



University of Idaho

College of Engineering

DFIG Design Review

Team member: Xin Han
Zhengqi Li
Manasa Pothamsetty

Mentor: Dr. Herbert Hess

OVERVIEW

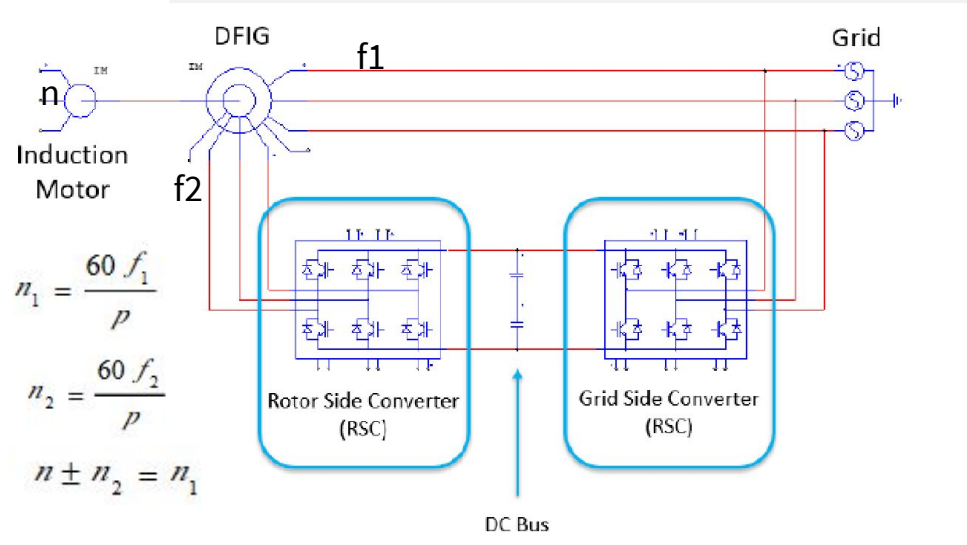
Introduction:

Main goal of the project is to build a motor generator system that mimics a wind energy system, which is based on a Type-III DFIG

Goal:

We want to design a controller for the rotor side that will enable the machine to turn at a very low frequency, but generate at 60 Hz using a variable speed drive system

Plan—Spring

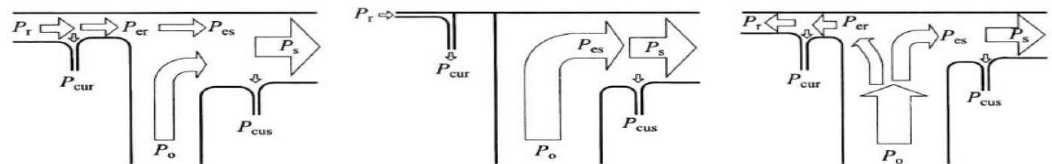


- Be familiar with DFIG
- Get model parameter
- Simulation starts

subsynchronous

synchronous

supersynchronous

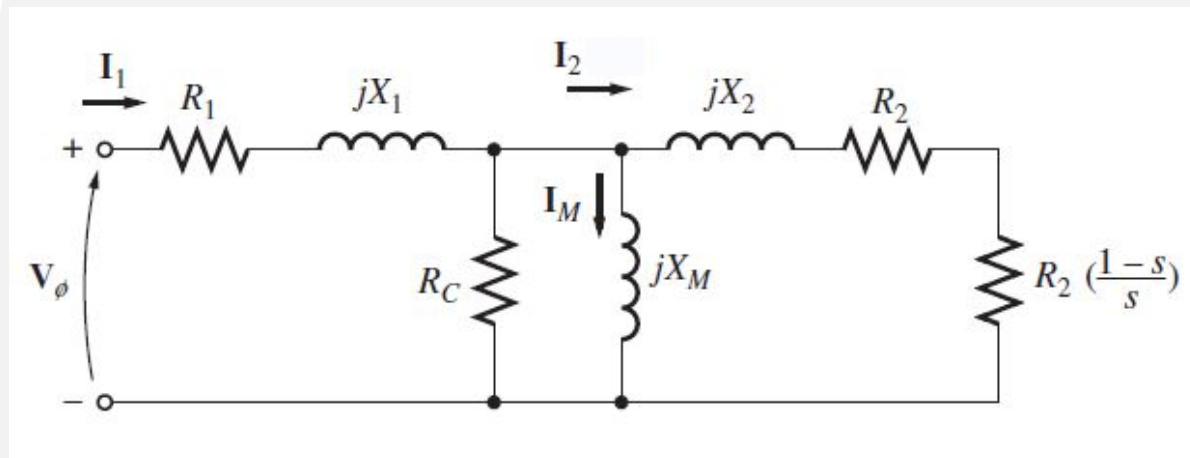




Plan—Fall

- Study for control part of the DFIG
- Finish and simulate control design
- Build physic hardware of the control design
- Conclusion and report

Model parameter

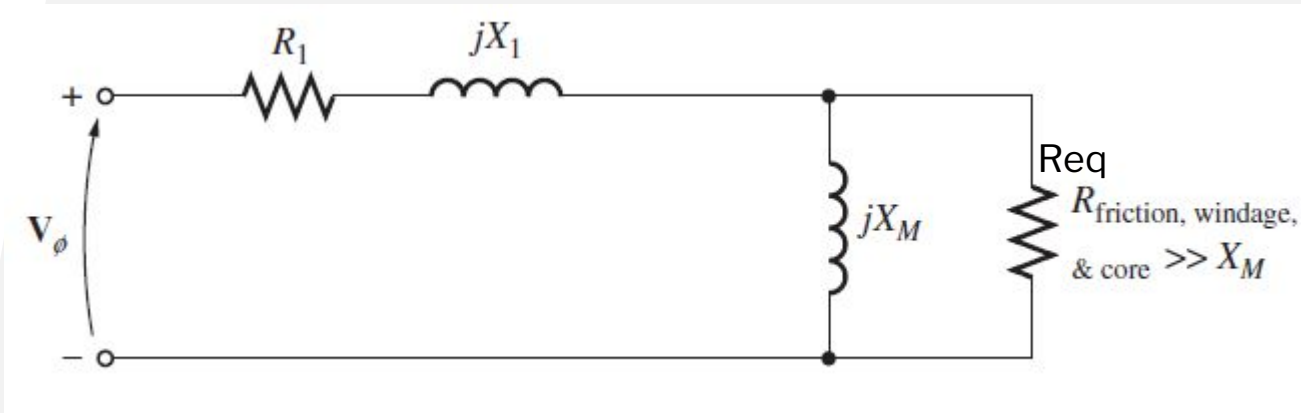


No-load test : open circuit test

Locked-Rotor test : short circuit test

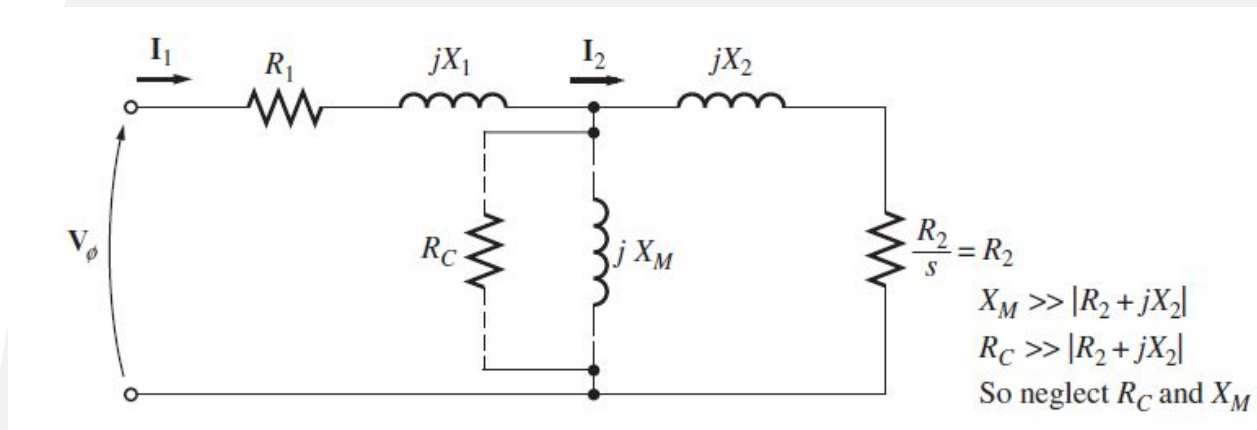
DC test : calculate R_1 and R_2

No-load test



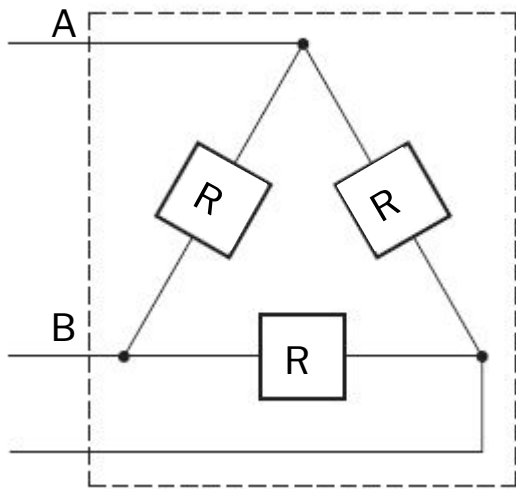
- Apply rated voltage on stator side and short rotor side to make slip close to zero
- R_{eq} become open
- Large lagging current resulting equivalent input impedance equal to $X_1 + X_m$

Locked-Rotor test



- Apply voltage on stator side with rated current
- Clamp the rotor to make slip equal to 1
- X_m become open
- Equivalent input impedance equal to $R_1 + jX_1 + R_2 + jX_2$

DC test



- Delta connected stator
- Apply DC across phase A and B
- Equivalent resistance is $\frac{2}{3} R$

Result

$$V_{AB} := 120V \quad I_A := 2.23A \quad P := 270W \quad f := 60\text{Hz} \quad \text{NO-LOAD} \quad \text{OPEN CIRCUIT}$$

$$V_{LR} := 43V \quad I_{LR} := 8.1A \quad P_{LR} := 390W \quad f_{LR} := 3.9\text{Hz} \quad \text{LOCKED-ROTOR} \quad \text{SHORT CIRCUIT}$$

$$V_{DC} := \frac{7.3}{\sqrt{3}}V \quad I_{DC} := 4.89A$$

$$R_1 := \frac{3}{2} \cdot \frac{V_{DC}}{I_{DC}} = 1.293\Omega$$

$$X_{eq} := \frac{V_{AB}}{\sqrt{3} \cdot I_A} = 31.068\Omega$$

$$Z_{LR} := \frac{V_{LR}}{\sqrt{3} \cdot I_{LR}} = 3.065\Omega$$

$$\Theta_R := \arccos\left(\frac{P_{LR}}{\sqrt{3} V_{LR} I_{LR}}\right) = 49.724\text{deg}$$

$$R_{LR} := Z_{LR} \cdot \cos(\Theta_R) = 1.981\Omega$$

$$R_2 := R_{LR} - R_1 = 0.689\Omega$$

$$X_{LR} := Z_{LR} \cdot \sin(\Theta_R) = 2.338\Omega$$

$$X_{LR_60} := \frac{X_{LR} \cdot 60}{3.9} = 35.975\Omega$$

$$X_1 := 0.5 \cdot X_{LR_60} = 17.987\Omega$$

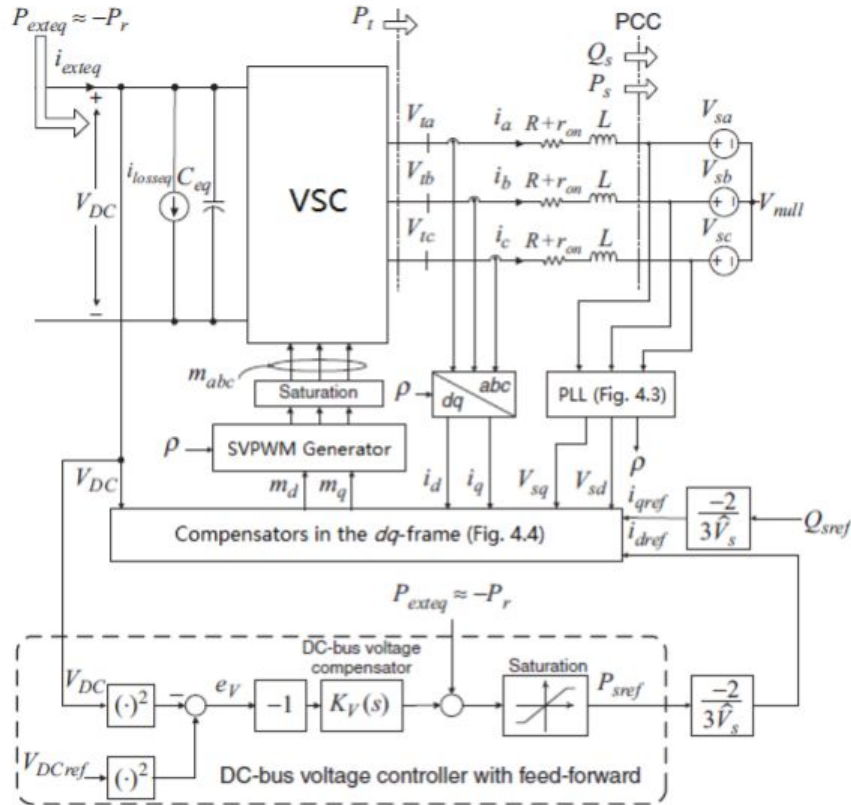
$$X_2 := 0.5 \cdot X_{LR_60} = 17.987\Omega$$

$$X_m := X_{eq} - X_1 = 13.081\Omega$$

- Results might be off due to inaccurate data reading and improper testing connection
- X_m should be much larger than the rest of the parameters
- Retest to get reasonable data

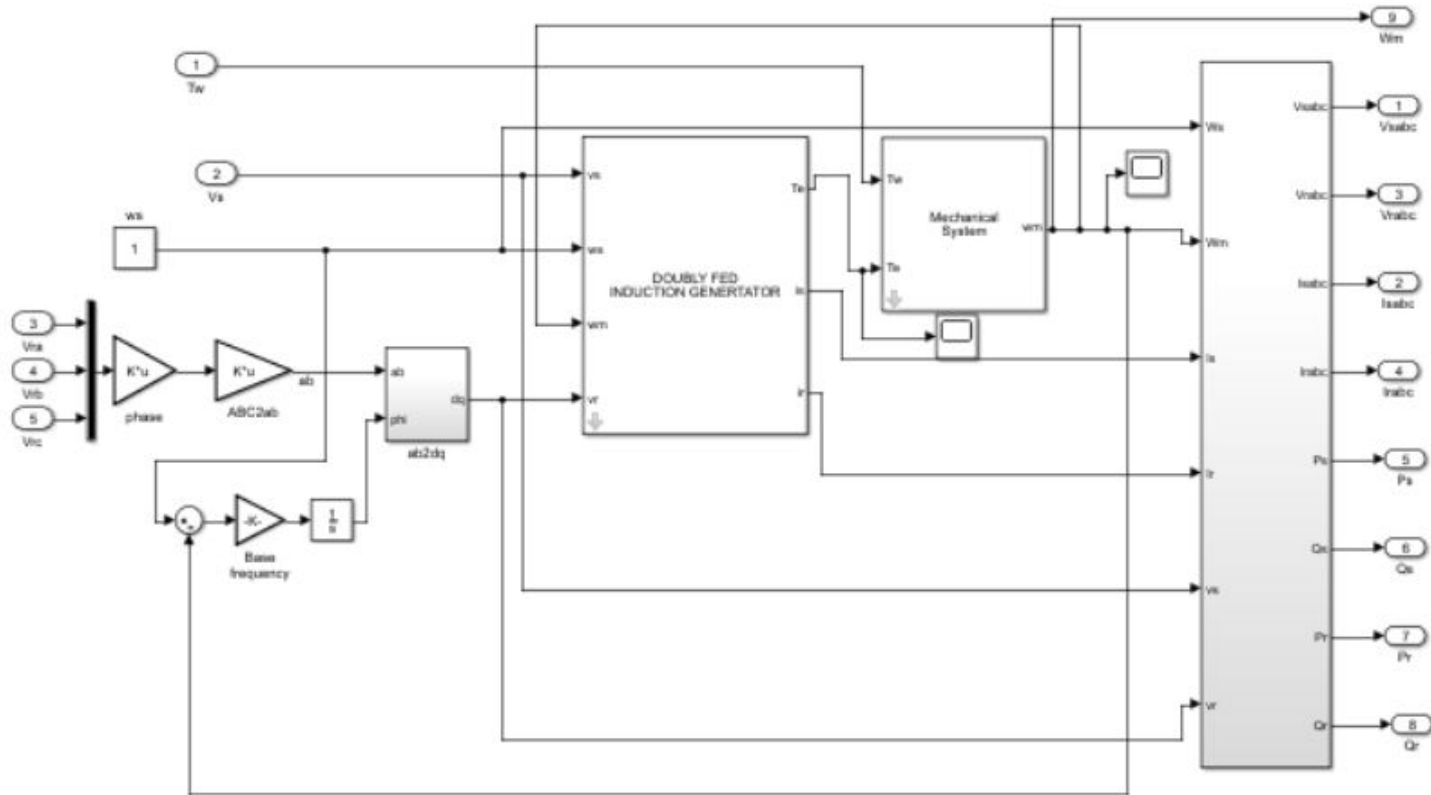


CONTROL OVERVIEW

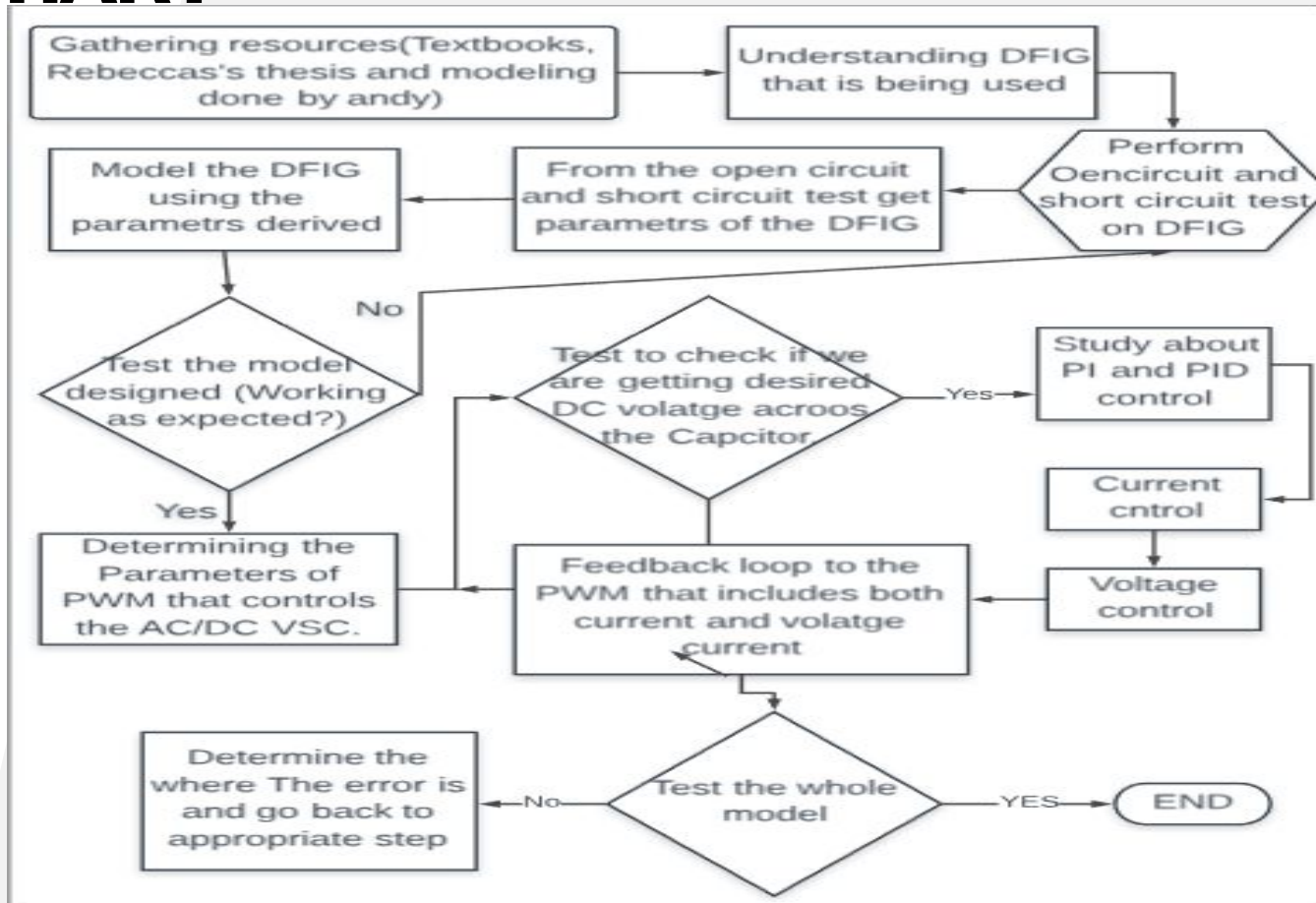


Schematic Diagram of a Current-controlled Real/Reactive Power Controller with a Controlled DC-Voltage Power Port in dq-frame

Simulink



CPM CHART



Conclusion

- We have finished basic understanding of the DFIG
- Retesting of the data is required
- Understand and perfect the model of the DFIG and the wind energy system