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Title

EXERCISE 11: *LCL* FILTER, ACTIVE DAMPING

Course Name

EE-465 Industrial Electronics I

1 INTRODUCTION

Depending on filter design, the resonance at $\omega_{res} = 1/\sqrt{L_{eq}C_f}$ might be excited. This is especially true for high power converters with relatively small passive elements in opposition to low power converters, like the one used in the frame of these exercises, where the filter parameters such that *LCL* filter resonances are not easily self maintainable nor critical.
The system parameters are summarized in Table 1.

V_{DC}	750 V	f_g	50 Hz	$f_{sw,I}$	10 kHz
$L_c = L_g$	5 mH	$R_c = R_g$	10 mΩ	C_f	2 µF

Table 1 System parameters.

2 TASKS DESCRIPTION

1. Download the skeleton model on Moodle. Import your PLL and grid current control from previous exercises. Verify that it still works. The response of your controller will most likely be less stable than before, as it is now acting on an LCL filter instead of an RL filter.

2. One option to damp this system is passive damping by addition of resistors in series with the filter capacitors. Implement this solution for an optimal resistive damping. How should the damping resistance R_d be chosen?

3. Now, set $R_d = 0$ and implement the active damping method based on the virtual resistor concept. What should be the K_{ad} gain? Assume that capacitor current sensors are present. In the report, show a capture of your implementation and briefly explain the concept of this damping method.

4. Current sensors are usually more expensive than voltage sensors. How should your active damping implementation be modified in order to remove the need for capacitor current sensors and use a voltage measurement instead ? Implement this solution (you will probably need to approach it as in a discrete time control system). In the report, show a capture of your implementation, and describe how it was adapted from the previous one.

5. In conclusion, briefly compare the without damping, with passive damping and the two variations of active damping. Discuss the advantages and disadvantages of passive and active damping. Support the discussion by showing simulation results for all these cases.

6. Are the P and Q power reference met ? If not, explain why.