EE 394J: 11 - Advanced Topics in Power Electronics
Project 2: Three-phase bridge rectifier simulation

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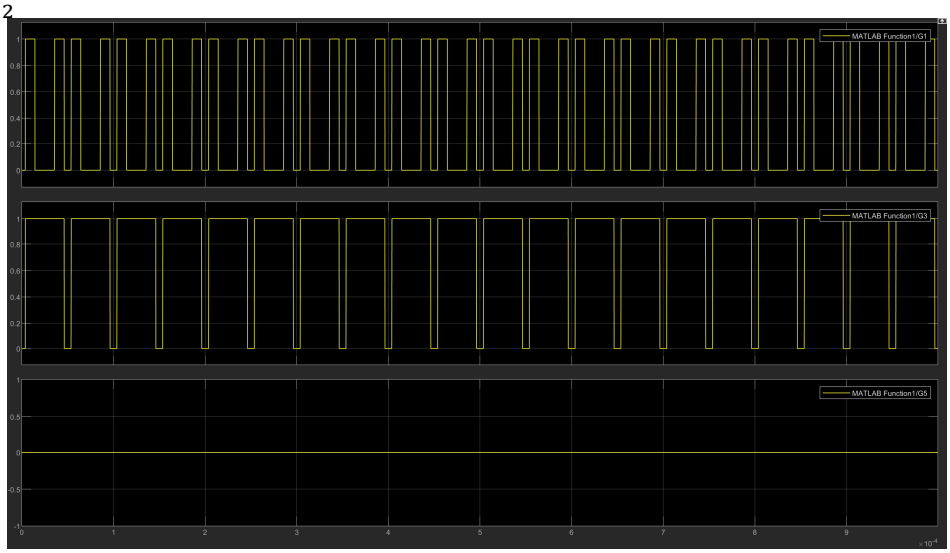
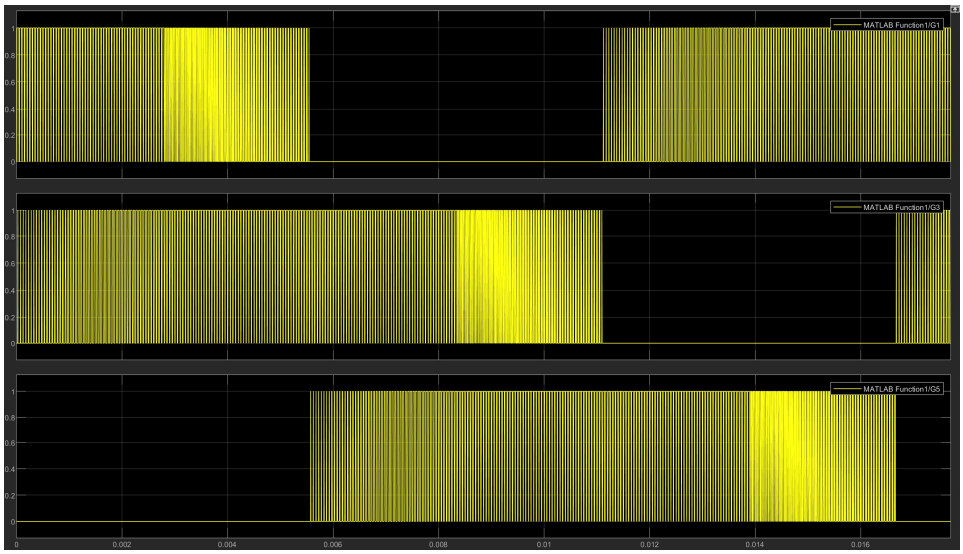
Academic Integrity Statement: Please note that it is an individual project. The design and reports represent the student's own original work. Absolutely no sharing of schematics, designs, plots and write-ups was done. If found in violation of this policy, the student will be reported to the UT Austin Office of the Dean of Students, with repercussions including placement on academic probation and grade penalties including but not limited to receiving a zero on the design project.

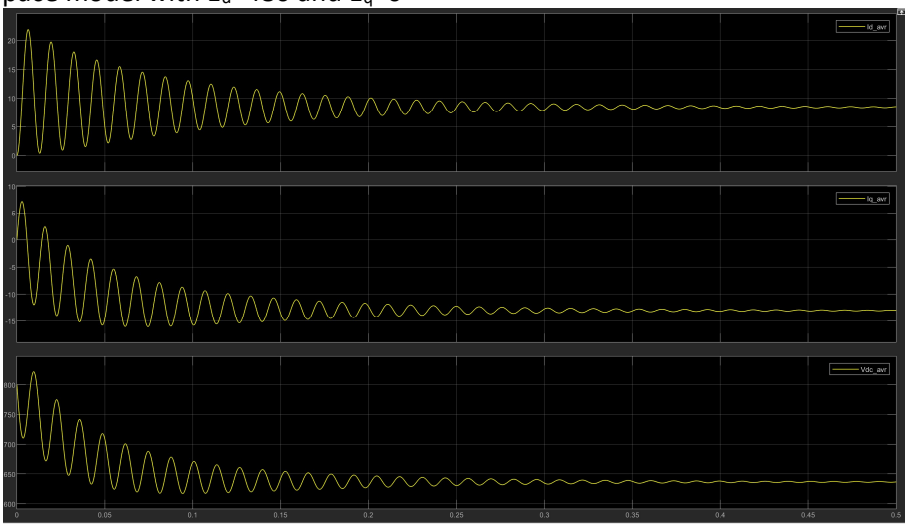
1. a. $\omega t = \frac{\pi}{2}$



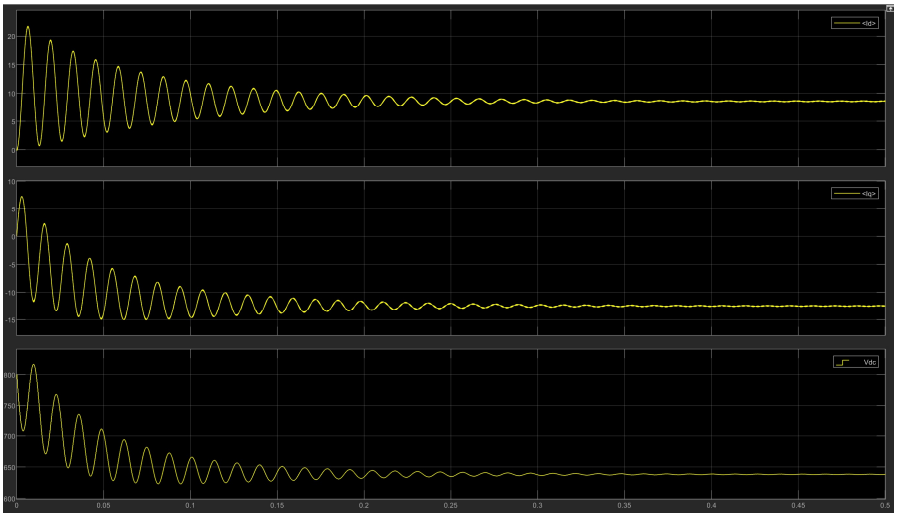
b. $0 \leq \omega t \leq 2\pi$



2. d-q state space model with E_d=480 and E_q=0

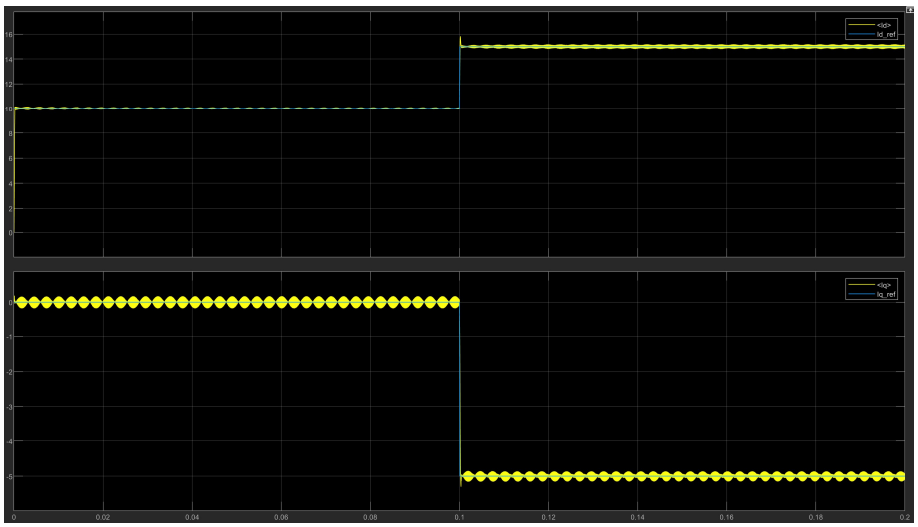


Switch model:

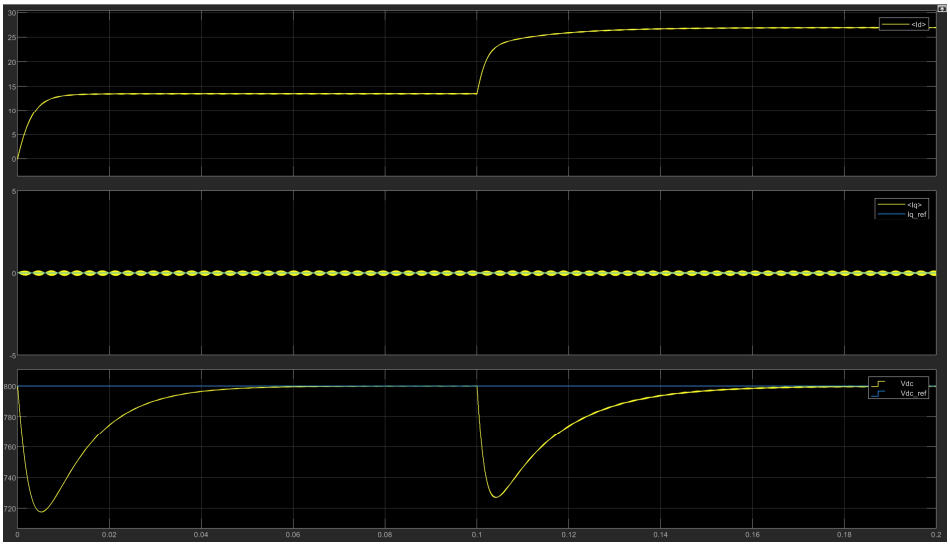


The responses of both models for all state variables (I_d, I_q and V_{dc}) are very similar in terms of dynamics and steady-state value.

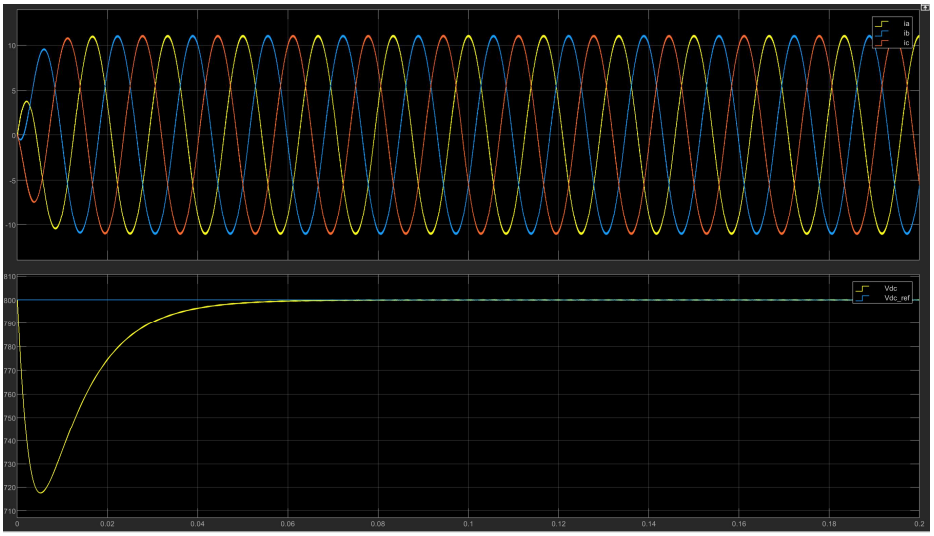
3.



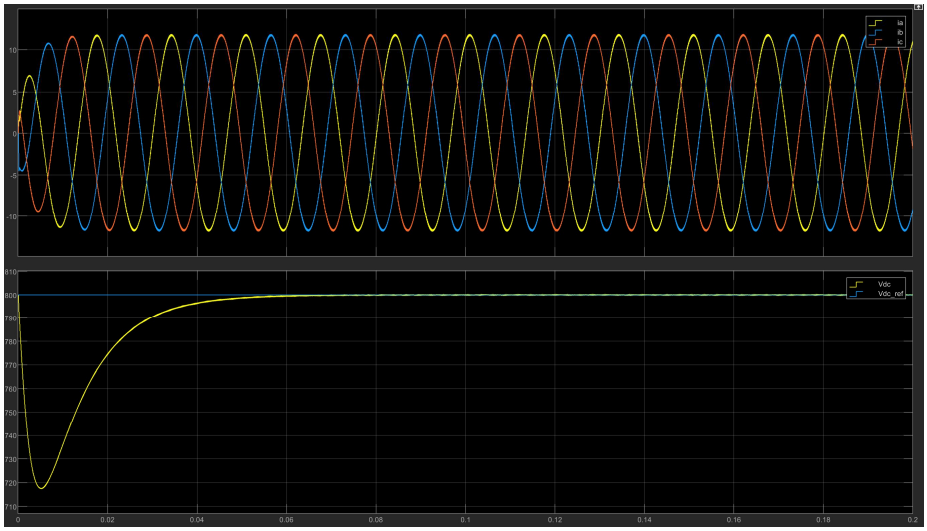
4.



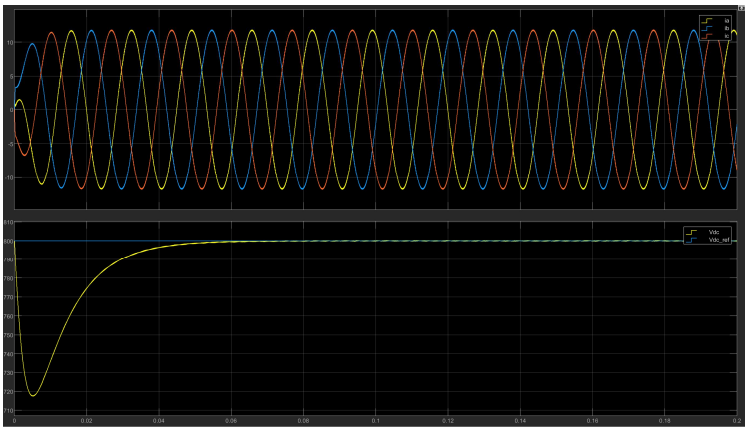
5. $I_{q,ref} = 0$



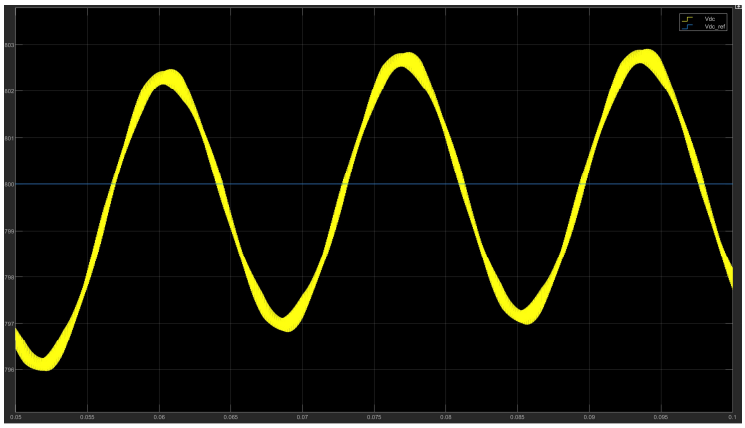
$I_{q,ref} = -5A$



$I_{q,ref} = 5A$

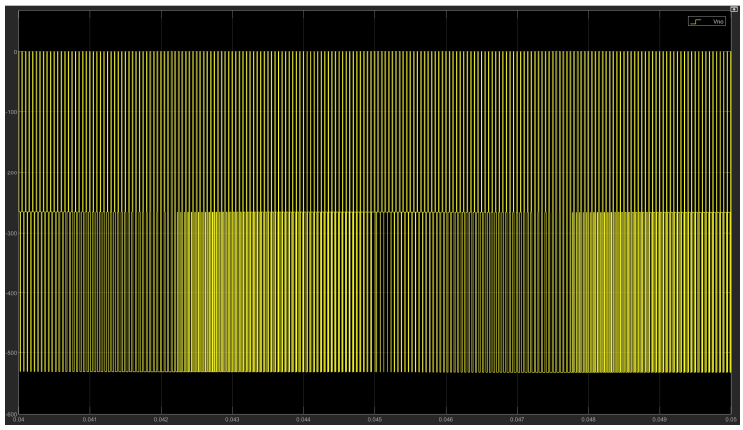


6.



The V_{dc} waveform shows a lot of oscillation because I_a, I_b and I_c do not form a balanced set of phasors now, due to the measurement offset in I_a. Thus I_d and I_q are no longer constant, and hence the controller does not have steady reference values to which it can converge.

7.



3 voltage levels are observed here: 0V, -266V and -532V. This is because the voltage at the negative node of the capacitor experiences a step change whenever any of the bottom 3 MOSFETs Q_2, Q_4 or Q_6 close, thereby connecting the 3 inductors L_a, L_b or L_c to the DC link's negative node.