NPTEL ONLINE CERTIFICATION COURSES

DIGITAL CONTROL IN SMPCs AND FPGA-BASED PROTOTYPING

Dr. Santanu Kapat
Electrical Engineering Department, IIT KHARAGPUR

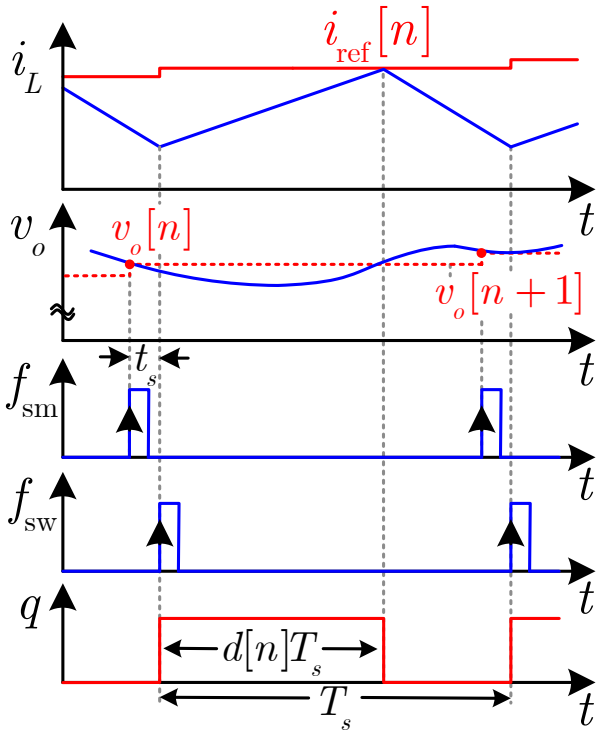
Module 02: Fixed and Variable Frequency Digital Control Architectures

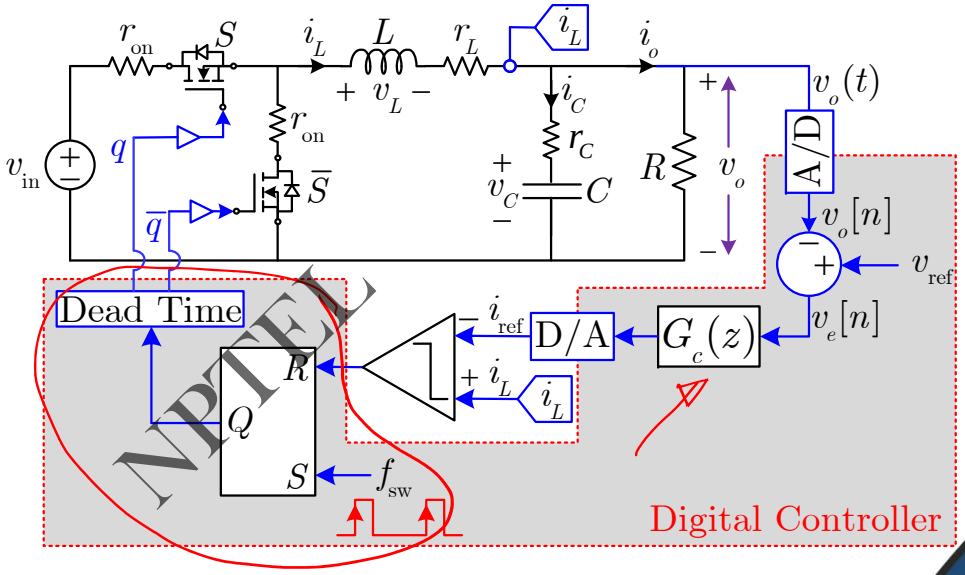
Lecture 17: Constant On/Off- Time Mixed-Signal Current Mode Control Architectures

CONCEPTS COVERED

- Steady-state operation under mixed-signal constant off-time CMC
- Complete architecture of mixed-signal constant off-time peak CMC
- Complete architecture of mixed-signal constant on-time valley CMC
- Applications of mixed-signal constant on/off-time CMC

Mixed-Signal Peak CMC Architecture : Recall

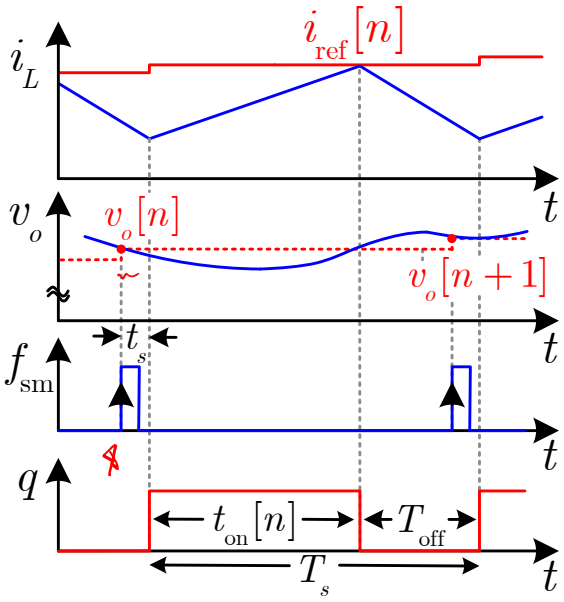


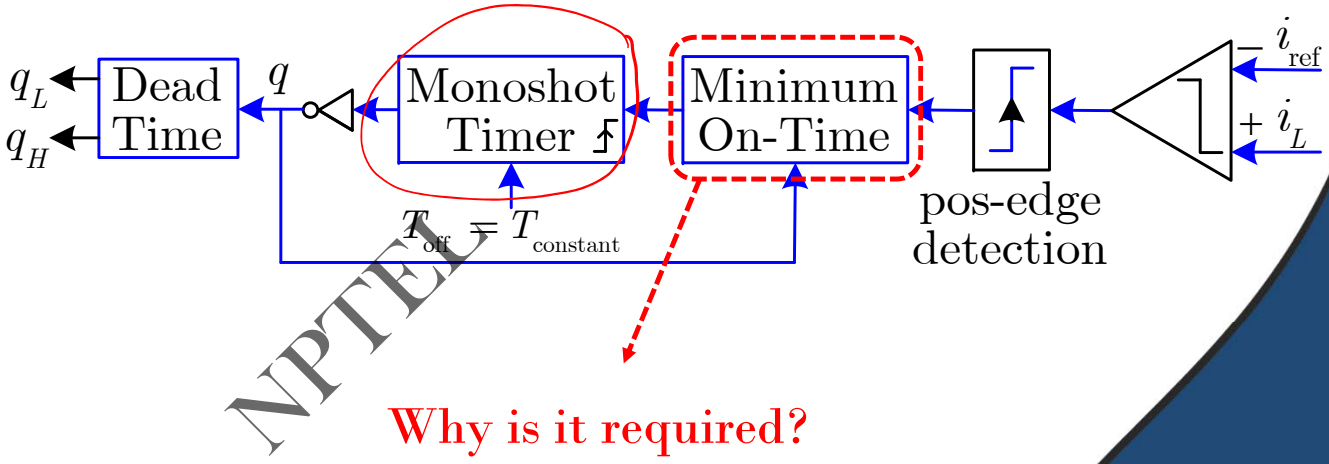


- Structurally different sub-harmonic instability with duty ratio saturations

S. Kapat , "Fixed and Variable Frequency Digital Current Mode Control: Structural Stability …", *IEEE APEC* , 2021

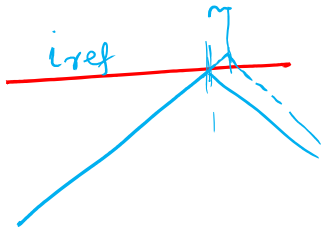
Mixed-Signal Constant Off-time CMC : Basics (contd…)

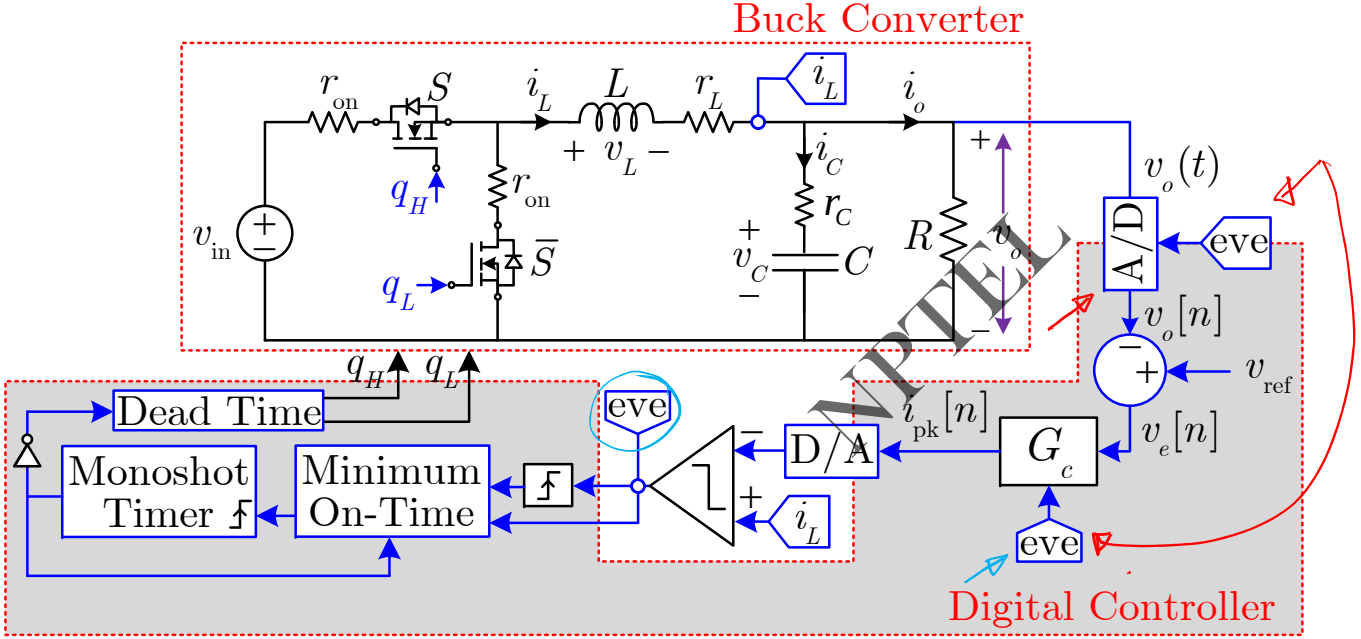




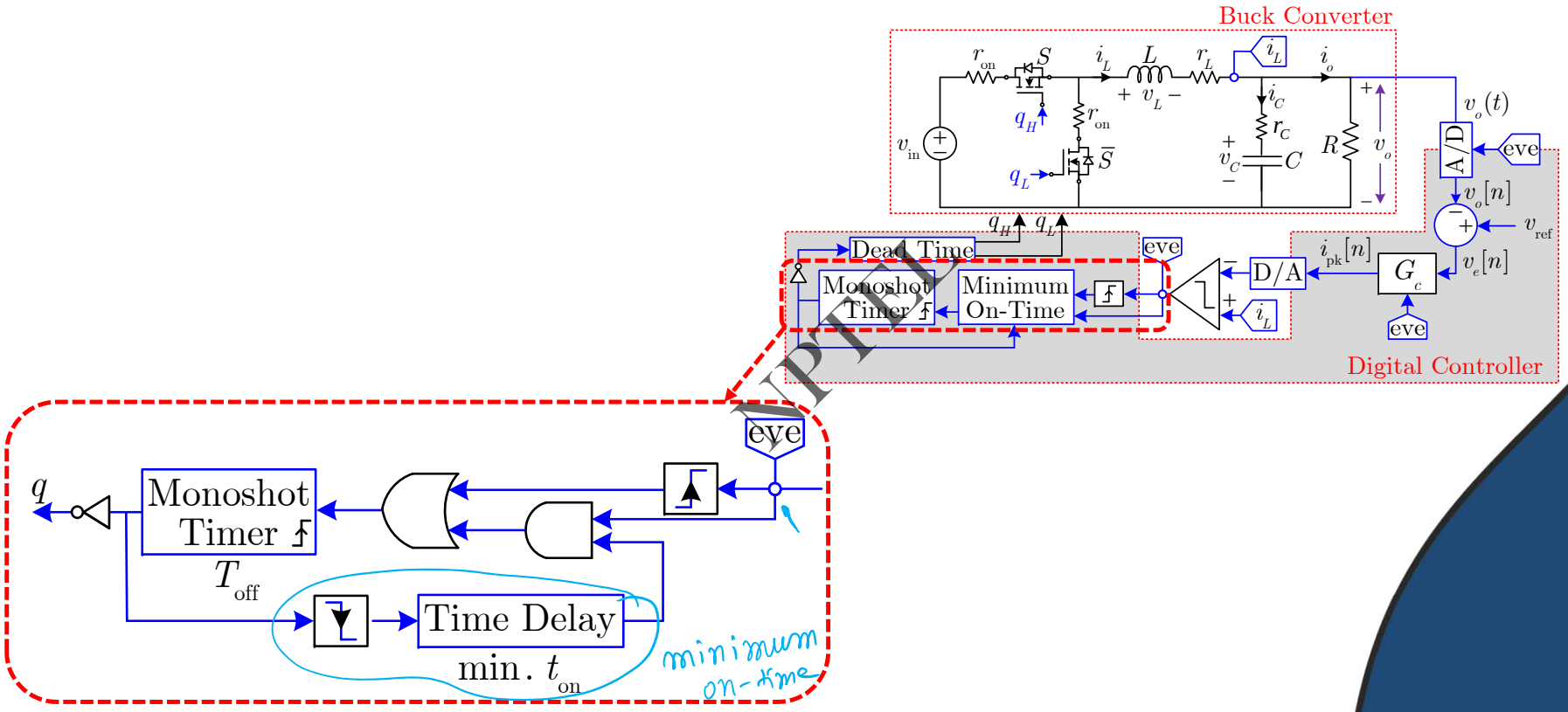
[For details, refer to Lecture~20, NPTEL "Control and Tuning Methods …" course (Link)

Mixed-Signal Constant Off-time CMC | *Event based sampling*

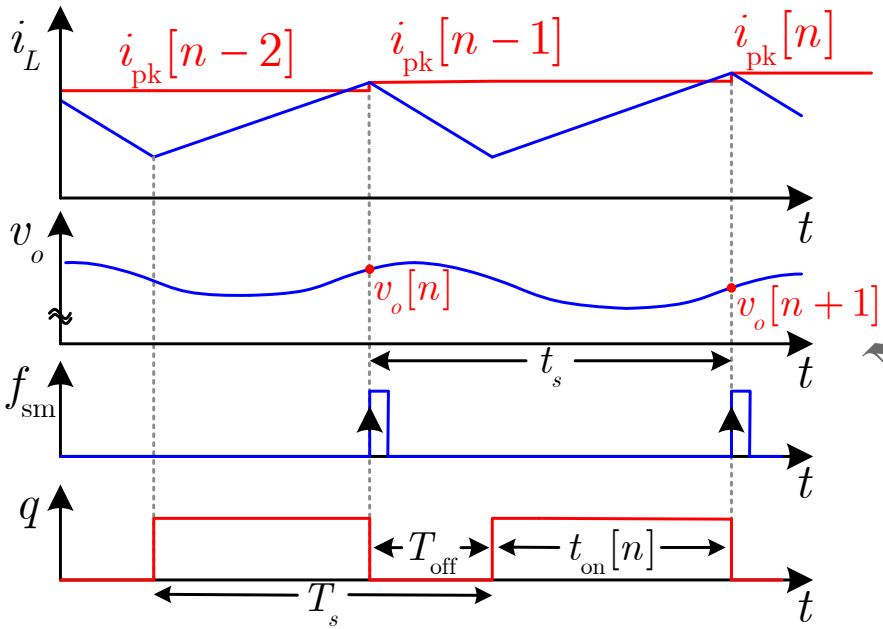




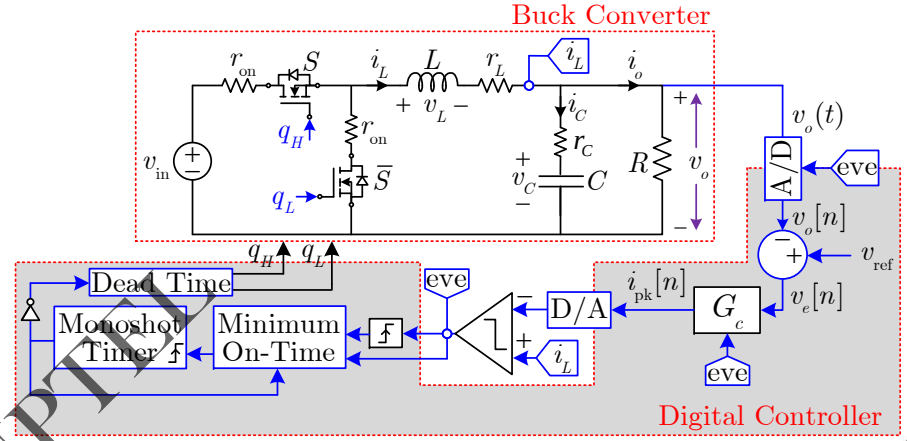
Mixed-Signal Constant Off-time CMC | *Event based sampling* (*contd…*)



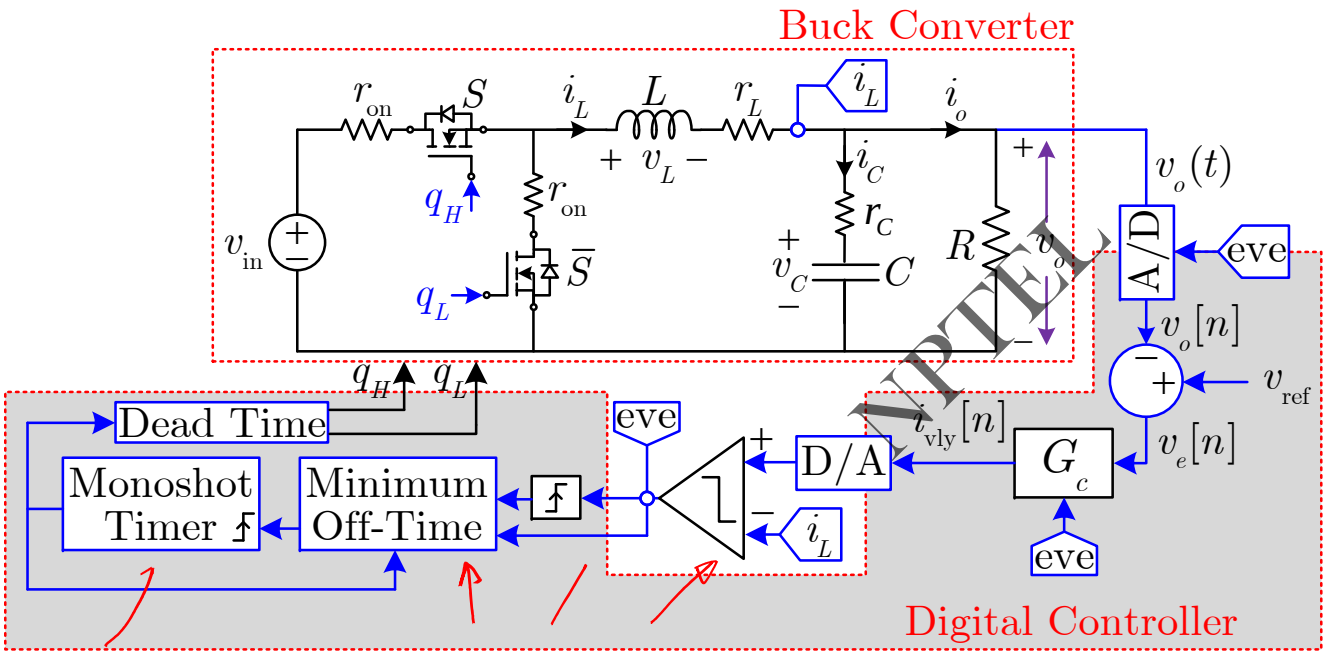
Mixed-Signal Constant Off-time CMC | Event based sampling (contd…)

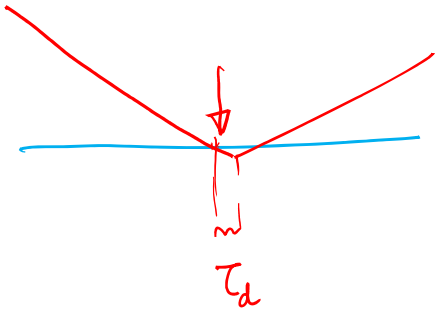


Interval 1 sampling : one cycle delay

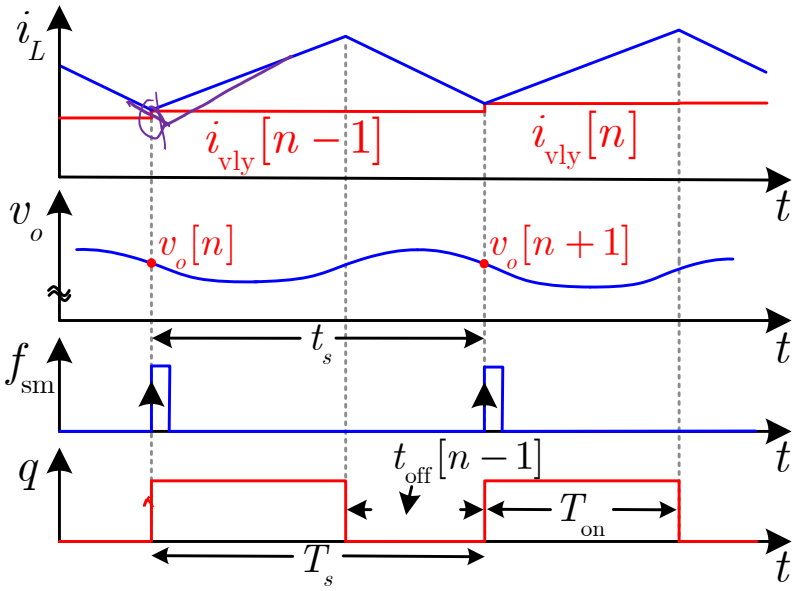


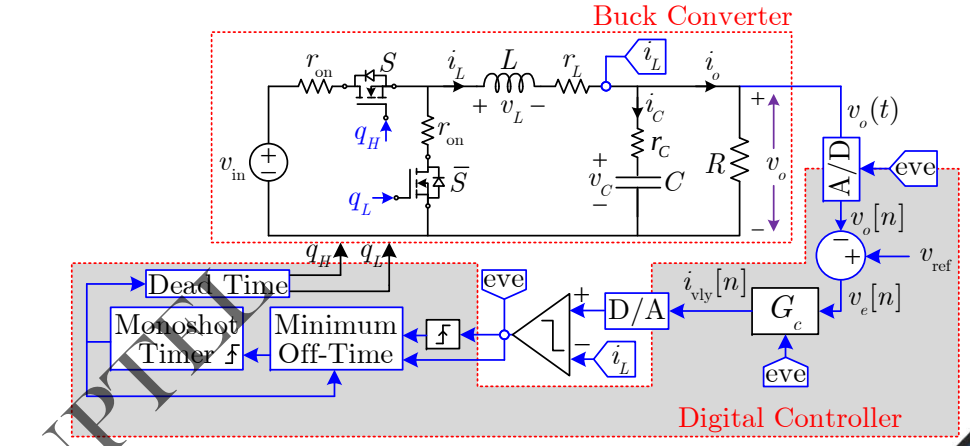
Mixed-Signal Constant On-time CMC | *Event based sampling*





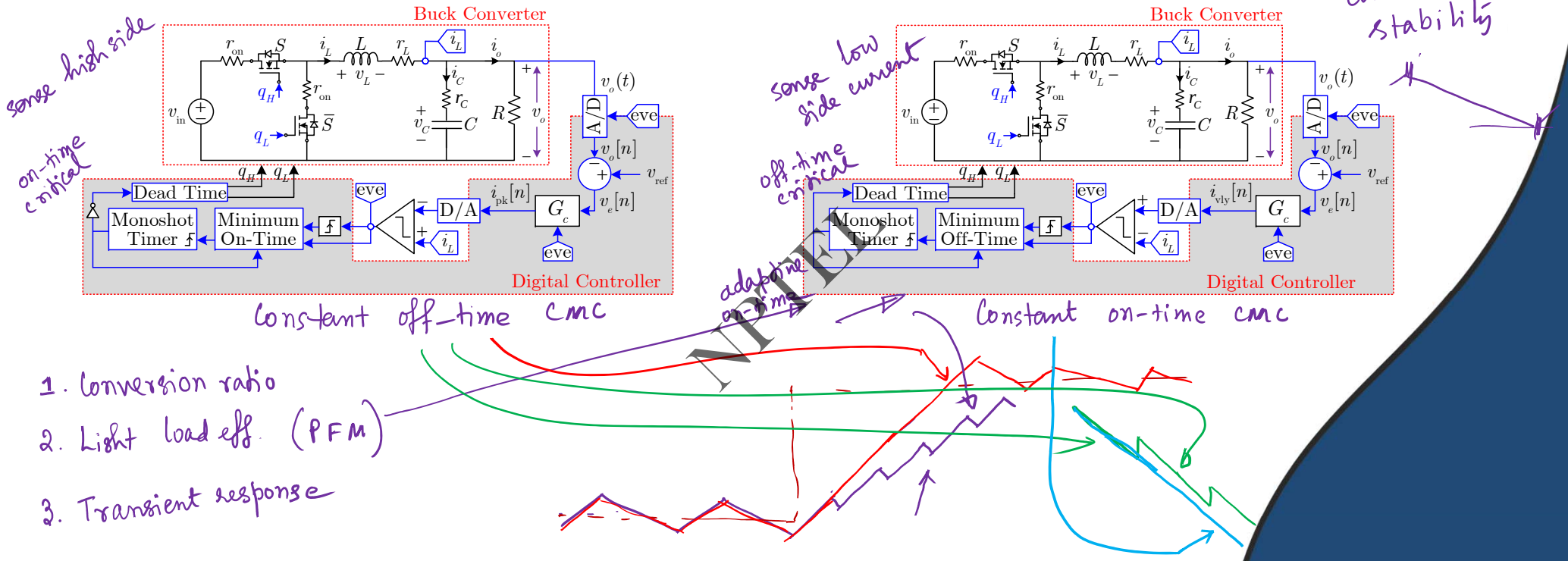
Mixed-Signal Constant On-time CMC | Event based sampling (contd…)





Interval 2 sampling : one cycle delay

Applications of Mixed-Signal Constant On/Off-time CMC



sense high side

on-time critical

Constant off-time cmc

1. Conversion ratio
2. Light load eff. (PFM)
3. Transient response

sense low side current

off-time critical

adaptive on-time

Constant on-time cmc

inherent current-loop stability

K. Hariharan, et. al. " Constant On/Off-Time Hybrid Modulation in Digital ...", *IEEE Trans. Power Electron.*, vol. 34 (4) April 2019

CONCLUSION

- Steady-state operation under mixed-signal constant off-time CMC
- Complete architecture of mixed-signal constant off-time peak CMC
- Complete architecture of mixed-signal constant on-time valley CMC
- Applications of mixed-signal constant on/off-time CMC

THANK YOU !