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Title

EXERCISE 3: BOOST CONVERTER CONTROL DISCRETIZATION

Course Name

EE-465 Industrial Electronics I

1 INTRODUCTION

Modern power electronics control is implemented most of the time on digital processor, hence a discrete controller model is required. The discretization will be exercised on current and voltage controller developed in the previous week.

2 TASKS DESCRIPTION

1. For the discrete time control of the boost converter, assume single update PWM and a sampling time $T_s = T_{sw}$. Use the Tustin discretization method and discretize the inner control from the previous exercise. Use "Exercise_3-InnerLoop_skeleton" . Dynamic saturation block on duty cycle (Dyn. Sat. block) is given and you need to add integrator anti-windup using the back calculation method as seen in the lecture. (*Show the discretized control loop and the anti-windup implementation*)

2. Show the effect of your anti-windup by applying a current reference from 50 A to 150 A, with and without anti-windup. Using the magnitude optimum criterion may have resulted in a very small integral constant making the effect of anti-windup hard to observe. In that case, you can try making your K_i bigger (in our case we had to multiply by 1000). (If you cannot observe the effects of your anti-windup after trying a few different values of K_i, continue with the other questions).
   Change K_i back to normal for the other questions

3. Compare the response of the discrete-time controller implementation against the continuous-time one (Fig. 1). You can use the model from the previous week. To do so, do a step in $i^{\star}_{L,B}$ at $t = 0.05$ s from 100 A to 50 A (Re-use the provided references) (*Give the scope capture in PLECS of the "Measurements and comparisons" scope and give brief comparative analysis*)

4. Use the Tustin discretization method and discretize the cascaded control from the previous exercise. (*Show the discretized control loop*). Use "Exercise_3-CascadeLoop_skeleton". The reference filter can be discretized using other methods (forward Euler is probably the simplest).

5. Compare the response of the discrete-time controller implementation against the continuous-time one (Fig. 1). Re-use the provided steps of references. (*Give the scope capture in PLECS of the "Measurements and comparisons" scope and give brief comparative analysis*)

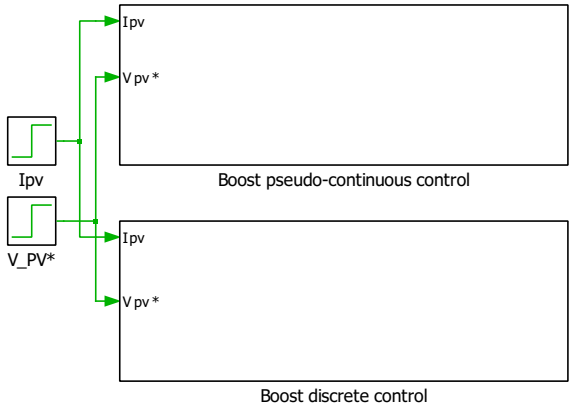

Fig. 1 Model for comparing the continuous-time cascaded Boost control with the discrete-time one.