ECE 595S Project 10

Indirect Field Oriented Control of an Induction Machine

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- Parameter Identification
  - Estimated new “hot” machine parameters using previous GOSET code with new measured data
  - Acceptable fits to measured data whether setting leakage inductances equal or allowing them to vary
  - Values for R’s and L’s higher than those fitted to “cold” data
    - Hot: R_s= 2.515Ω, L_{ls} = 1.102μH, L_m = 213.5mH, L_{lr} = 23.96mH, R_r = 1.6255Ω
    - Cold: R_s= 2.125Ω, L_{ls} = 0.4705nH, L_m = 208.4mH, L_{lr} = 22.26mH, R_r = 1.2904Ω

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- Indirect Field Oriented Control
  - ACSL used to implement with previous IM model
  - Base case run with same parameters entered in both IM model and control
  - Other runs done with differing values in the IM and control models to assess effects of parameter variation versus base run

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- Base Run
  - Parameters: Both cold (similar results for both being hot)
  - Commanded Torque: 4.0N-m
  - Commanded Flux Linkage (based on equation using rated voltage of 230V at 60Hz): 0.4324V-s
  - Load Torque: $1.0\omega_r^2$

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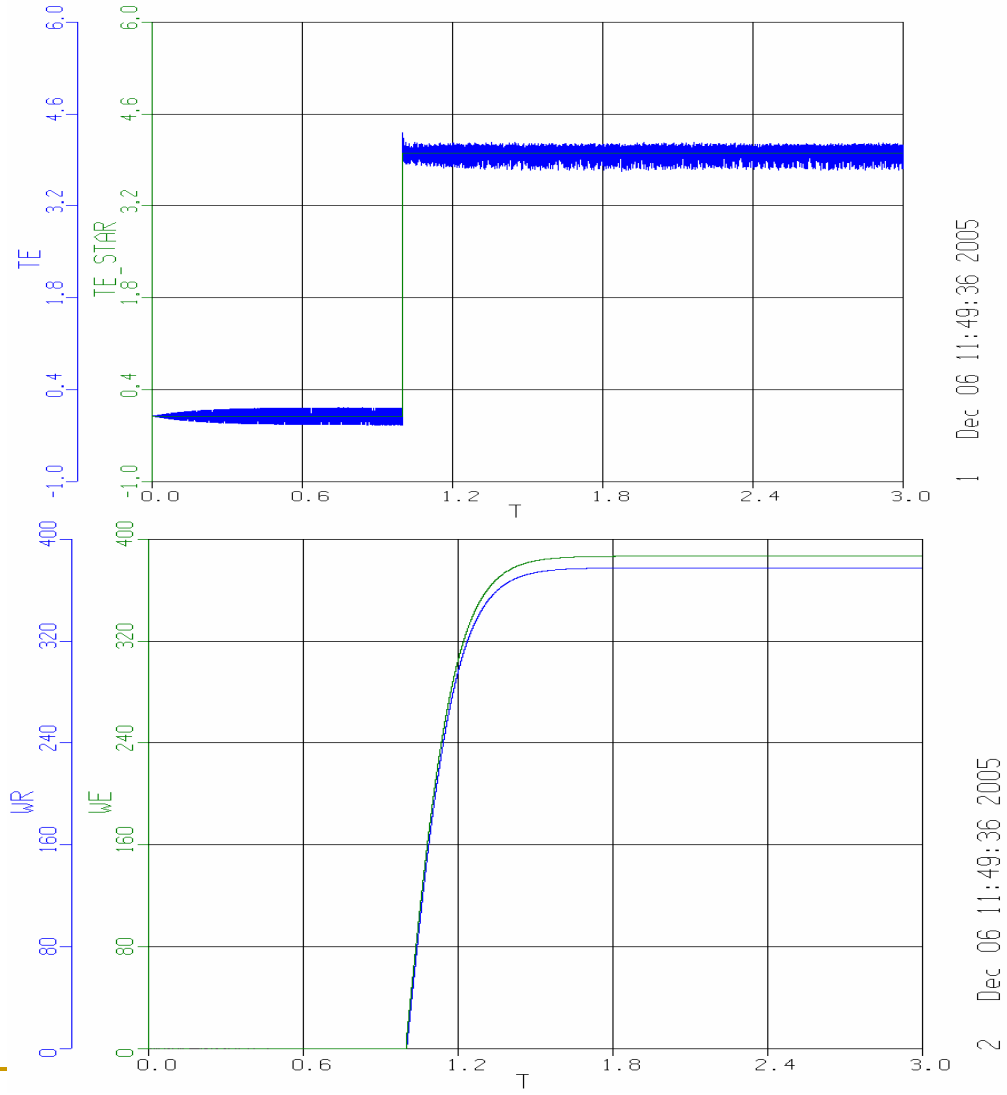
- Base Results
  - Torque
  - Speed



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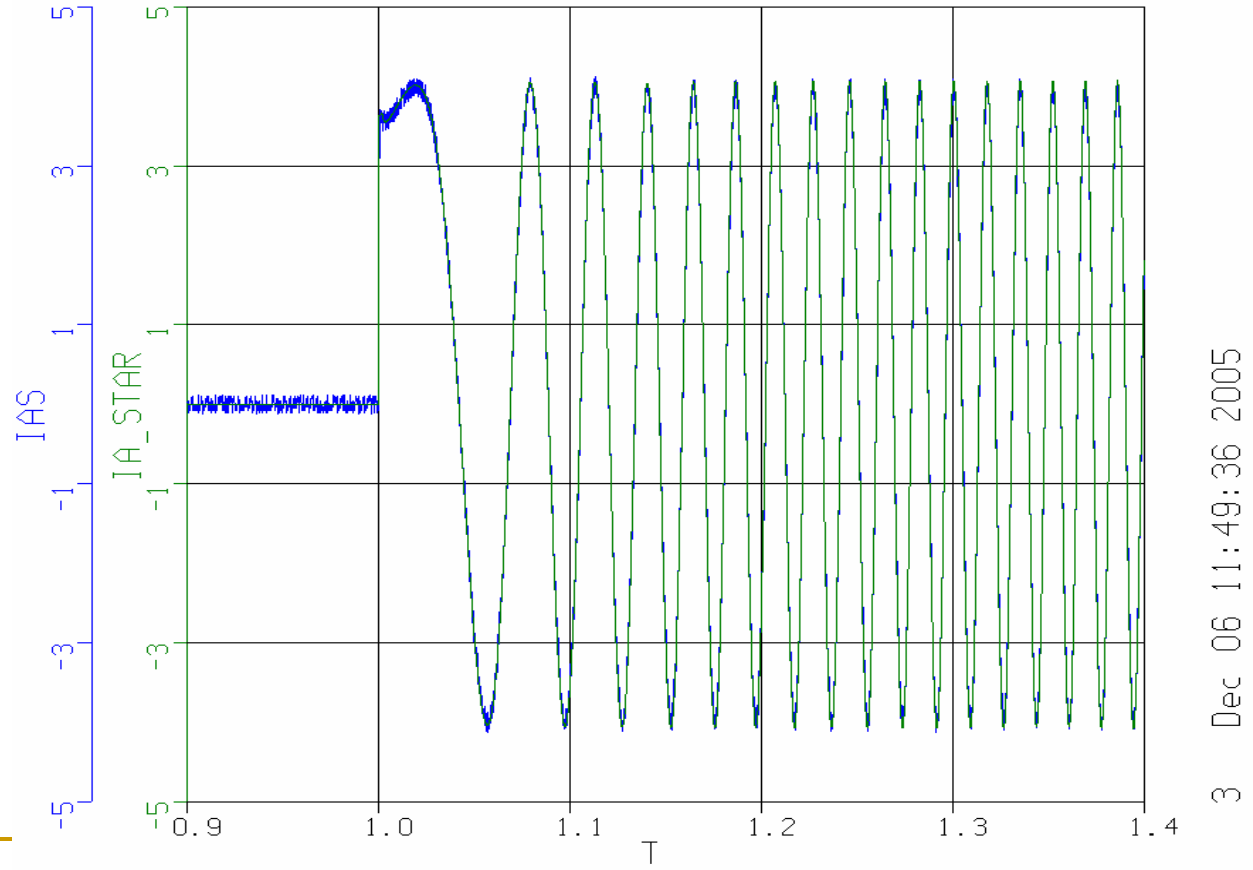
- Base Results (cont.)
  - Current



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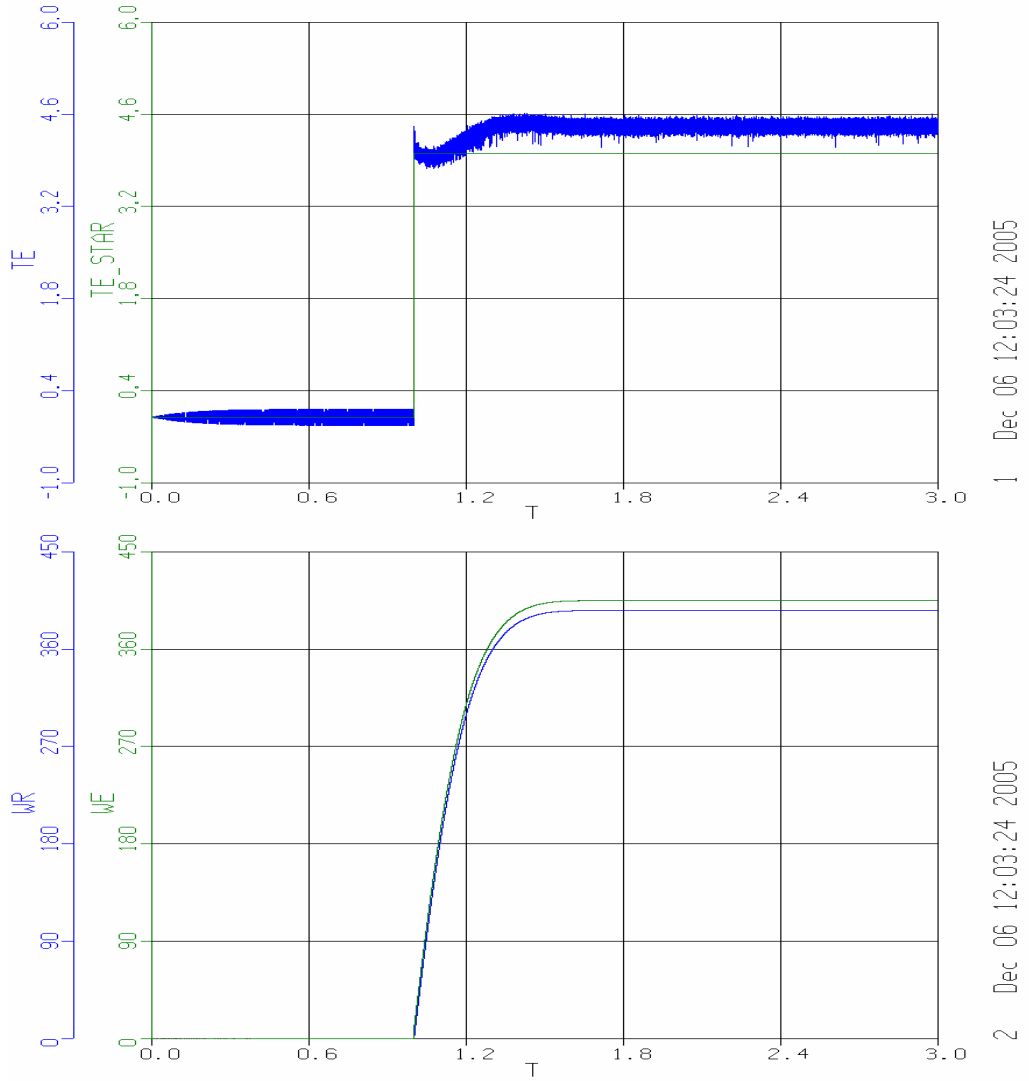
- Comparison:

  Cold Control, Hot Machine
  - Torque
    - Overproduced
    - More transient
  - Speed



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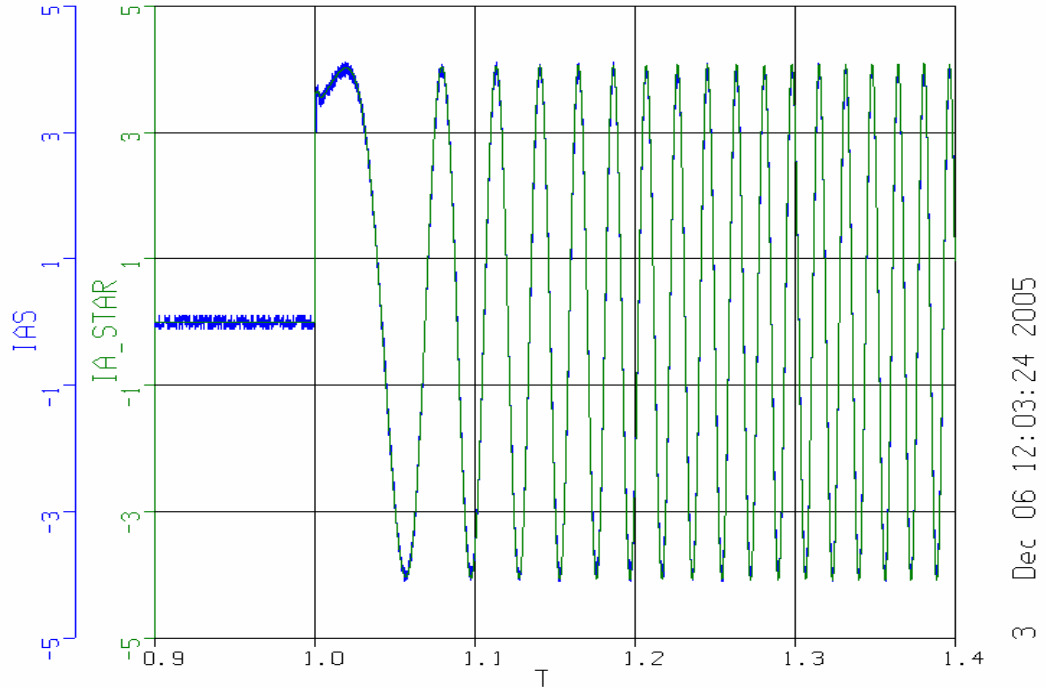
- Comparison:

  Cold Control, Hot Machine
  - Current still tracking



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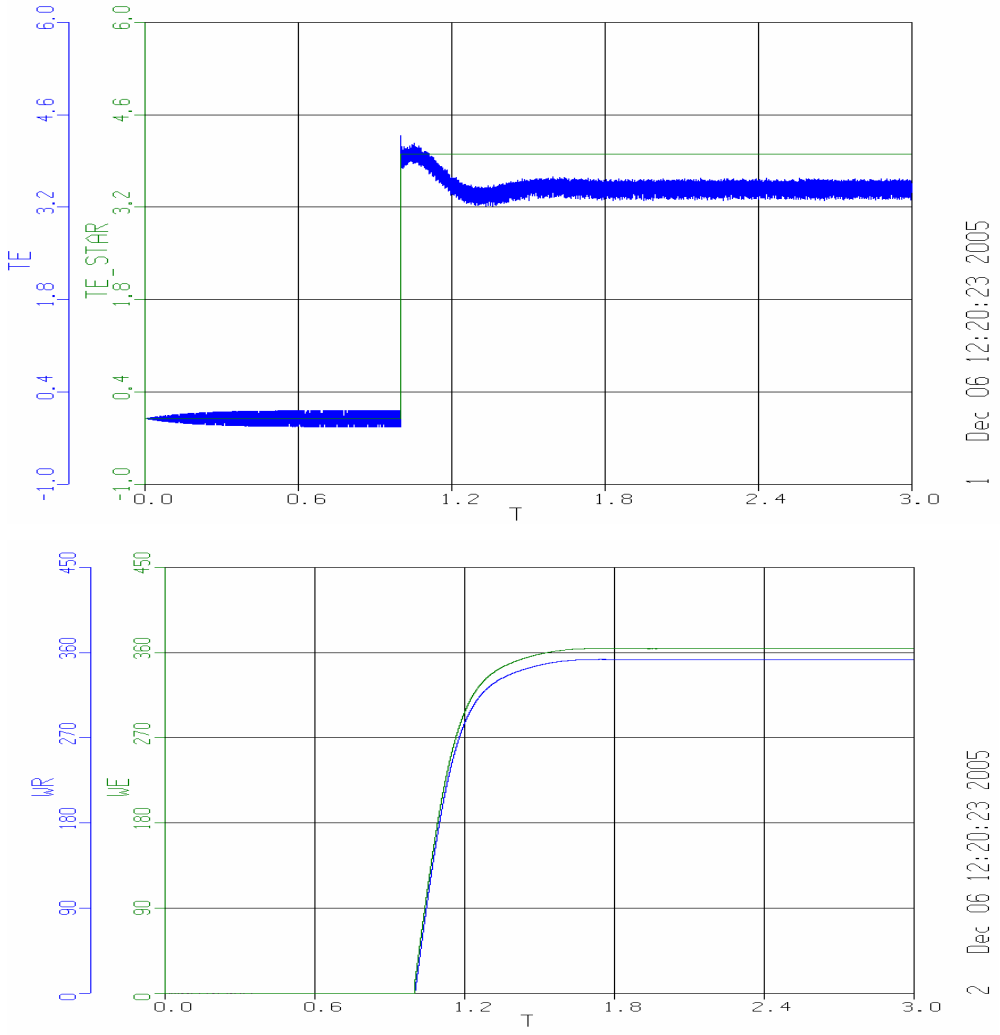
- "Start-up" Study:

  Hot control, cold machine
  - Torque
    - Under-produced
    - "Overshoots" steady state value
  - Speed
    - Greater difference

    in $\omega_r - \omega_e$



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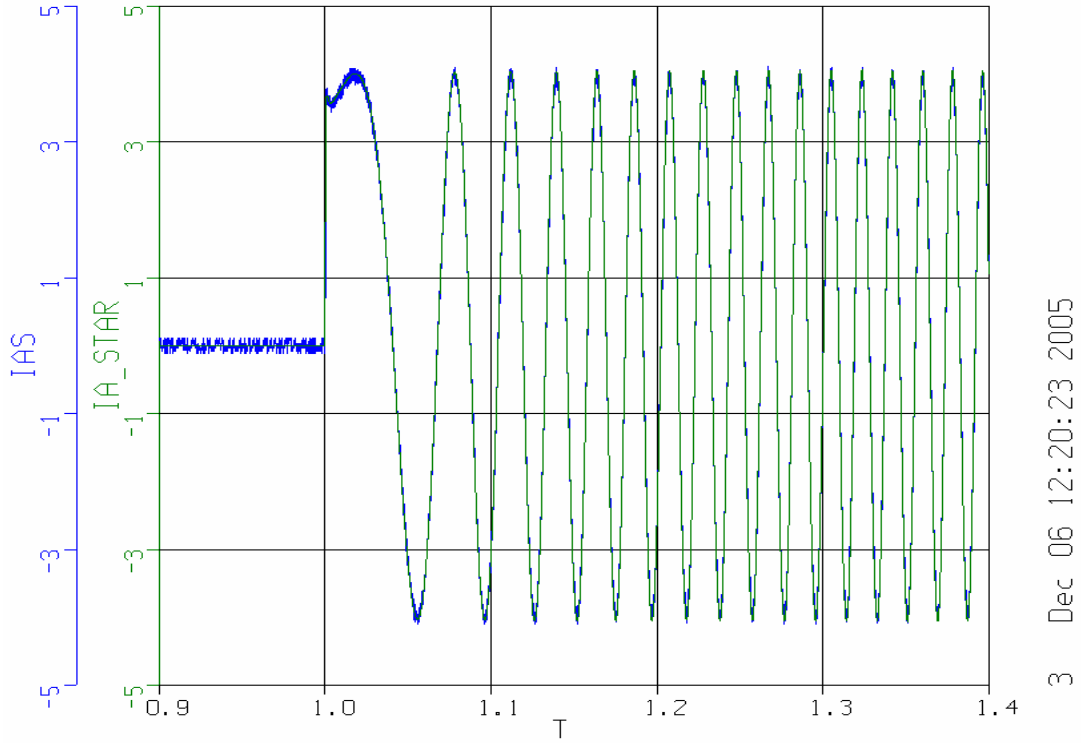
- "Start-up" Study:

  Hot control, cold machine
  - Current still tracks



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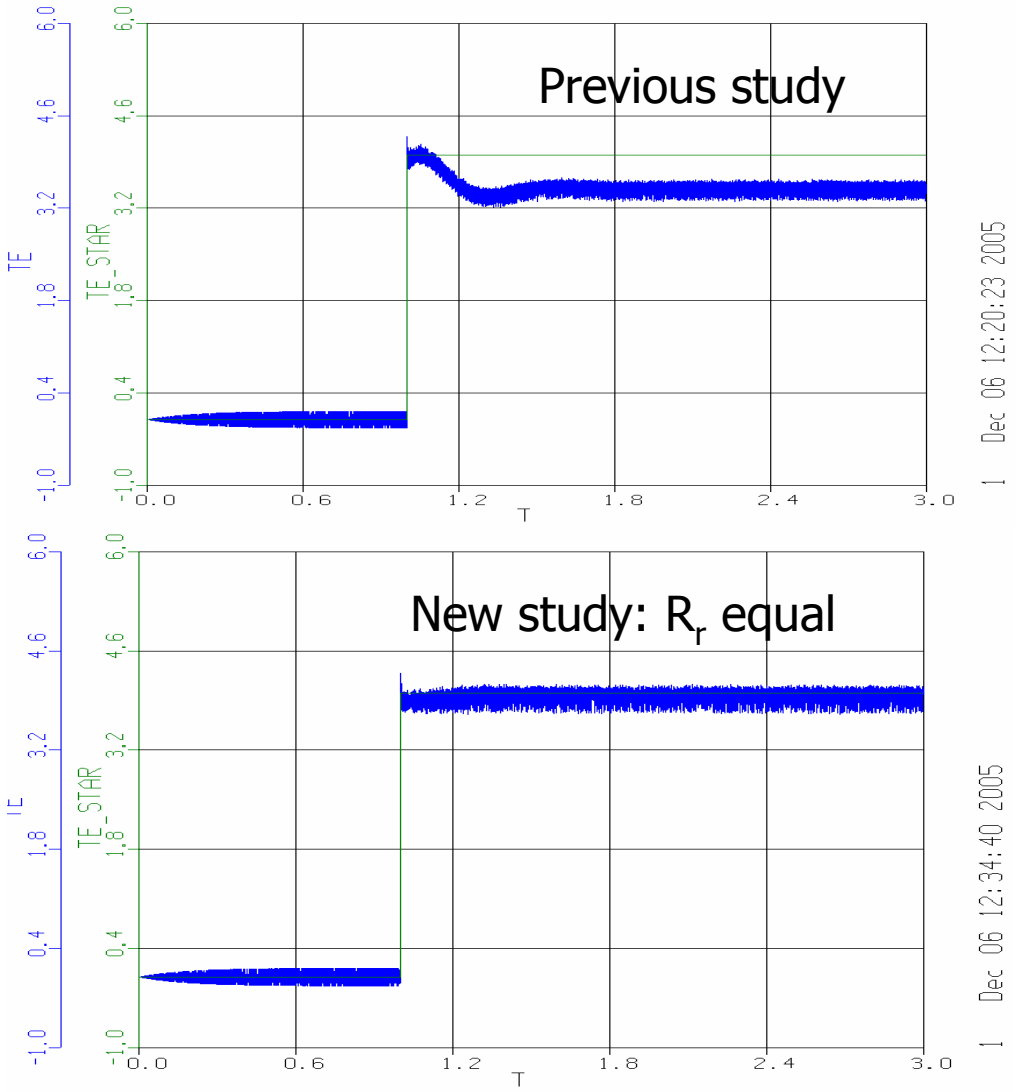
- Most Important Parameter?
  - Unmatched except for R_r
  - Torque (below) now almost tracks as good as when parameters matched



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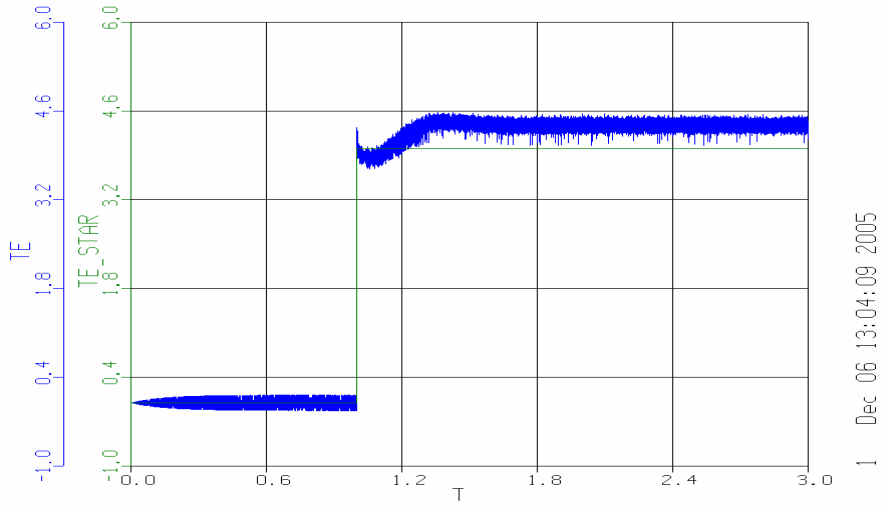
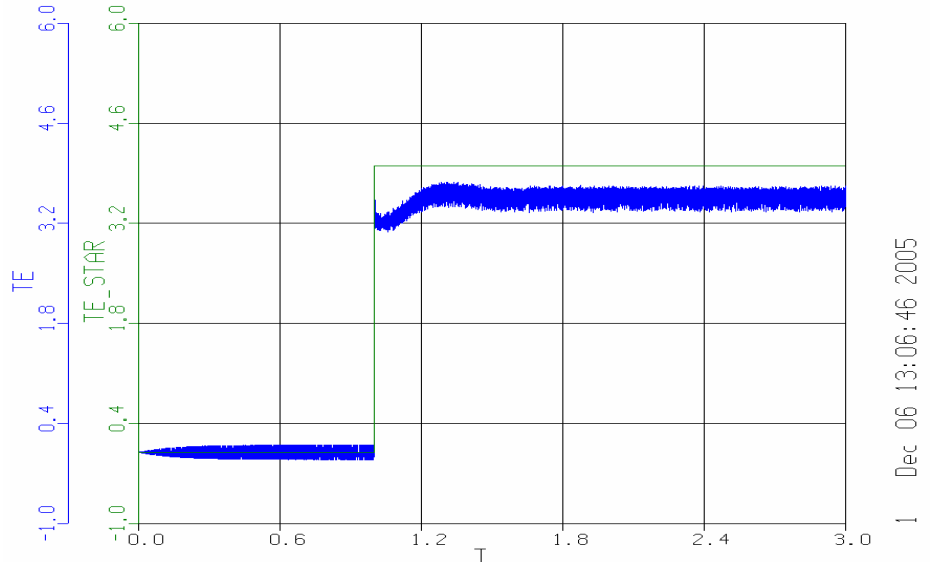
- Most Important Parameter?
  - Matched except R_r' underestimated by 20%



  - Matched except L_m overestimated by 20%



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- Conclusions
  - Heating up of the machine did cause a change in parameters
    - Could cause mismatch at start up or mismatch at steady state
  - Better IM simulation would map changes that occur in machine as it is operated
  - Possibility of active parameter estimation for better control?

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- **Conclusions**
  - If control overestimates IM parameters, torque will be under-produced
  - Inverse is true if control overestimates IM parameters
  - Heating had greatest effect on value of R_r', which had greatest effect on torque output for this case
  - However, hypothetical change in L_m had greater effect on torque output than equivalent change in R_r'

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QUESTIONS?