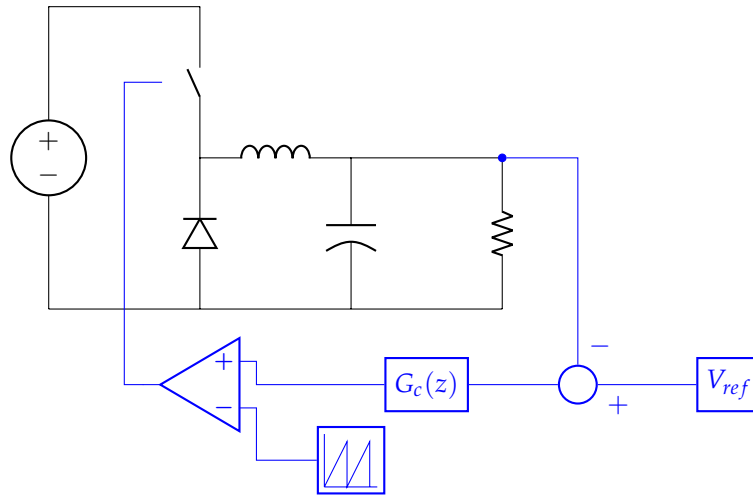


DIGITAL CONTROL OF POWER ELECTRONICS

Digital Voltage Mode Control of Buck Converter



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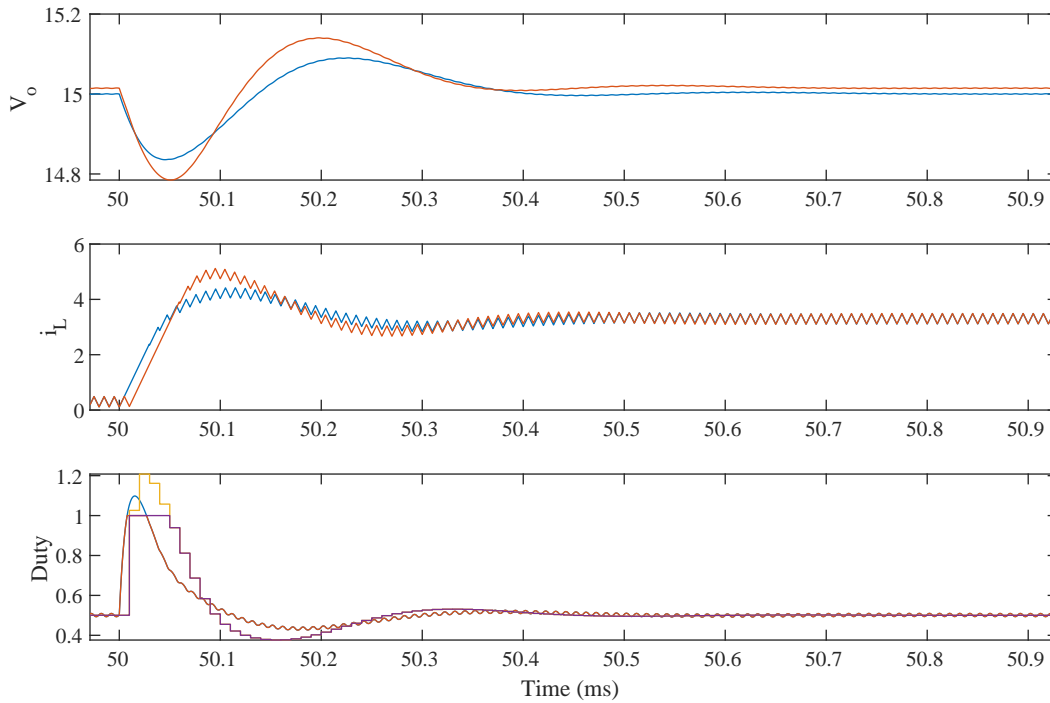
1 clear
2
3 s=tf('s')
4 opts = bodeoptions('cstprefs');
5 opts.FreqUnits = 'Hz';
6 Vin = 30
7 L = 200e-6
8 C = 400e-6
9 r = 0.1
10 R = 5
11
12 Gps = Vin/(L*C) * (1+s*C*r) / (s^2 + s*(r/L + 1/(R*C)) + 1/(L *C) )
13
14 fc = 5e3
15 pm = 60
16 kfb = 1
17 Gpwm = 1
18
19 [gain phase] = bode(Gps,2*pi*fc)
20 phiboost = -90 + pm - phase
21 kboost = tand(45 + phiboost/4)
22 gaincontroller = 1 / (kfb * Gpwm * gain)
23 fz = fc/kboost
24 fp = fc*kboost
25 kc = gaincontroller * 2*pi*fz/kboost
26 wz = 2*pi*fz
27 wp = 2*pi*fp
28 Gc = kc/s * (1+s/(2*pi*fz))^2 / ((1+s/(2*pi*fp))^2);
29
30 Ts = 1/100e3
31 Z = tf('z',Ts)
32 gc_dig_backward = minreal(kc/((Z-1)/(Z*Ts)) * (1+((Z-1)/(Z*Ts))/(2*pi*fz))
    ^2 / ((1+((Z-1)/(Z*Ts))/(2*pi*fp))^2))

```

```
gc_dig_tustin = c2d(Gc,Ts,'tustin')
```

Using a backwards euler transformation, the digital controller is shown below. Shown below is the output voltage, inductor current, and duty cycle in response to a jump from 10% load to 100% load.

$$G_c(z) = \frac{1.321z^3 - 2.36z^2 + 1.054z}{z^3 - 2.096z^2 + 1.396z - 0.3001} \quad (1)$$



$$G_c(z) = \frac{0.9882z^3 - 0.7652z^2 - 0.9756z + 0.7778}{z^3 - 1.831z^2 + 1.004z - 0.1728} \quad (2)$$

