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Title <b>EXERCISE 3: BOOST CONVERTER CONTROL DISCRETIZATION</b>
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  $I_{L,B}^*$  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)

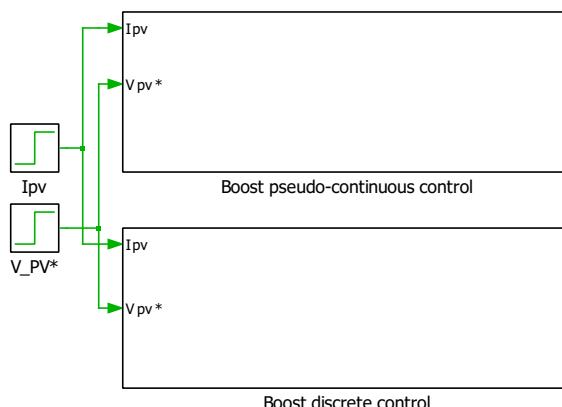


Fig. 1 Model for comparing the continuous-time cascaded Boost control with the discrete-time one.