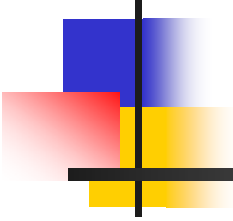
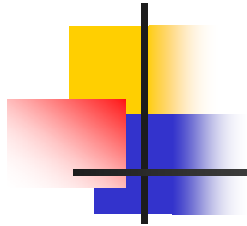


Influence of Parameter Variation on Induction Machine Indirect Field Oriented Control



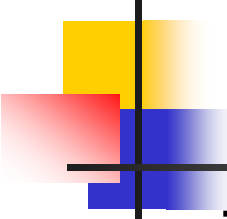
- ECE595S Lab10

Dezheng Wu
wu54@purdue.edu



Outline

- Induction machine parameters
- Indirect field oriented control
- Simulation results
 - torque transducer
 - speed control
- Conclusion

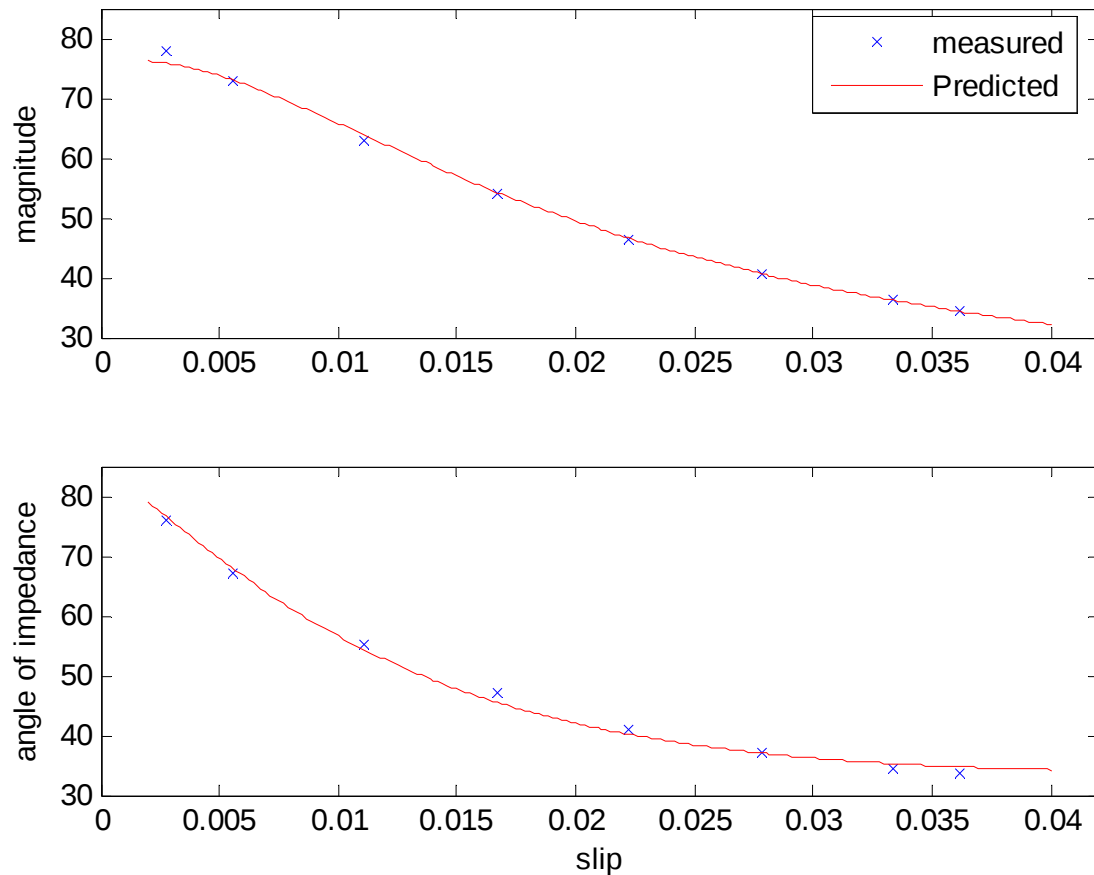


Machine Parameters with Genetic Algorithm ^[1]

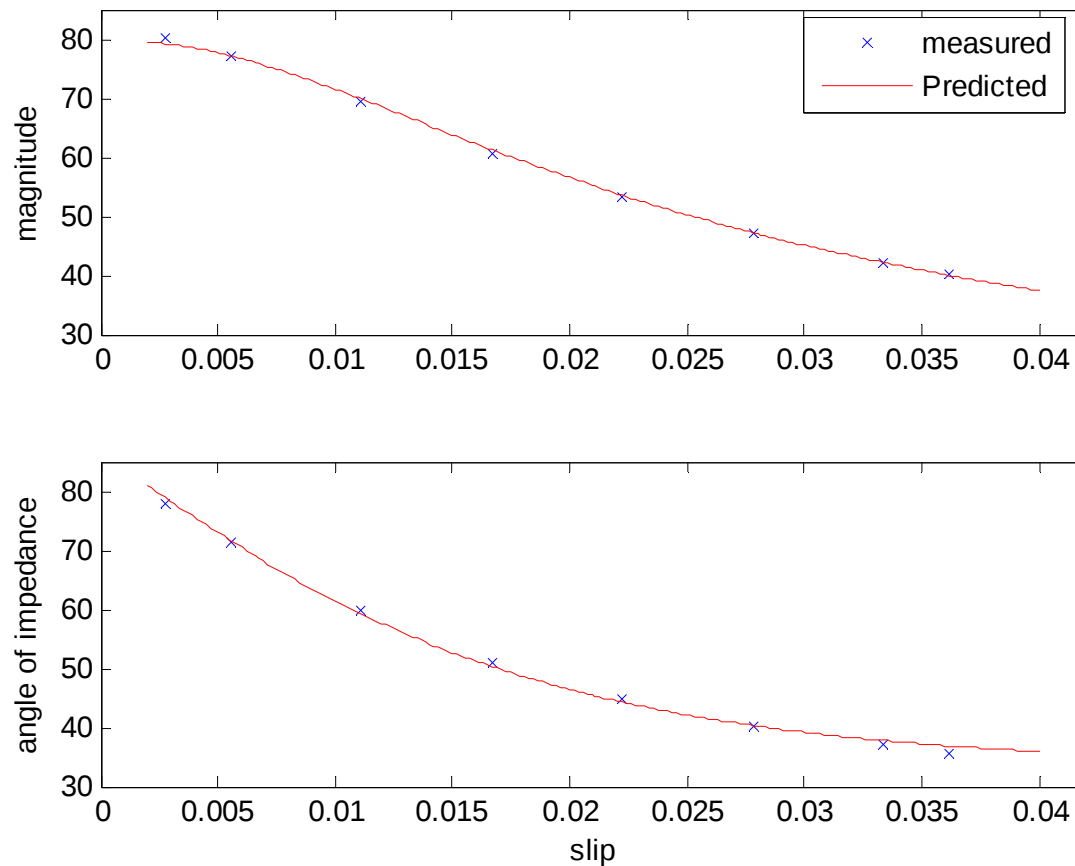
Estimated	Actual
$r_s=5.5706\Omega$	$r_s=4.8759\Omega$
$L_{ls}=12.7\text{mH}$	$L_{ls}=15.6\text{mH}$
$L_M=188.9\text{mH}$	$L_M=194.7\text{mH}$
$L_{lr}=16.3\text{mH}$	$L_{lr}=13.6\text{mH}$
$r_r=1.122\Omega$	$r_r=1.3939\Omega$

[1] "Energy Systems Analysis Consortium (ESAC) Genetic Optimization System Engineering Tool (GOSET) Ver 2.2," School of Electrical and Computer Engr., Purdue Univ., West Lafayette, IN, 47907, 2005.

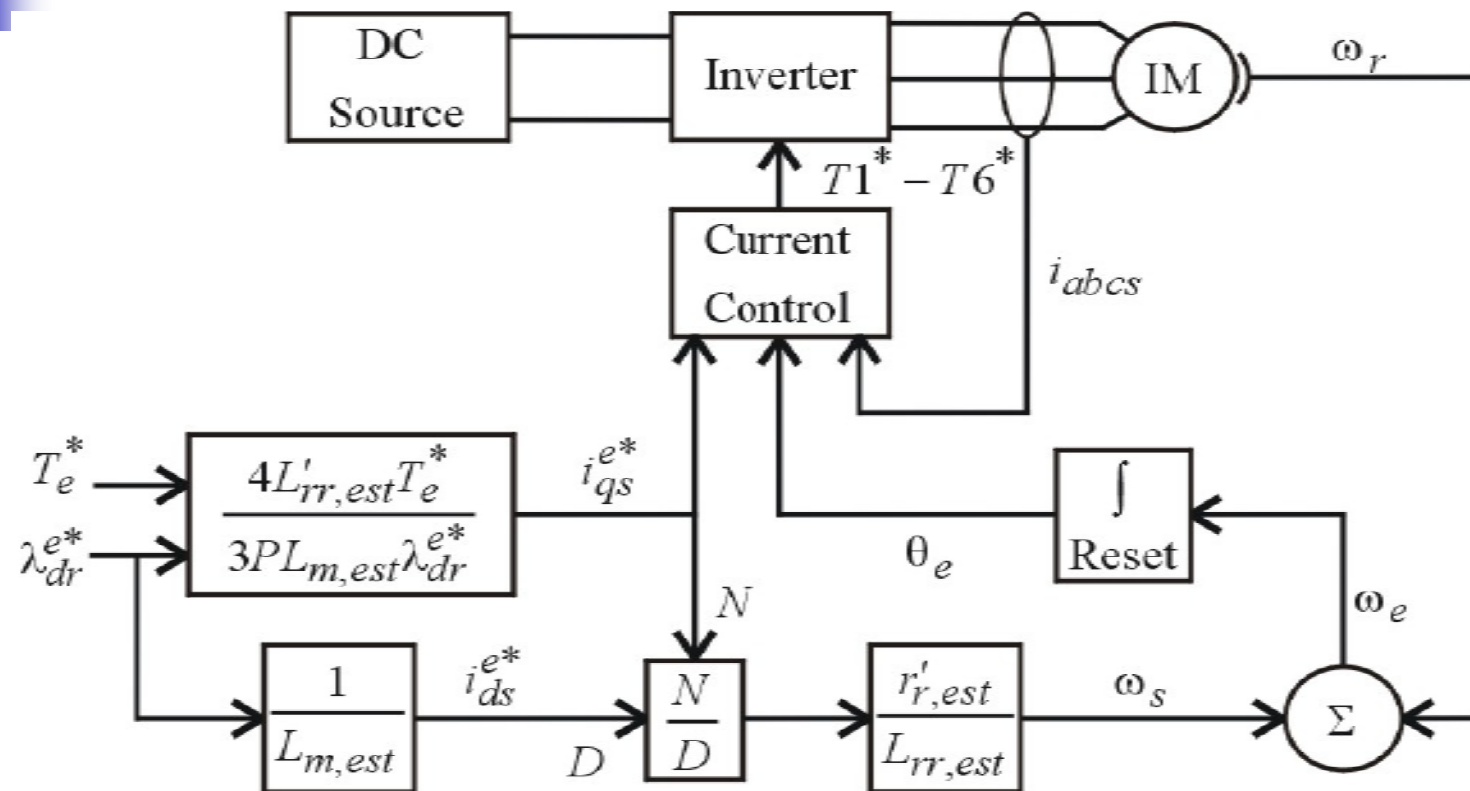
Curve Fitting (before temp. rises)



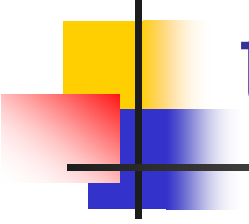
Curve Fitting(after 2-hr of running)



Indirect field oriented control [2]



[2] P.C.Krause, O.Wasynczuk, S.D. Sudhoff, Analysis of Electric Machinery and Drive Systems, IEEE Press, 2002

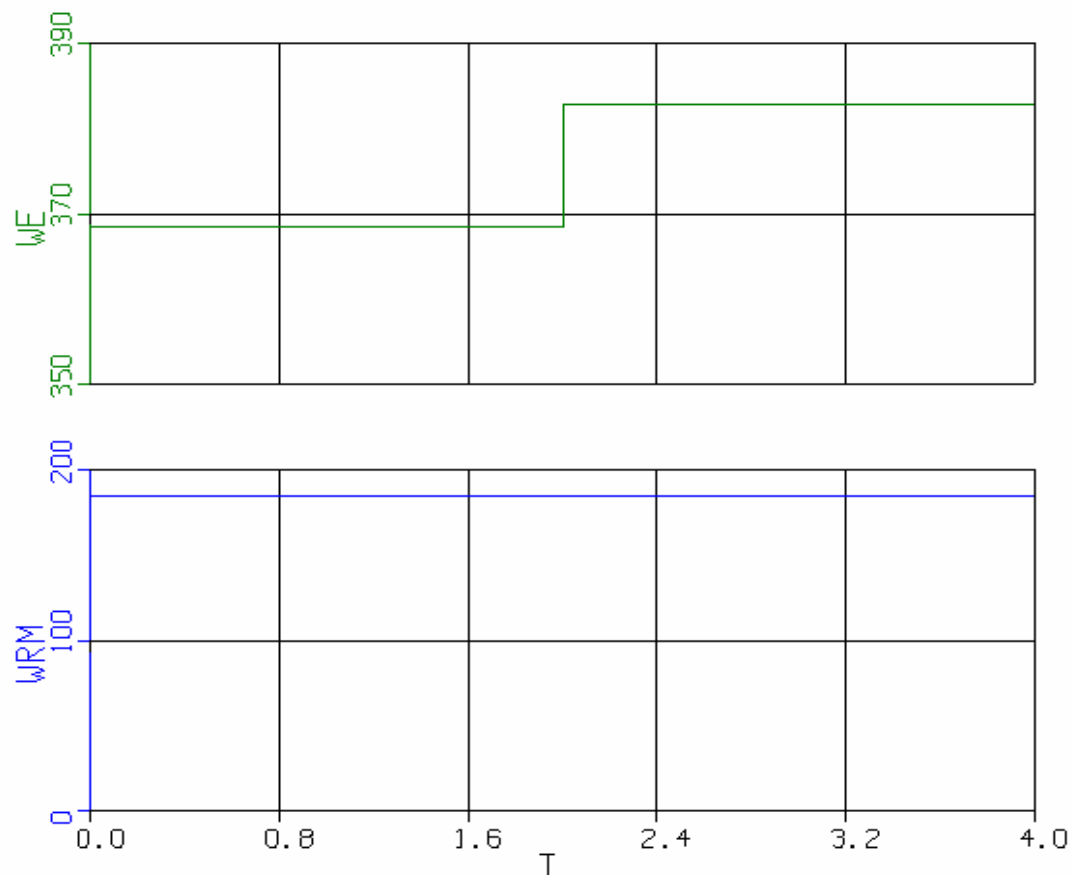


Performance as a torque transducer

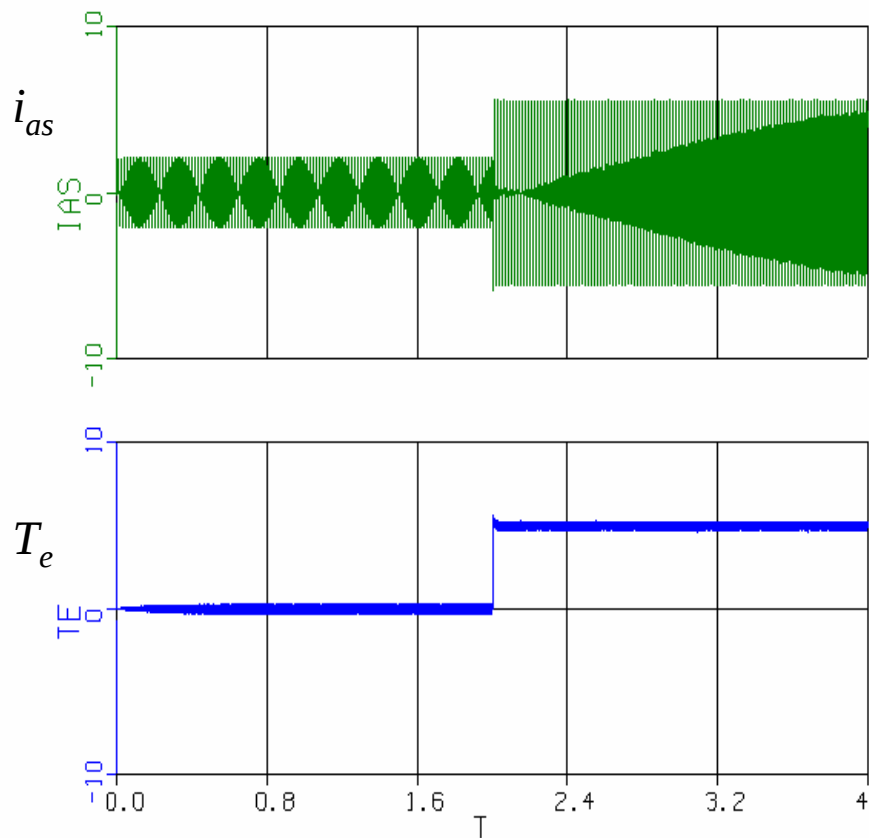
Operation Condition:

- Constant Speed $\omega_{rm}=184.3$ rad/s
- $T_e^* : 0 \rightarrow 5.0$ Nm at $t = 2.0$ second.
- Hysteresis current control $h=0.2A$
- $V_{dc} = 400V$
- Open-loop torque control, no torque sensor.

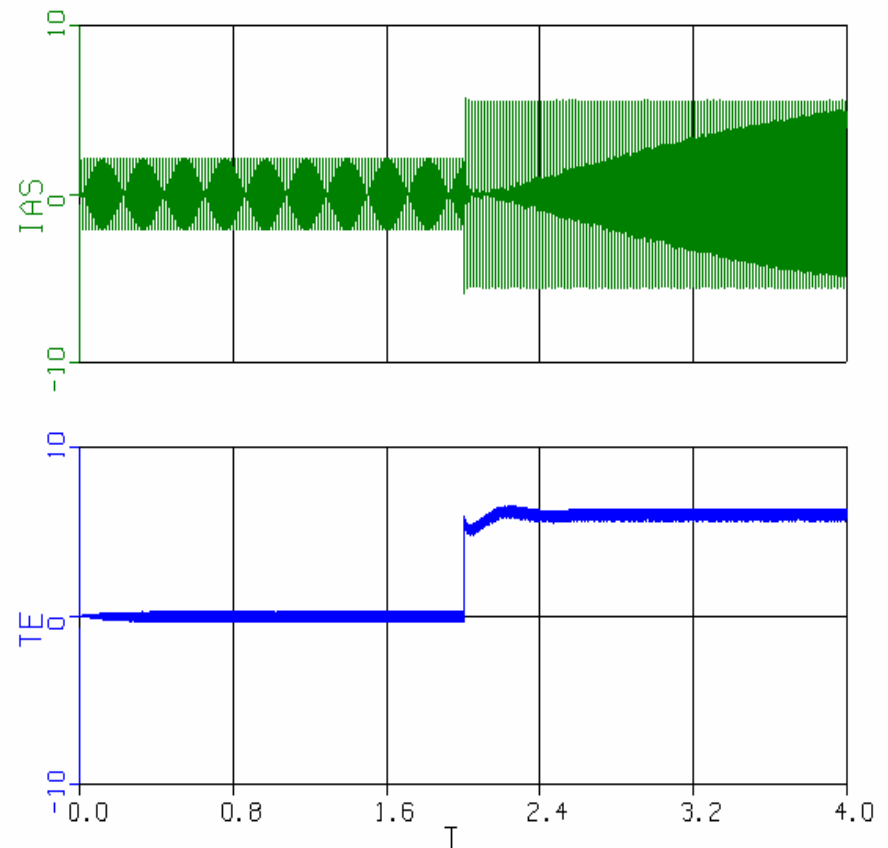
Performance as a torque transducer



Performance as a torque transducer



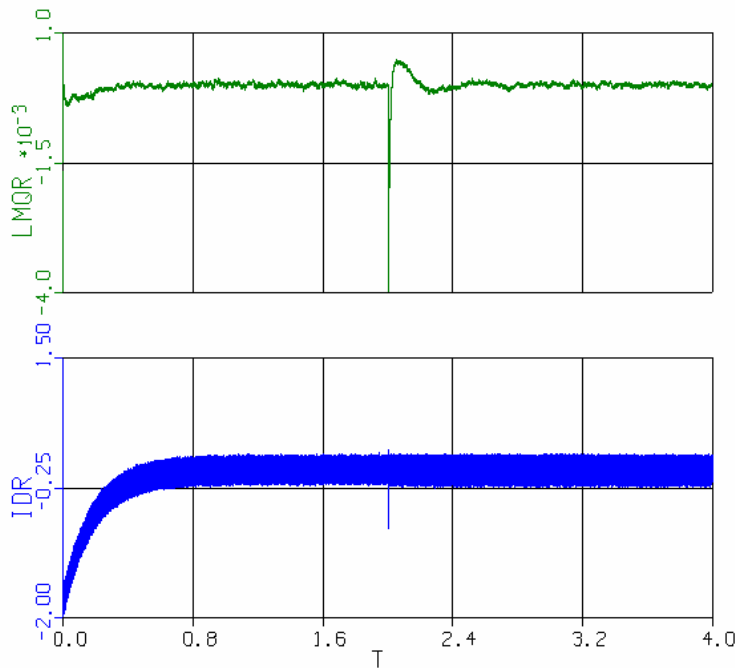
No errors, $T_e = 5.0$ Nm



with errors, $T_e = 6.0$ Nm

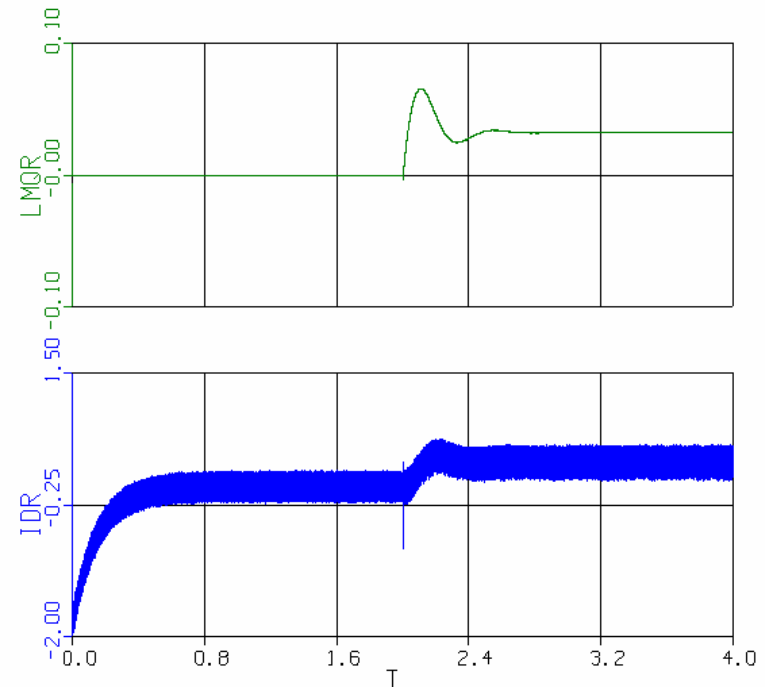
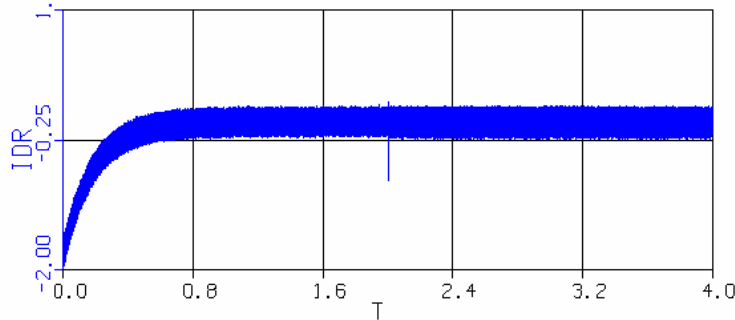
Performance as a torque transducer

*q-axis
rotor flux
linkage*



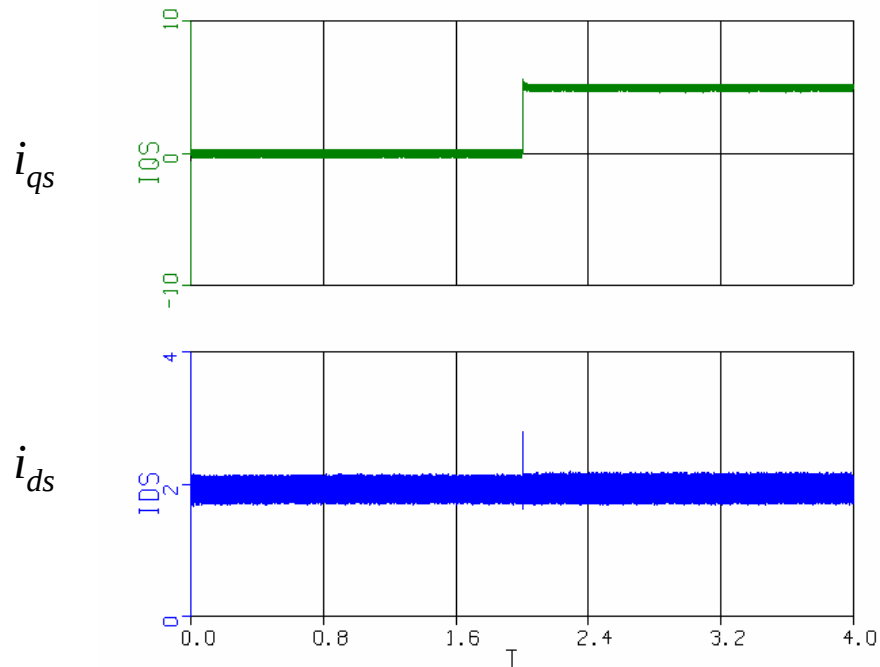
No errors

*d-axis
rotor
current*

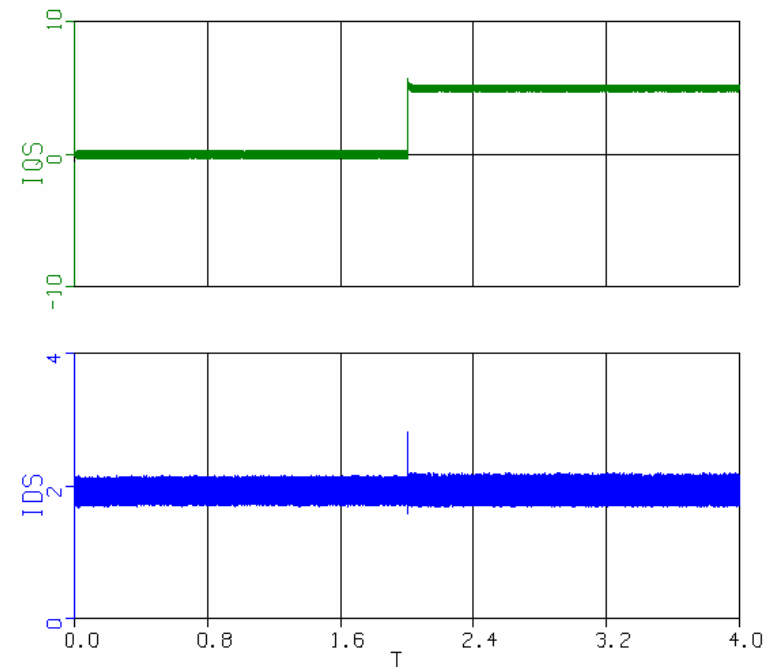


with errors

Performance as a torque transducer

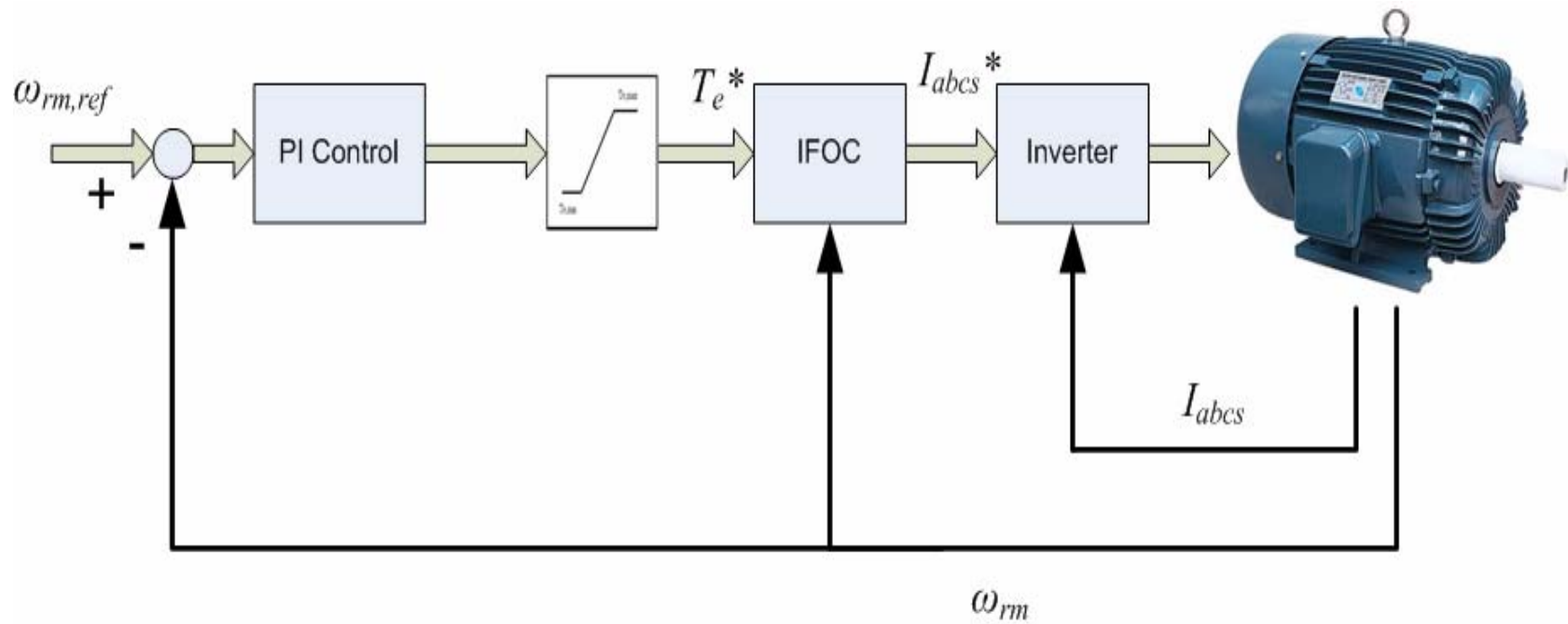


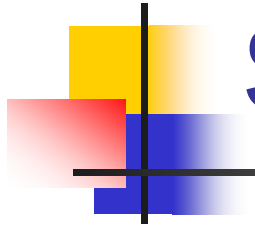
No parameter errors



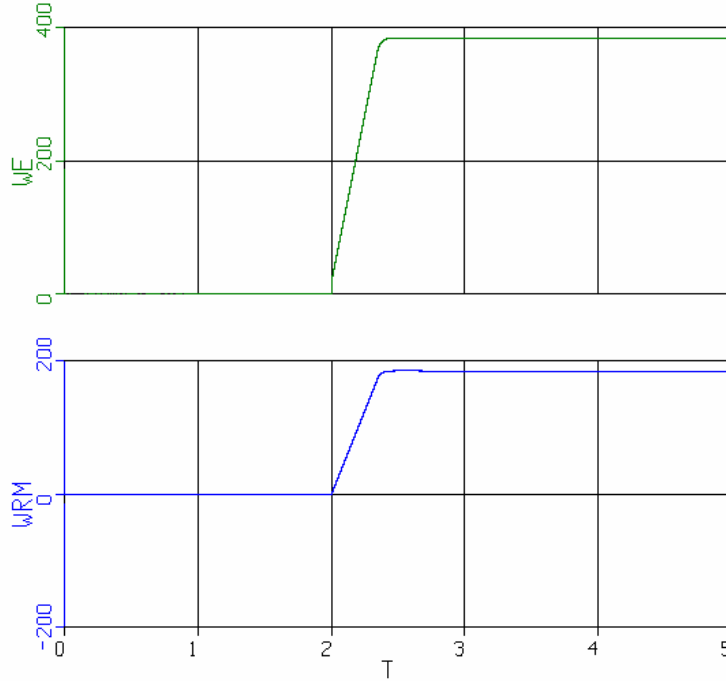
with parameter errors

Speed Control

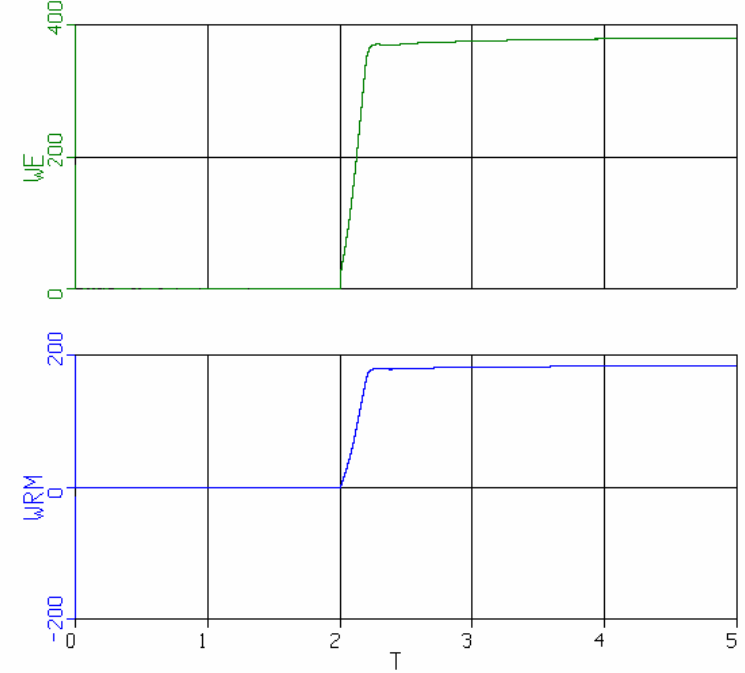




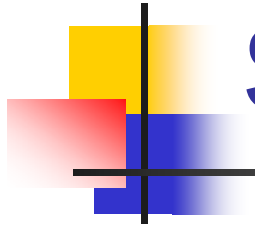
Speed control performance



No parameter errors

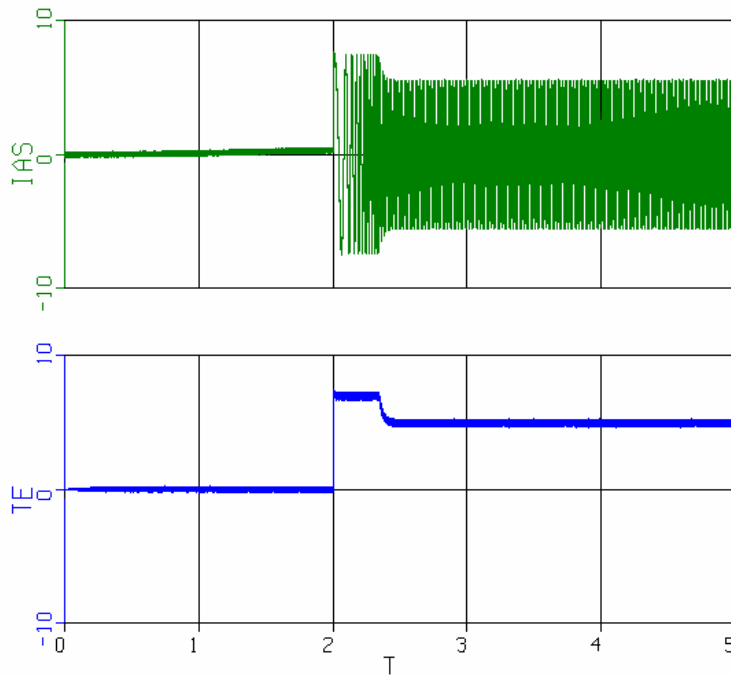


with parameter errors

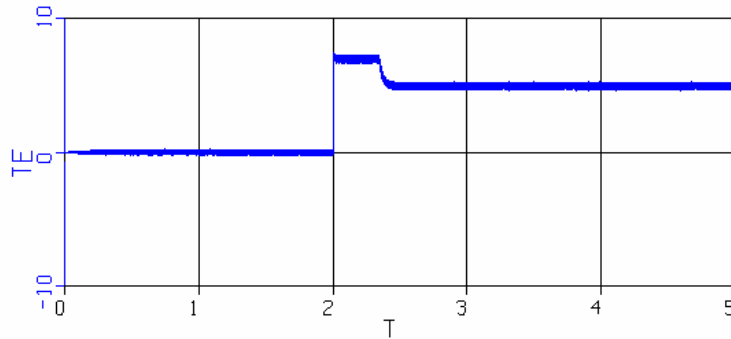


Speed control performance

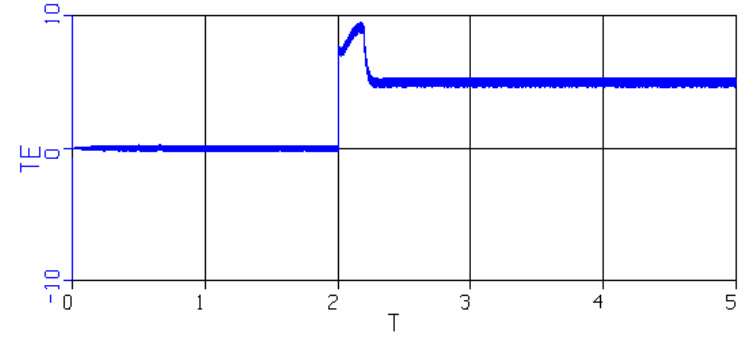
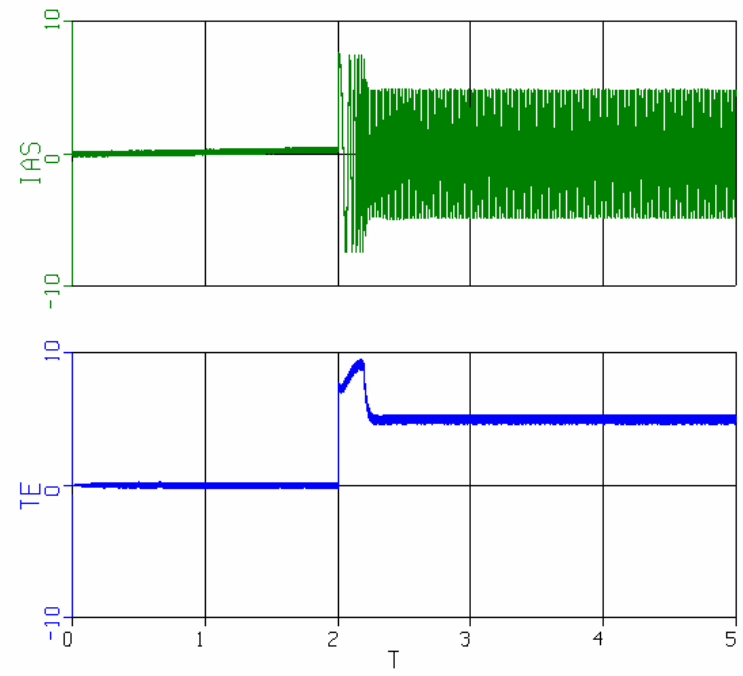
*A-phase
stator
current*



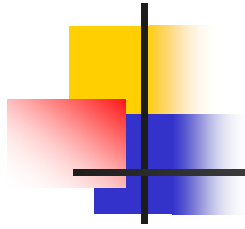
torque



No parameter errors

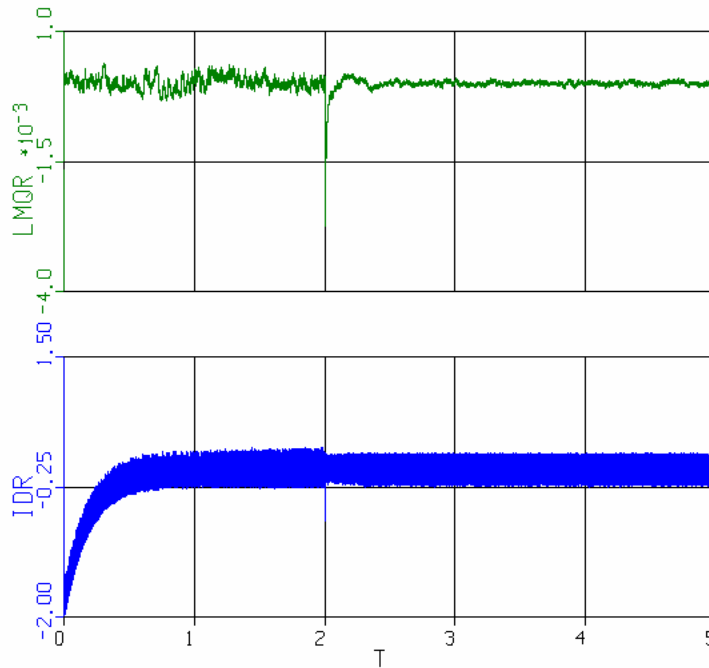


with parameter errors

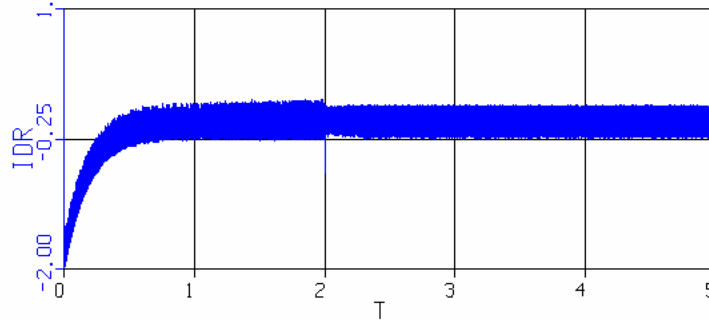


Speed control performance

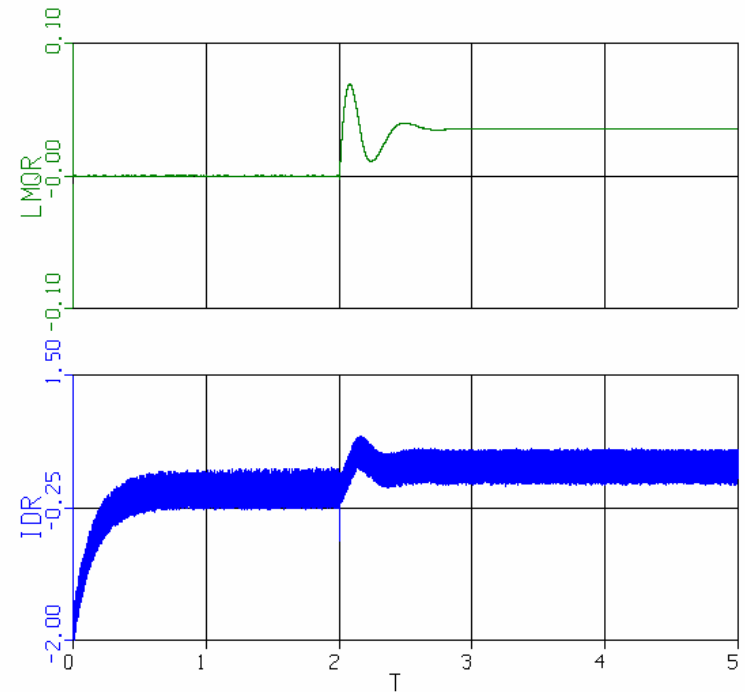
*q-axis
rotor flux
linkage*



*d-axis
rotor
current*

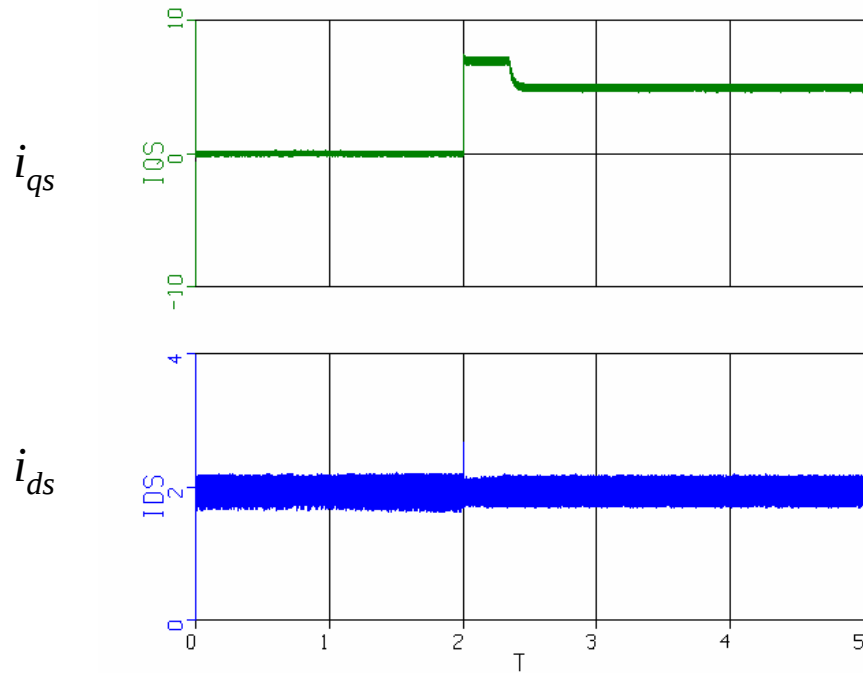


No parameter errors

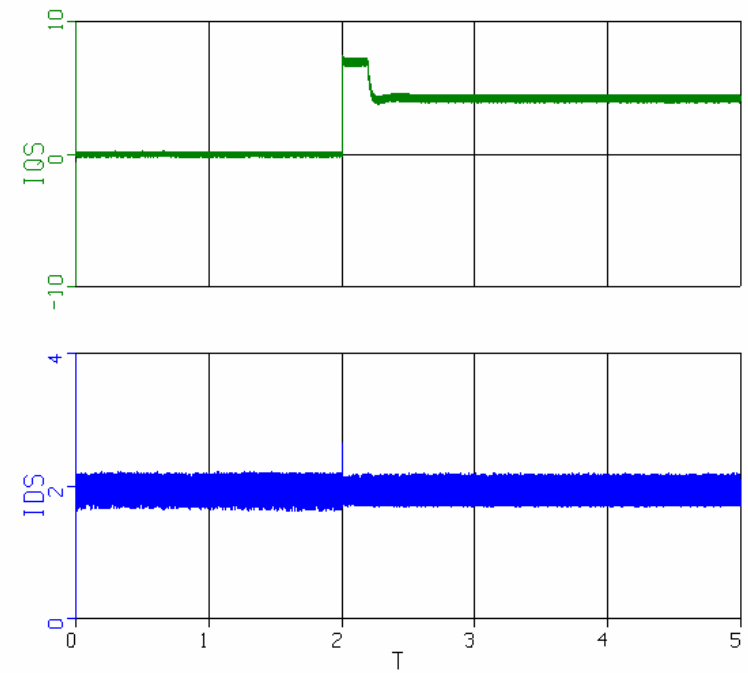


with parameter errors

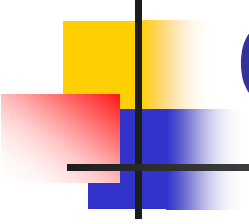
Speed control performance



No parameter errors



with parameter errors



Conclusion

- The stator resistance increase after 2-hour of running (temp. rises).
- IFOC works very well when parameters are precise.
- Parameter variation deteriorates IFOC performance, leading to misalignment of λ_{dr} and estimated λ_{dr} .