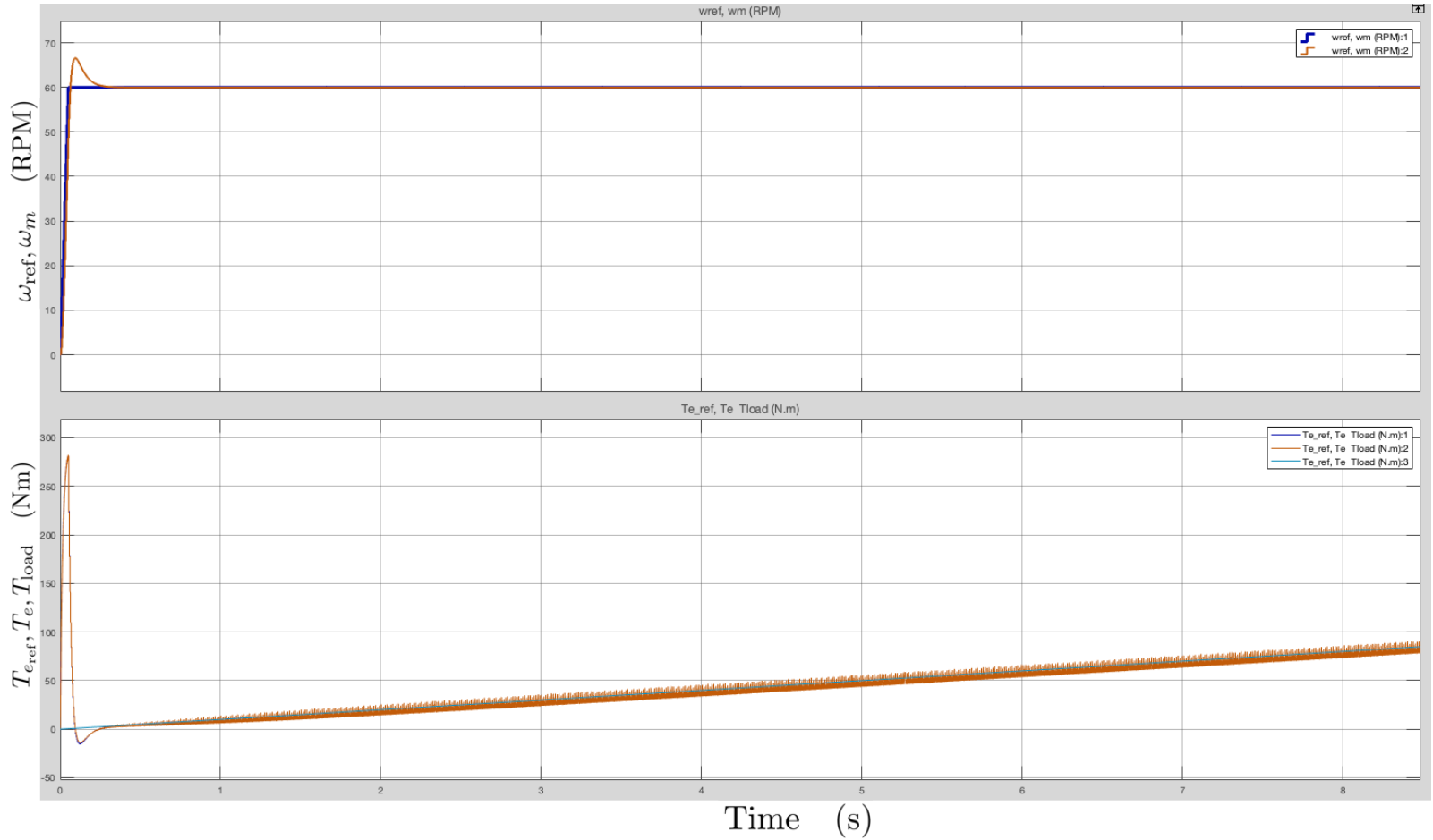

Figure: Torque Response of FOC with ramp input

Performance Comparison: Speed Response

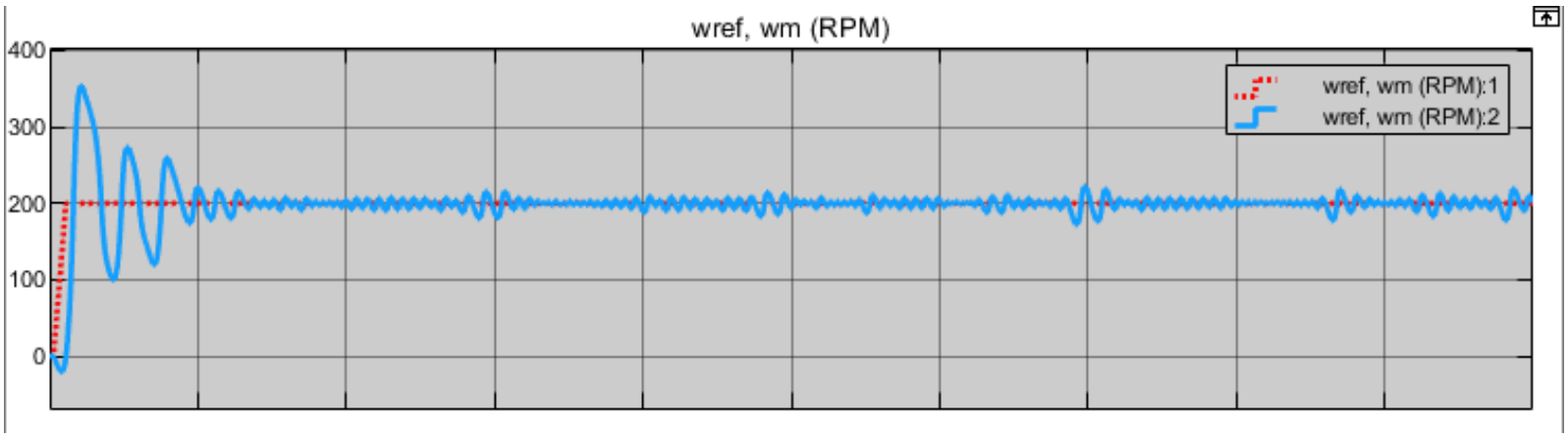

Figure: Speed Response Comparison

Harmonic Distortion Analysis

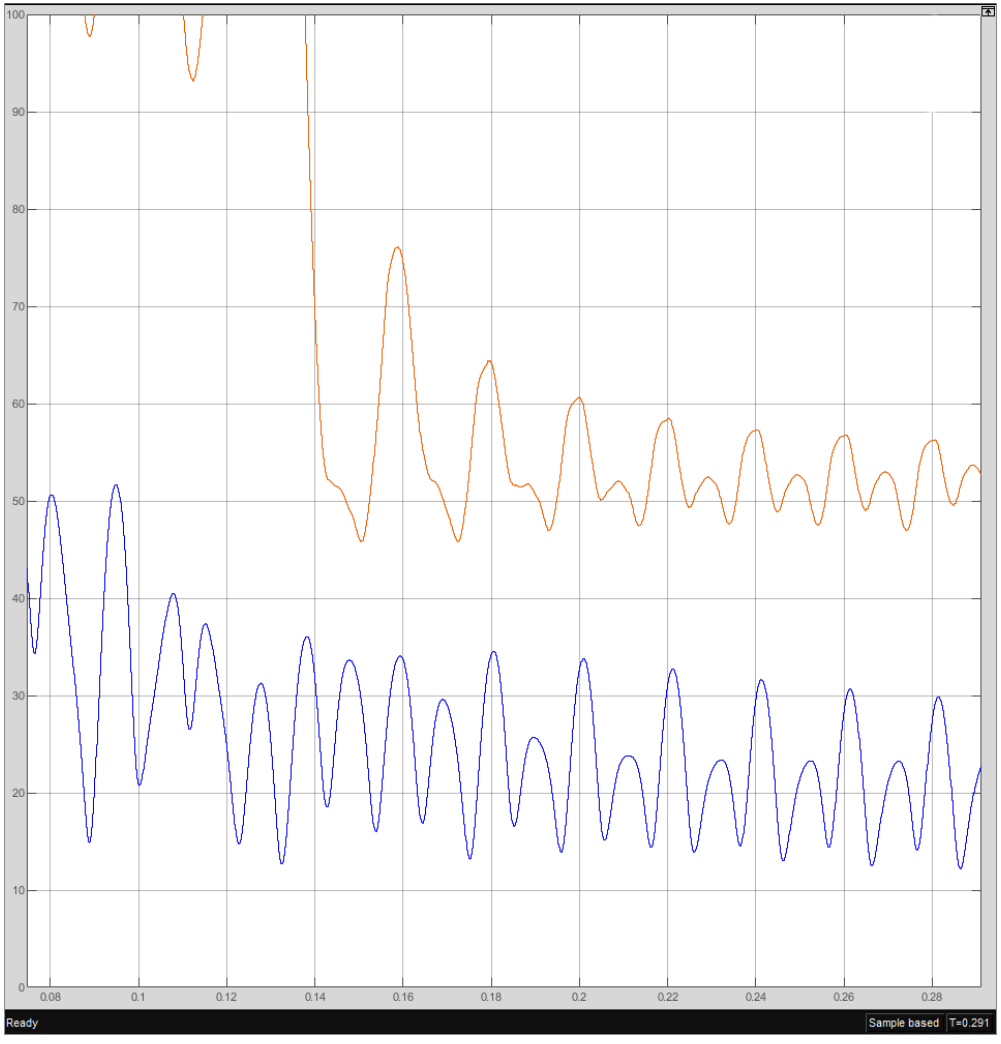

Figure: Without OTT Filter

Harmonic Distortion Analysis

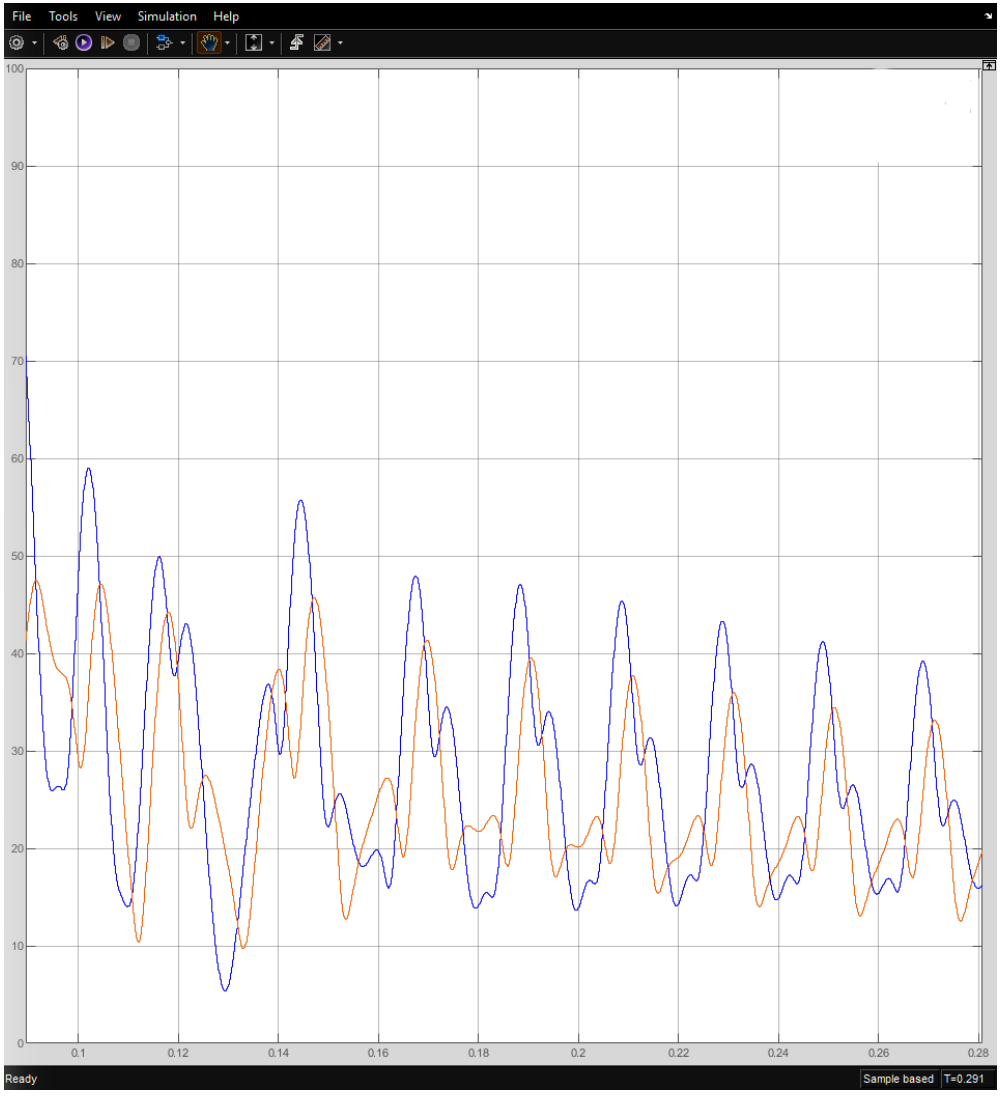

Figure: With OTT Filter

Conclusion

- FOC offers significant performance benefits.
- Simulation platform enables efficient design and analysis.
- Future work: Real-time implementation and sensor integration.

Applications of FOC

- Electric Vehicles
- Robotics
- CNC Machines
- High-Performance Industrial Drives

Thank You & Questions

- Thank you for your attention.