NPTEL ONLINE CERTIFICATION COURSES

DIGITAL CONTROL IN SMPCs AND FPGA-BASED PROTOTYPING

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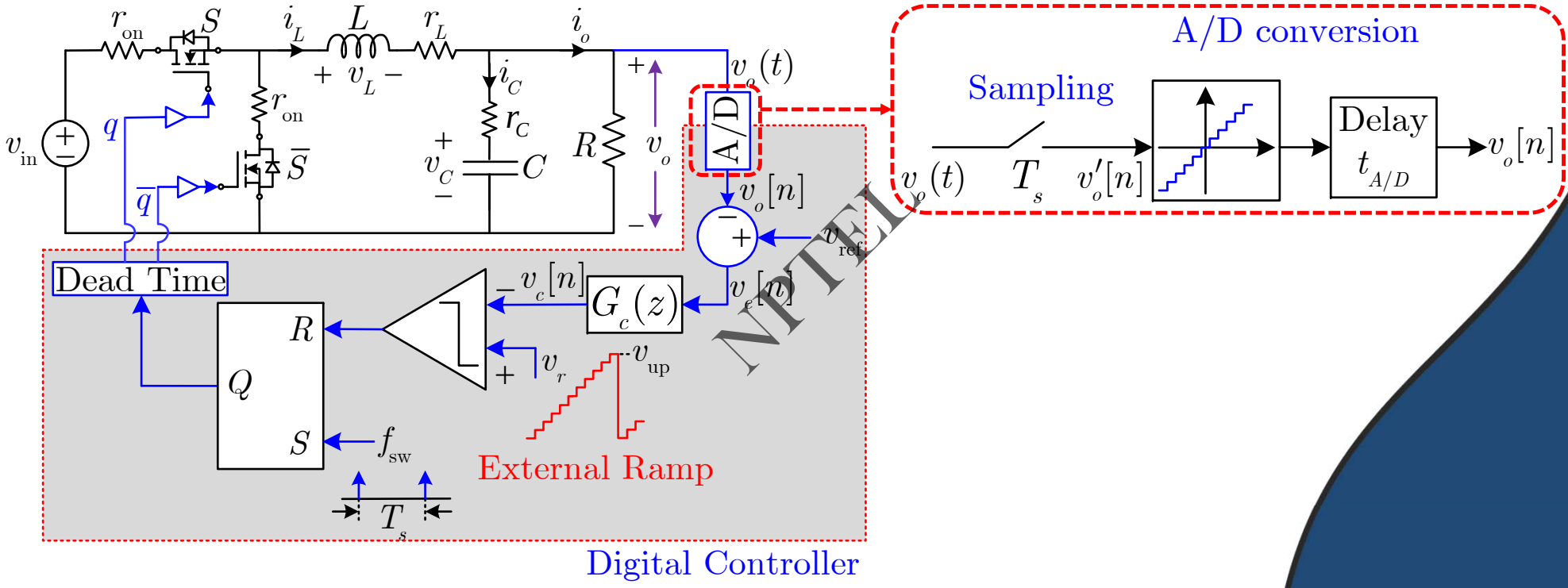
Module 03: MATLAB Custom Model Development under Digital Control

Lecture 22: MATLAB Model Development for Basic Digital Control Blocks

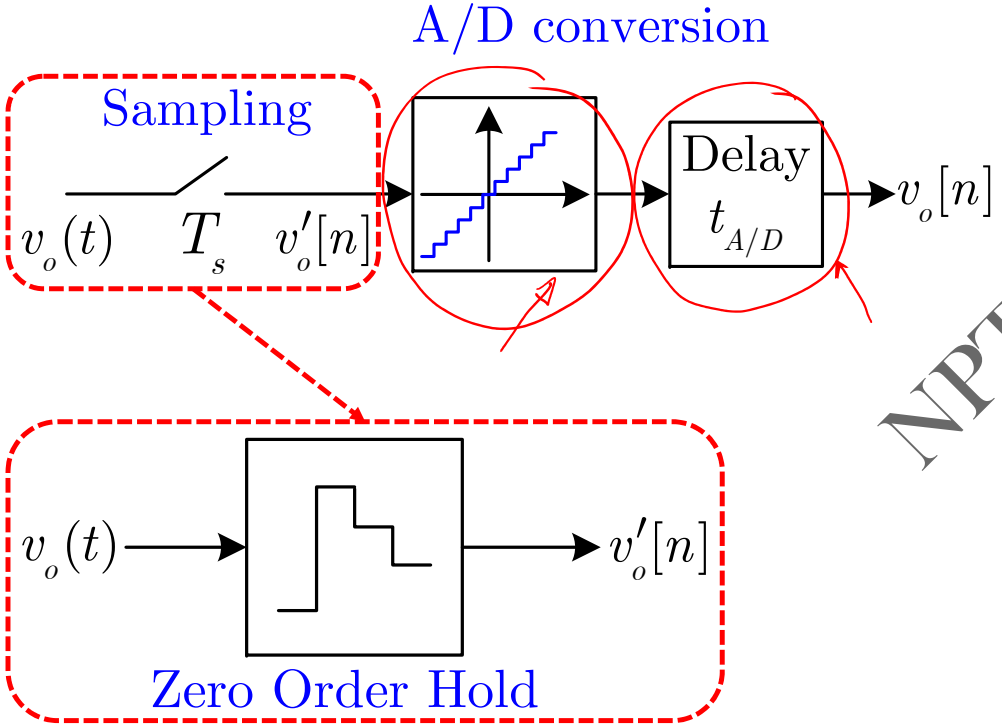
CONCEPTS COVERED

- MATLAB models for analog to digital converter
- Digital voltage mode control implementation using MATLAB
- Discrete-time PI and PID controller
- Performance comparison using analog and digital VMC

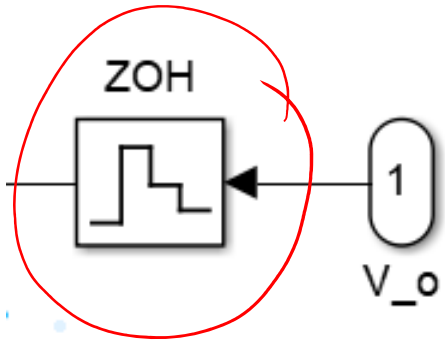
Digital Control of Buck Converter



ADC

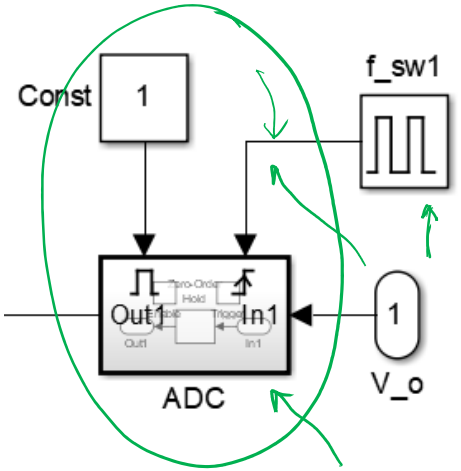


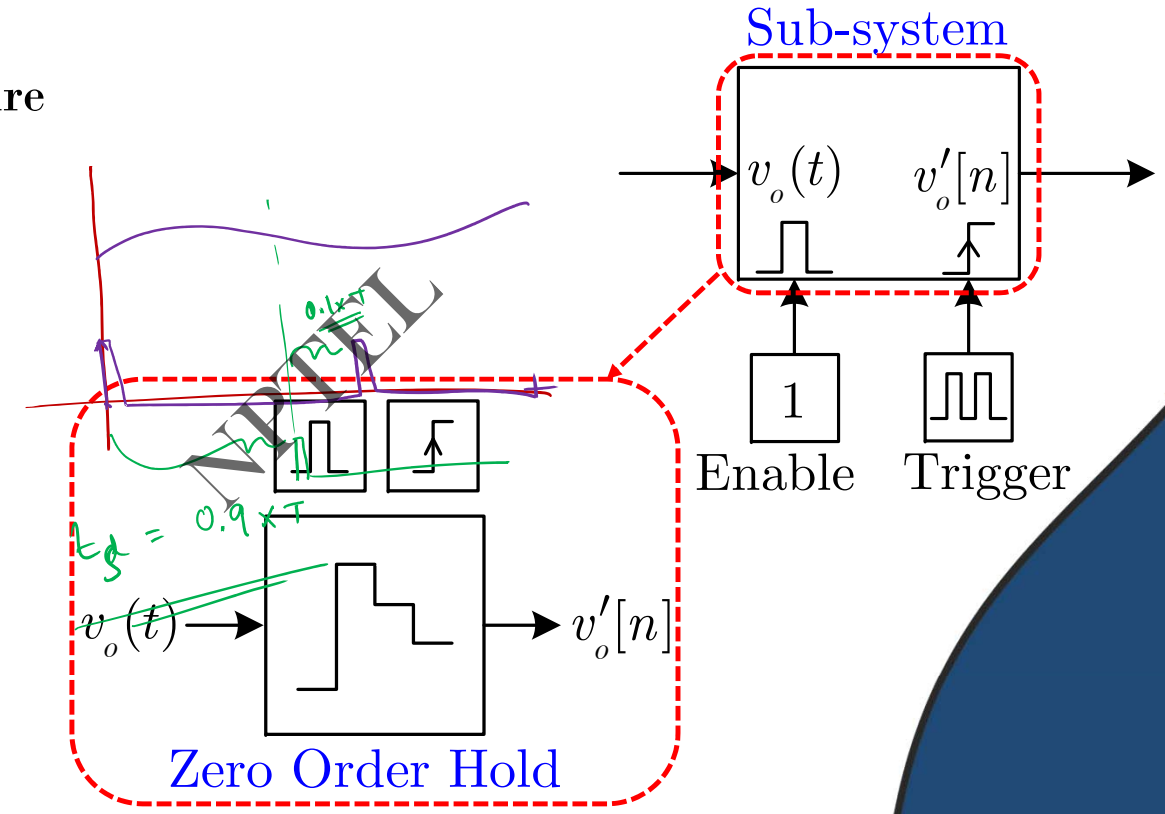
- MATLAB Implementation Figure



ADC (contd…)

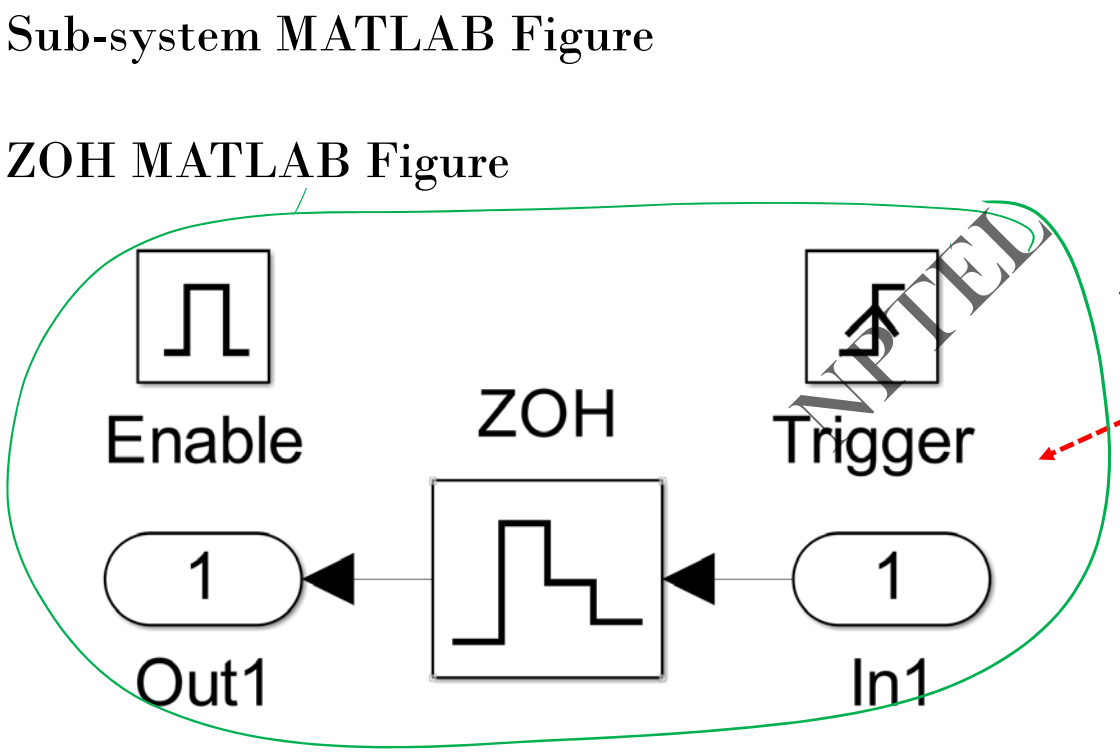
- **Sub-system MATLAB Figure**
- **ZOH MATLAB Figure**

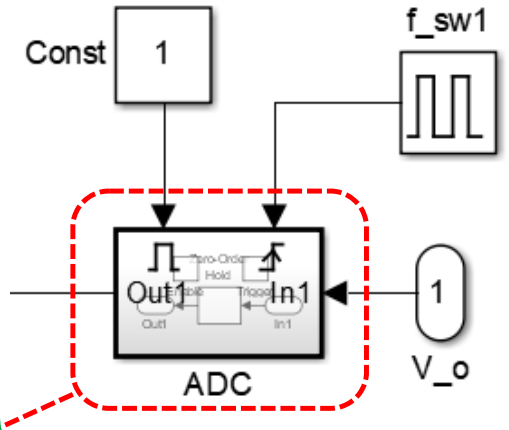




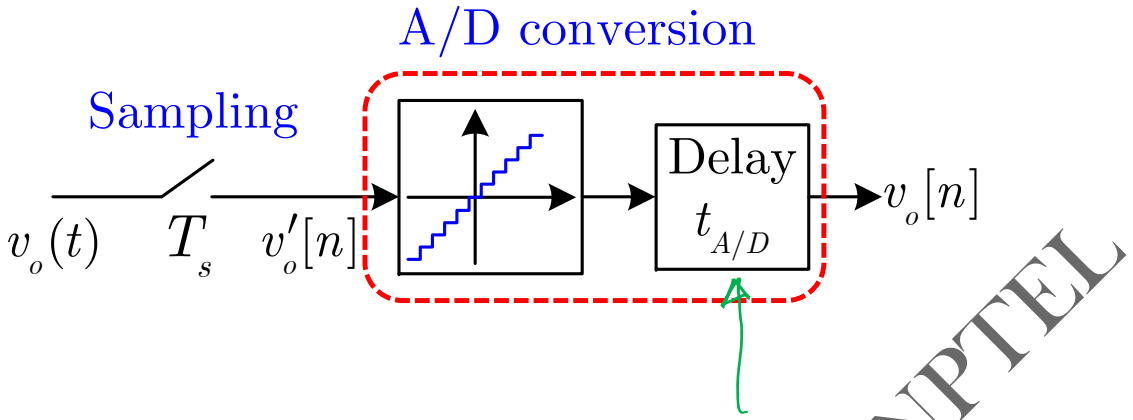
ADC (contd…)

- Sub-system MATLAB Figure
- ZOH MATLAB Figure

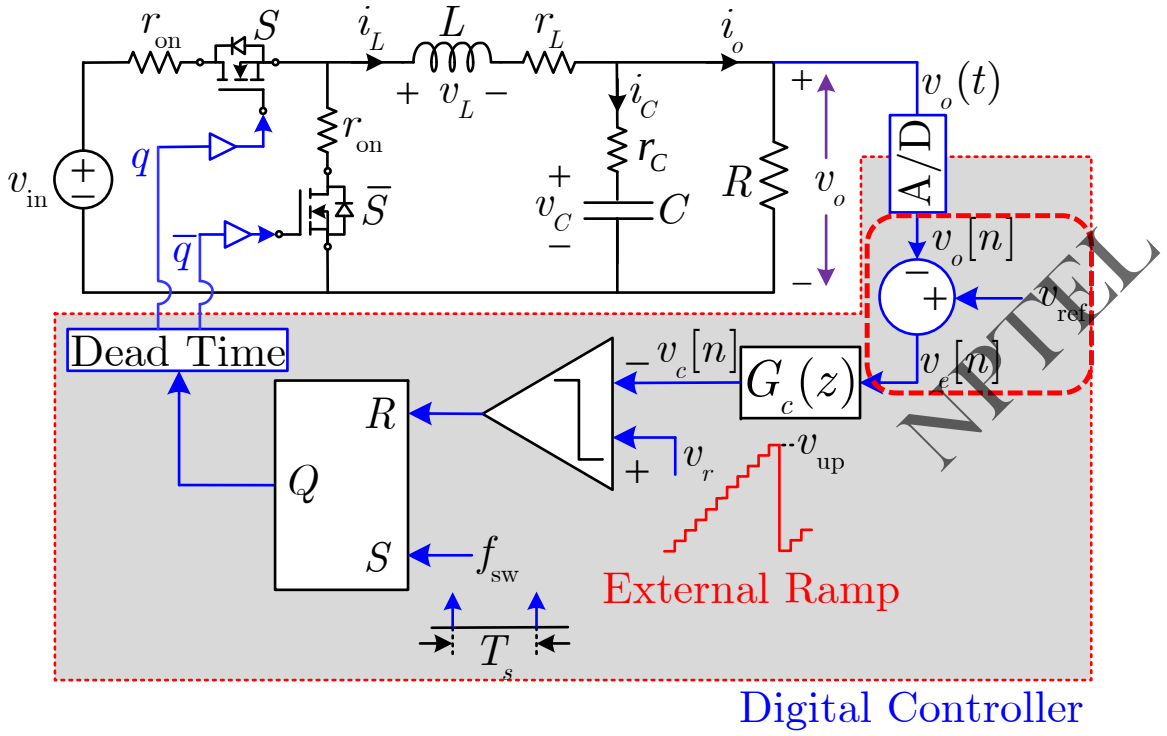




ADC (contd…)



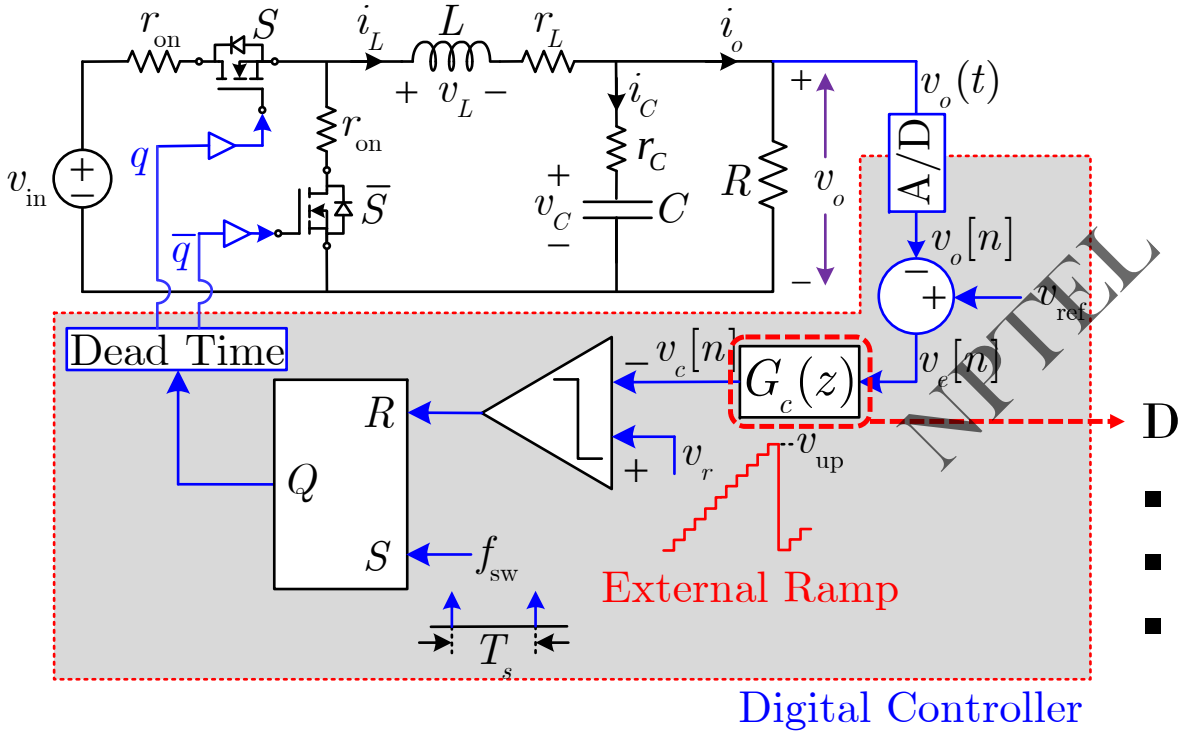
Voltage Error



- MATLAB Implementation

  Figure

Digital Compensator

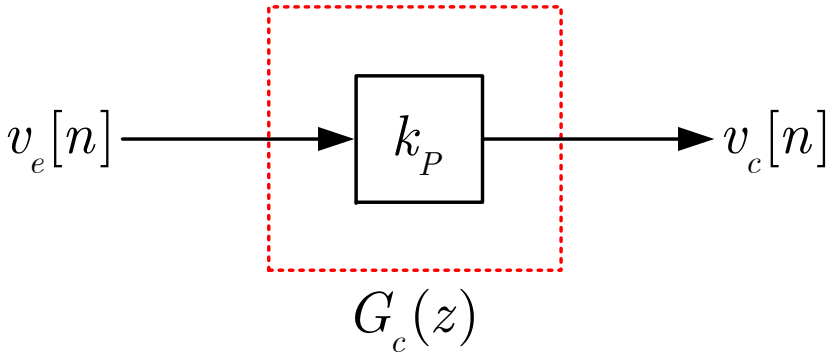


Digital Compensator $G_c(z)$

- P
- PI
- PID

Digital Compensator (contd…)

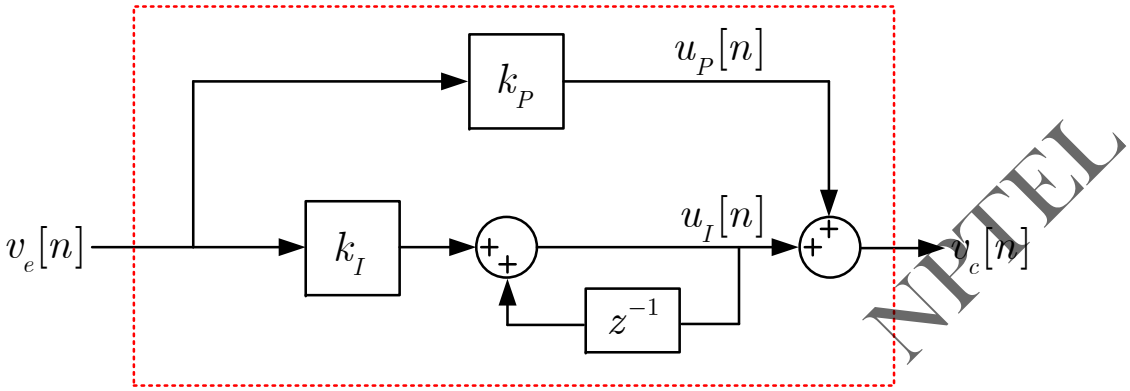
- Proportional



$$G_c(z) = k_P$$

Digital Compensator (contd…)

- Proportional-Integral



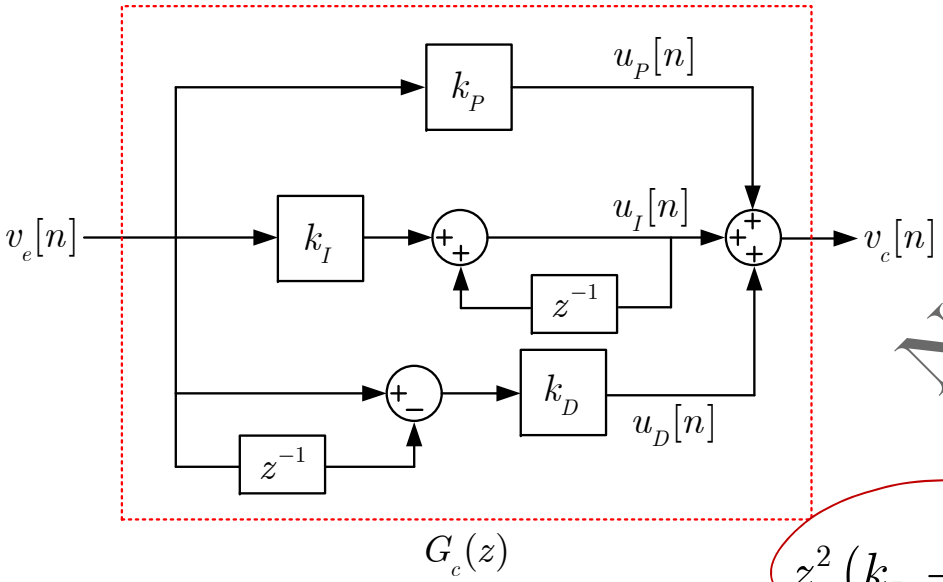
$$G_c(z) = k_P + \frac{k_I}{1 - z^{-1}}$$

- MATLAB Implementation Figure

Discrete-time PI controller

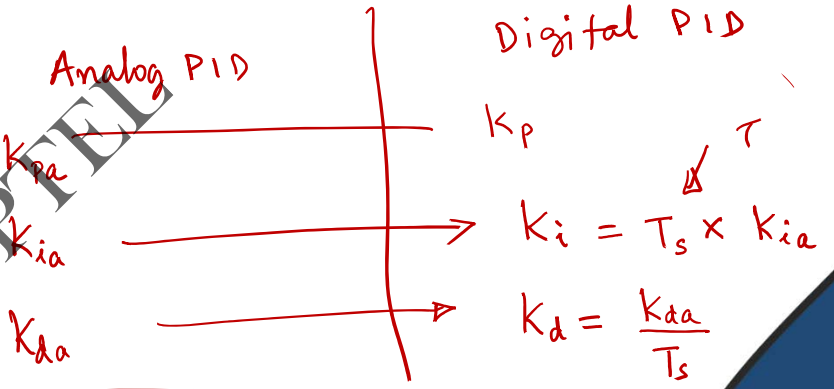
Digital Compensator (contd…)

- **Discrete-time PID controller**



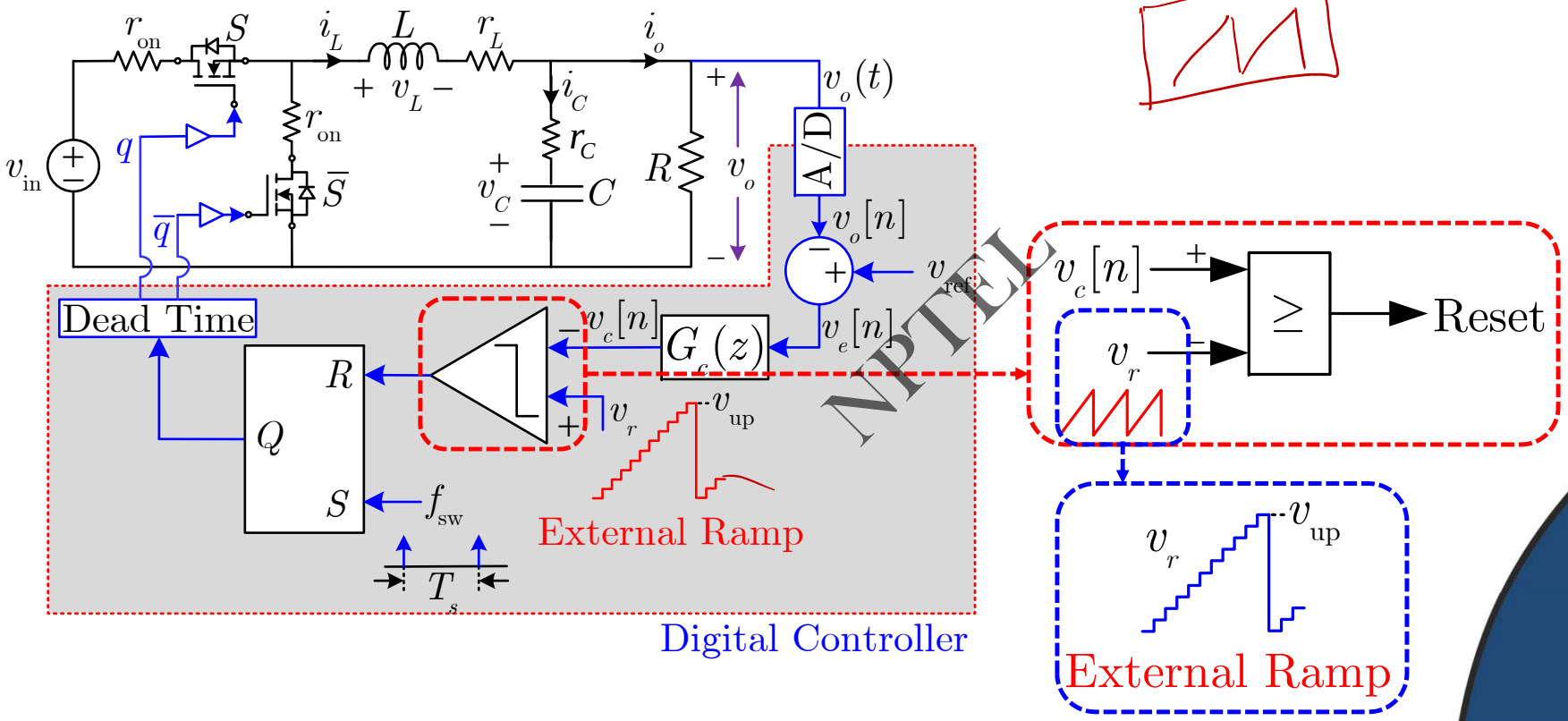
- **MATLAB Implementation Figure**

$$G_c(z) = k_P + \frac{k_I}{1 - z^{-1}} + k_D\left(1 - z^{-1}\right)$$



$$G_c(z) = \frac{z^2\left(k_P + k_I + k_D\right) - z\left(2k_D + k_p\right) + k_D}{z(z-1)}$$

Comparator



CONCLUSION

- MATLAB models for analog to digital converter
- Digital voltage mode control implementation using MATLAB
- Discrete-time PI and PID controller
- Performance comparison using analog and digital VMC

THANK YOU !