

A Study on the Influence of Induction Motor Models on Power System Stability

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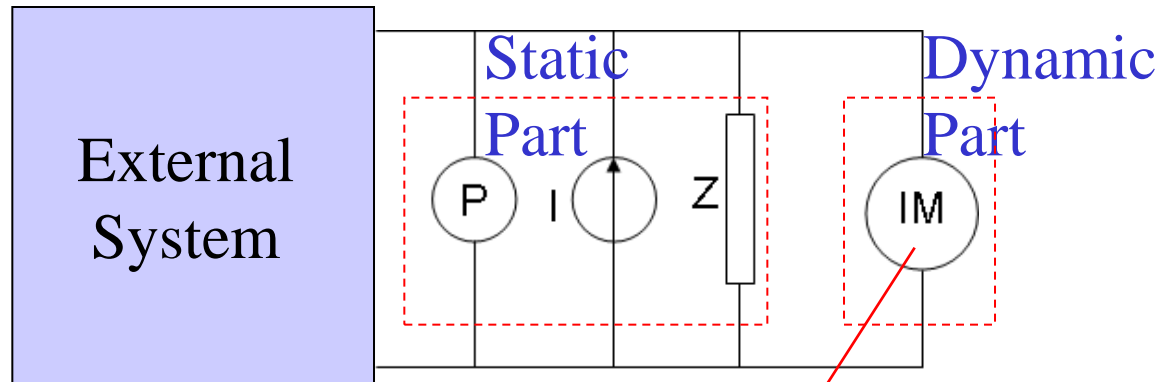
Presentation Outline

- **Background**
- **Objective**
- **Induction Motor Modeling Issue**
 - **Introduction of rotor speed based frame models**
 - **Comparison of Accuracy**
- **Comparative Study of PS Stability**
 - **Transient stability**
 - **Steady state stability**
- **Conclusion & Future Works**

Background

➤ PS Simulation: Phasor-based Modeling

➤ Load Models Represent the Load Behaviors



➤ Issues of Induction Motor Modeling

- Properness of the available models
- Choice of appropriate model

Objective

- Modeling in Rotor Speed Based Frame
- Accuracy Assessment of Proposed Models
- Comparison of IM behaviors on PS Stability

Induction Motor Modeling Issues

Induction Motor Modeling

➤ Different Frames

- ω_e -frame (in practice)
- ω_r -frame (proposed)

ω_o : Nominal Frequency

ω_e : System Frequency

ω_r : Rotor Speed

➤ Different Orders

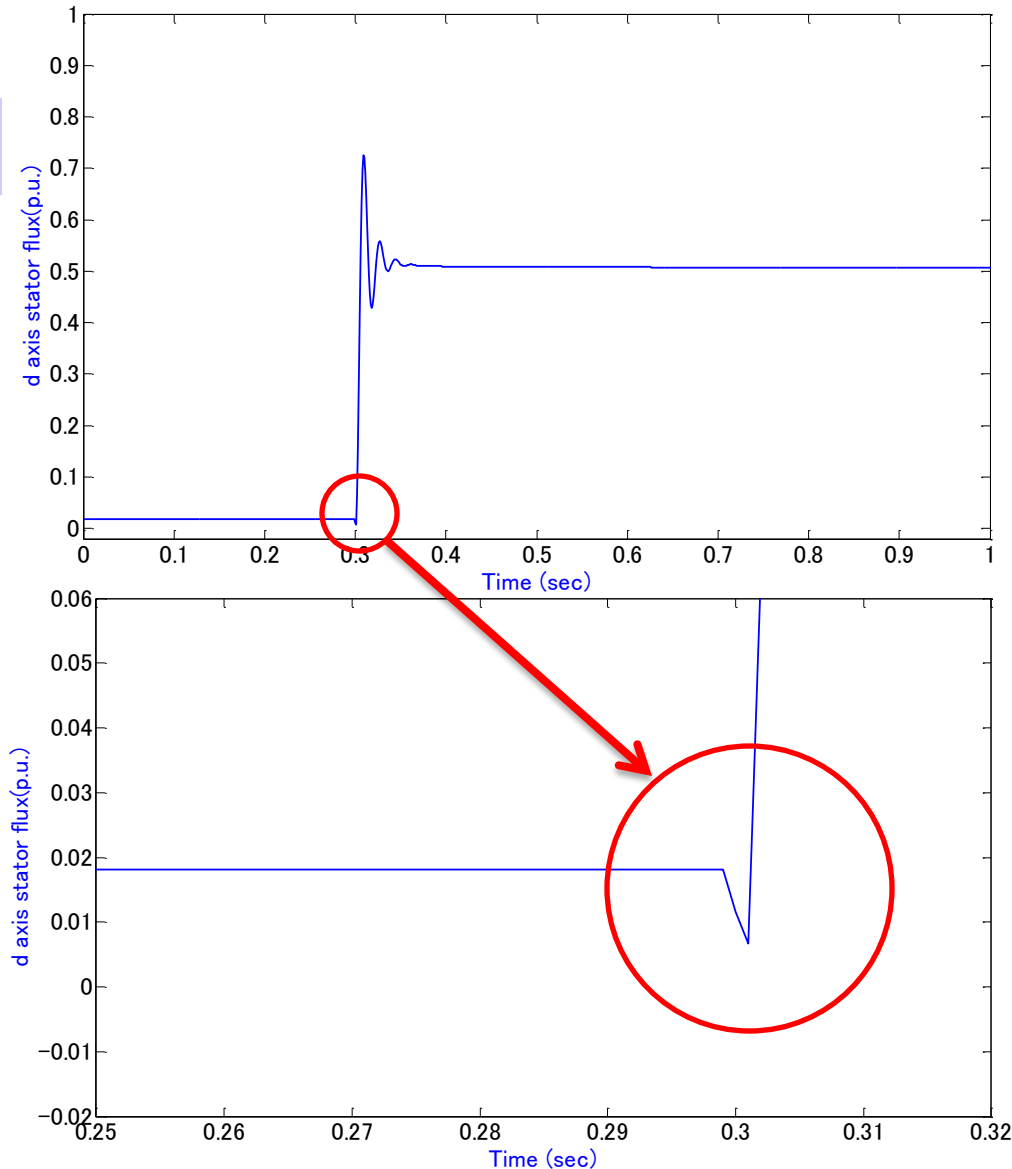
- First order
 - rotor inertia dynamics
- Third order
 - rotor flux, rotor inertia dynamics
- Fifth order (*For Reference*)
 - stator/rotor flux, rotor inertia dynamics

➤ Phase angle step

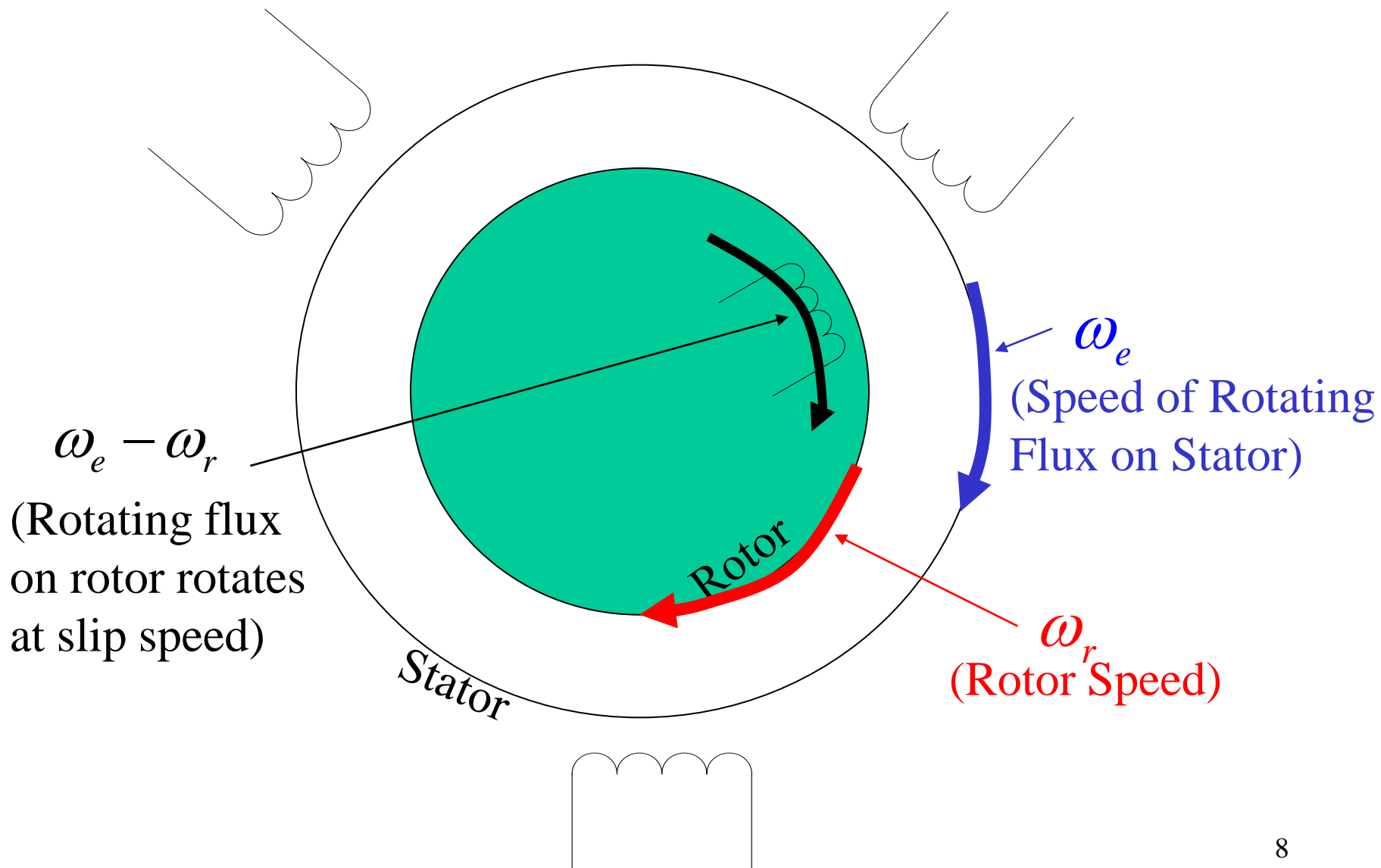
➤ At $t = 0.3$ second

➤ By 30 degree

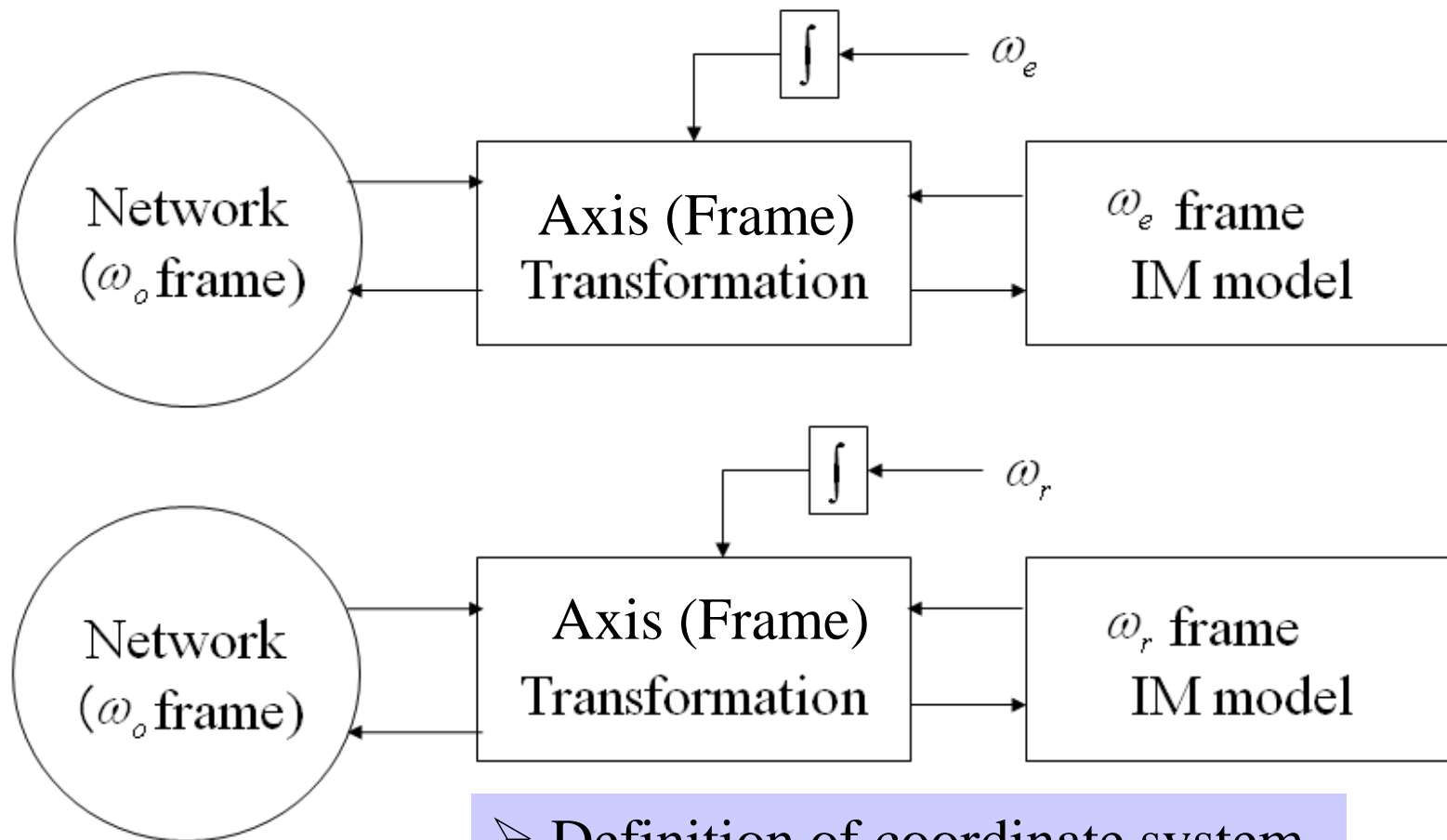
➤ Practical problem shown later



Introduction of “ ω_r -frame”



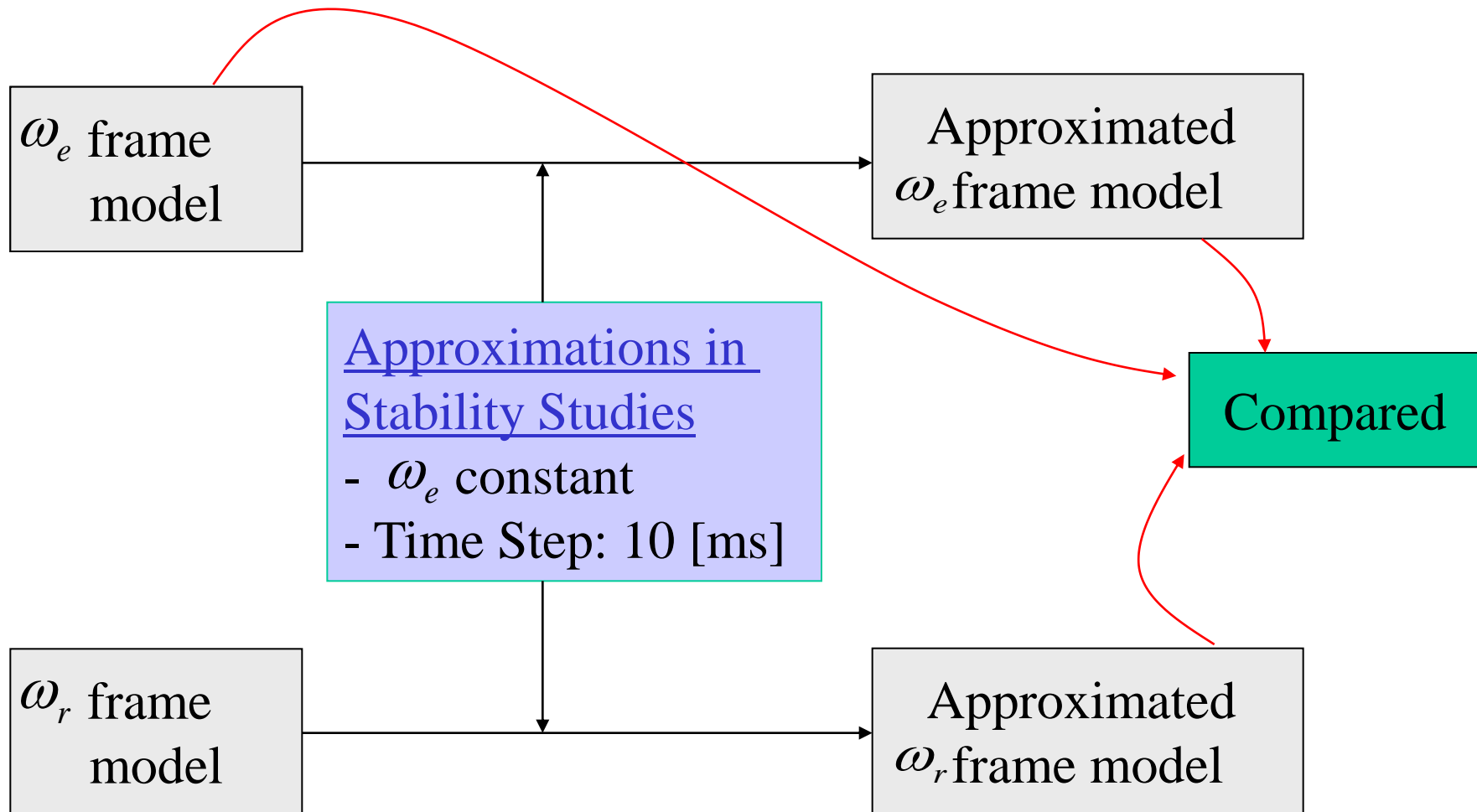
Proposed Implementation



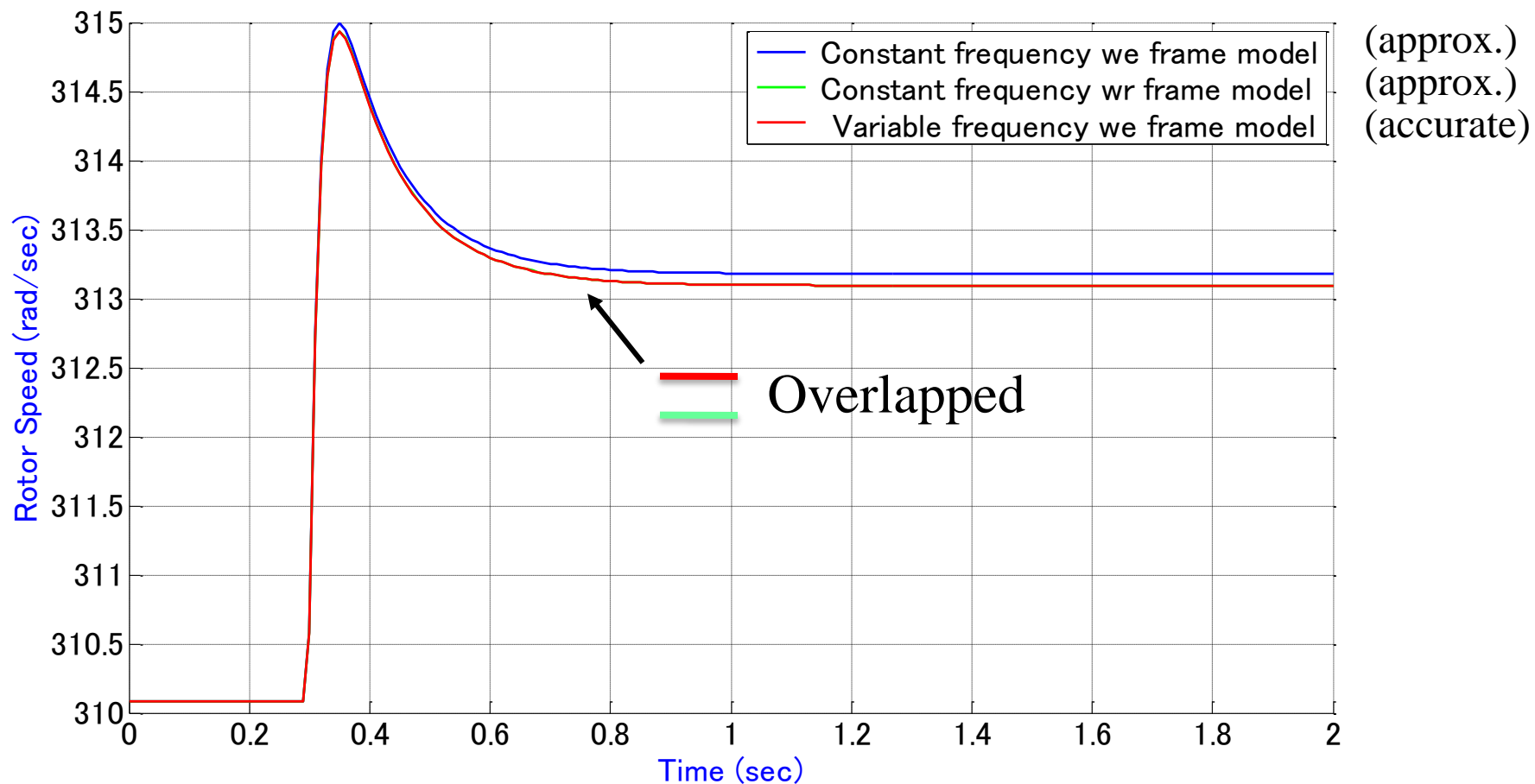
➤ Definition of coordinate system

➤ Similar to the synchronous machine implementation

Models for Stability Study

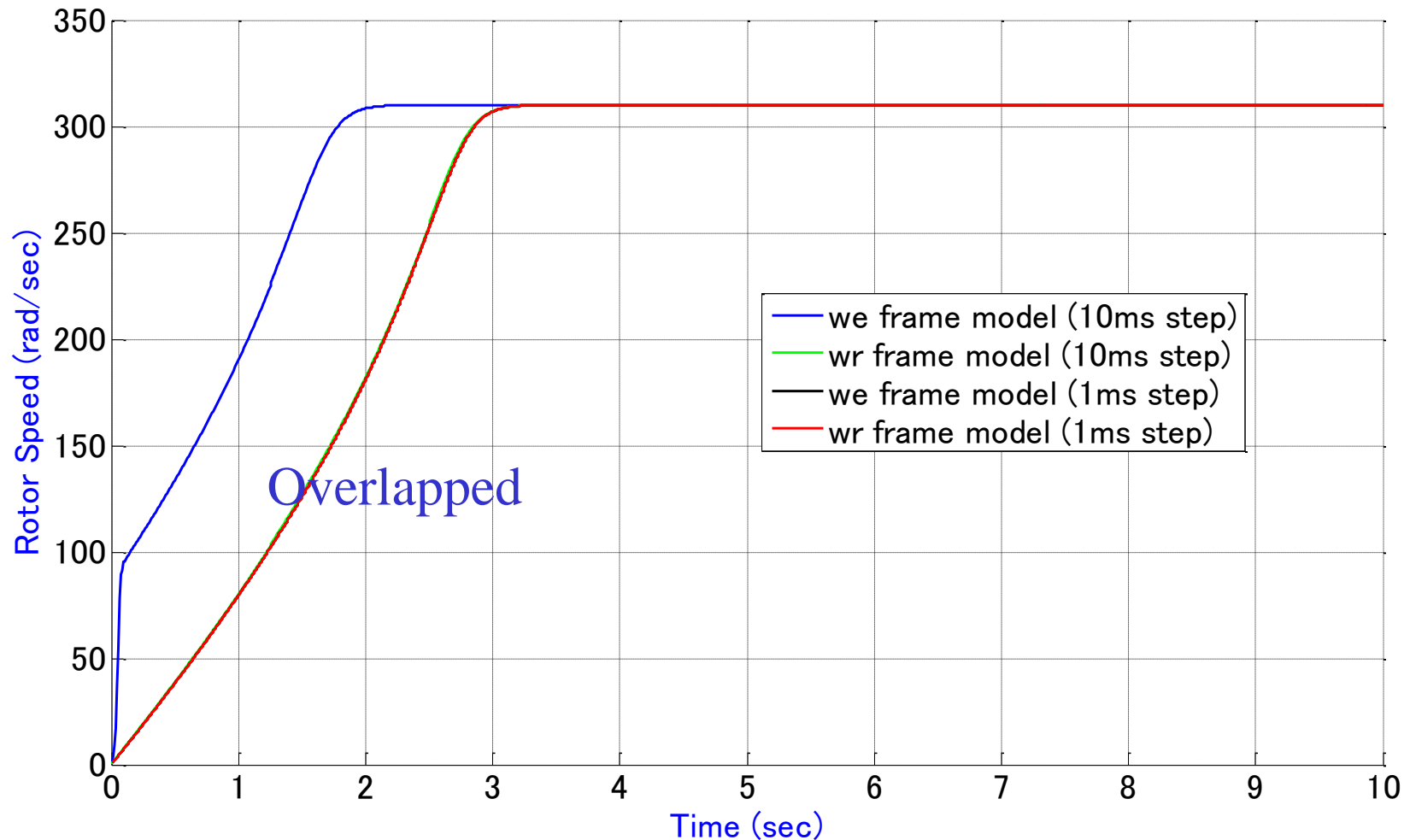


Comparison (Steady-State)



➤ ω_r frame model is better

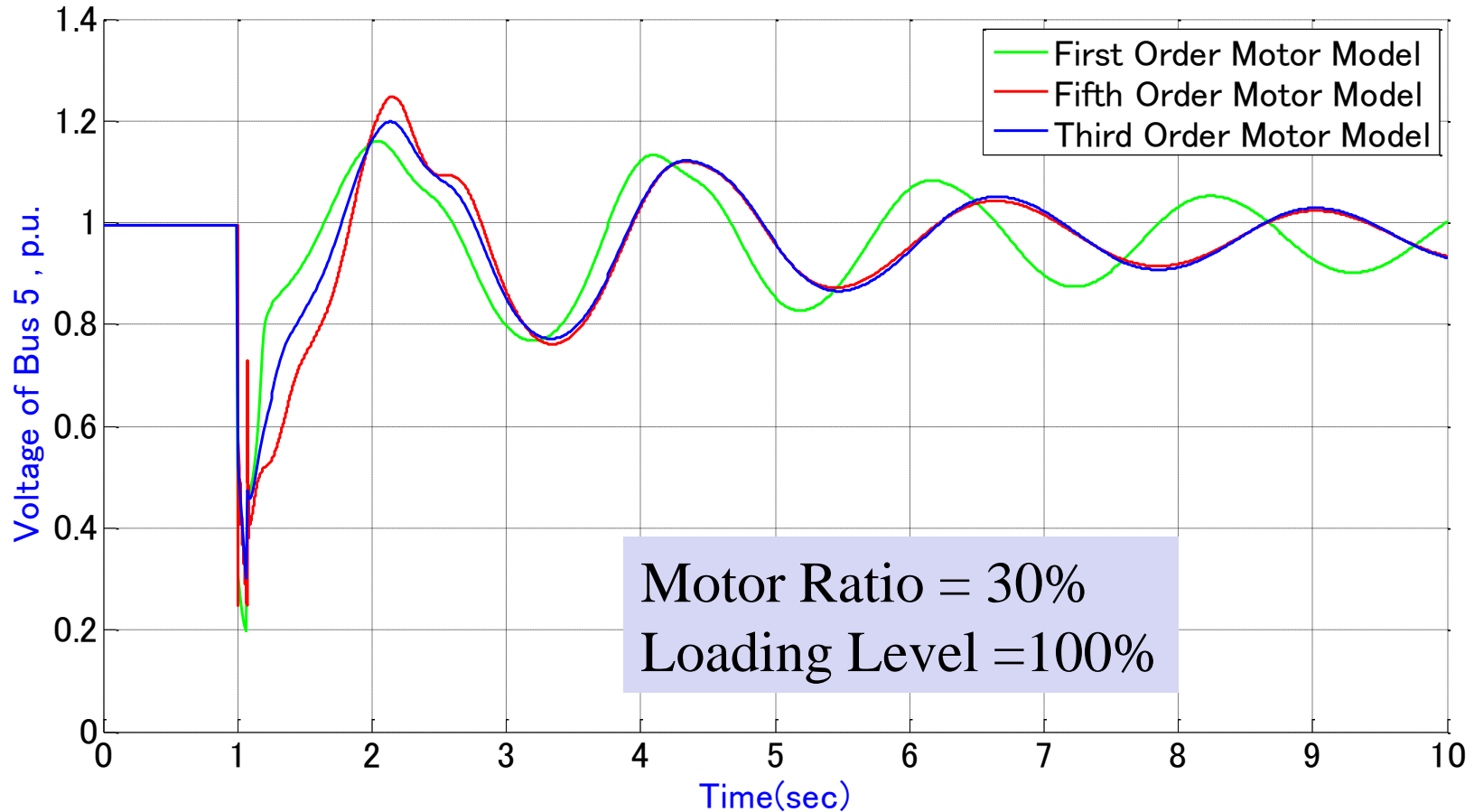
Comparison (Startup)



ω_e frame model has numerical problem with different time steps

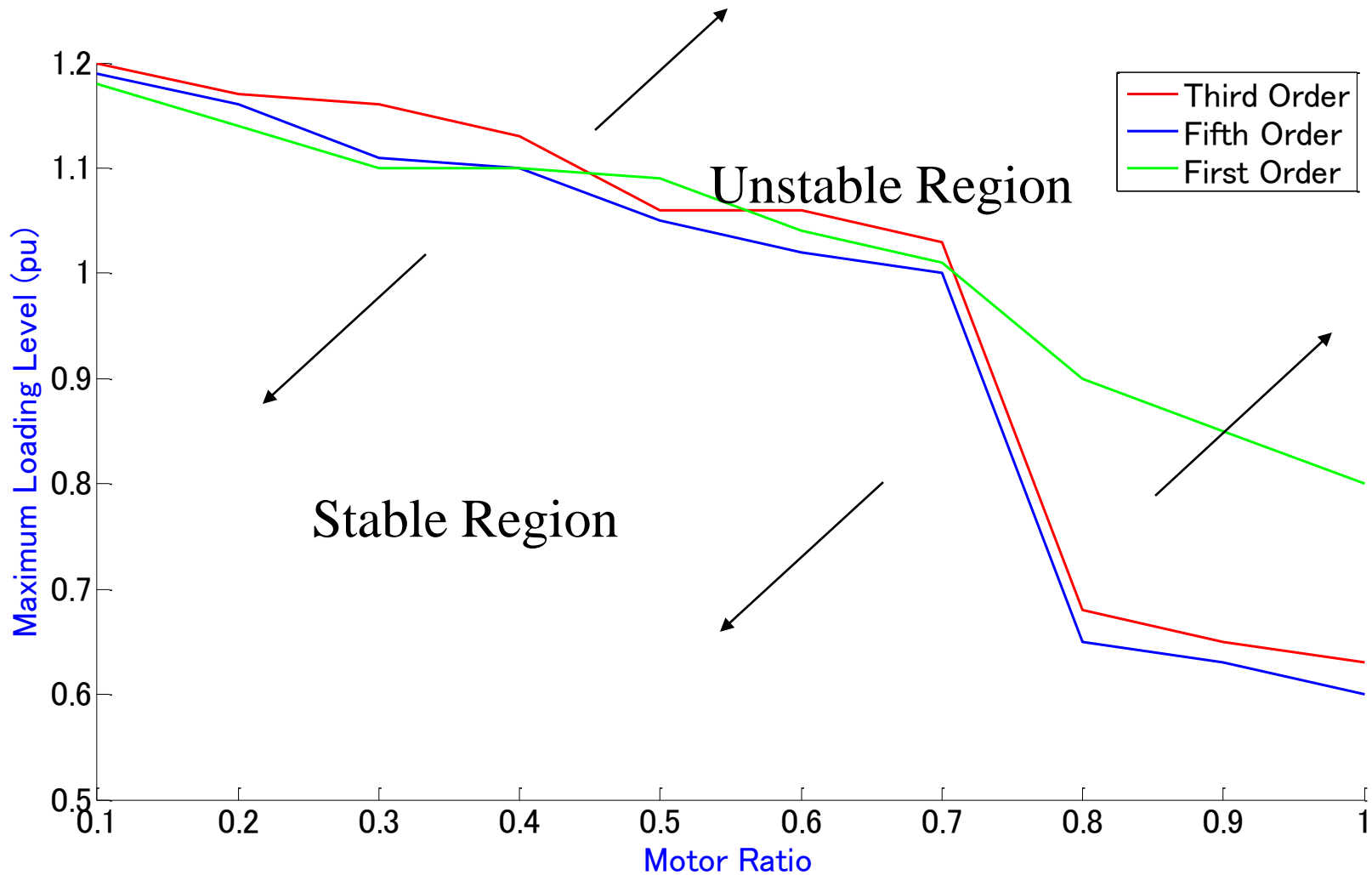
Comparative Study of PS Stability

Responses to a Disturbance



➤ 3rd and 5th order models have similar responses

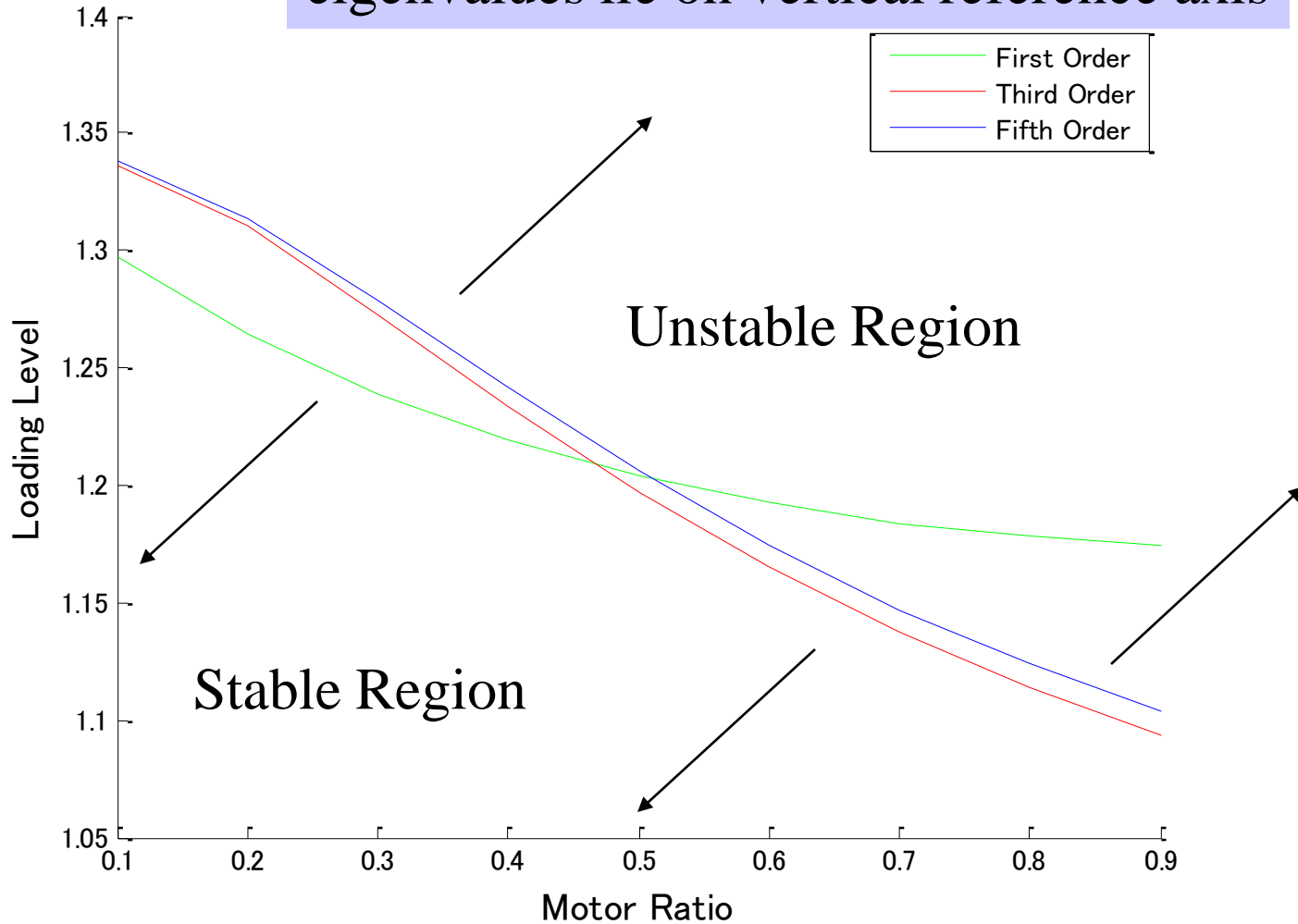
Transient Stability Limits



The 5th order and the 3rd order have similar characteristics

Steady-State Stability Limits

eigenvalues lie on vertical reference axis



3rd and 5th order has similar characteristics

Conclusion

- IM Modeling is better in ω_r -frame
- Lower Order IM Models give Optimistic Results
- 3rd Order Model is best choice for Stability Study

Future Works

- Development of two input general load models
- Inclusion of the nonlinearity issue