


NPTEL ONLINE CERTIFICATION COURSES

DIGITAL CONTROL IN SMPCs AND FPGA-BASED PROTOTYPING

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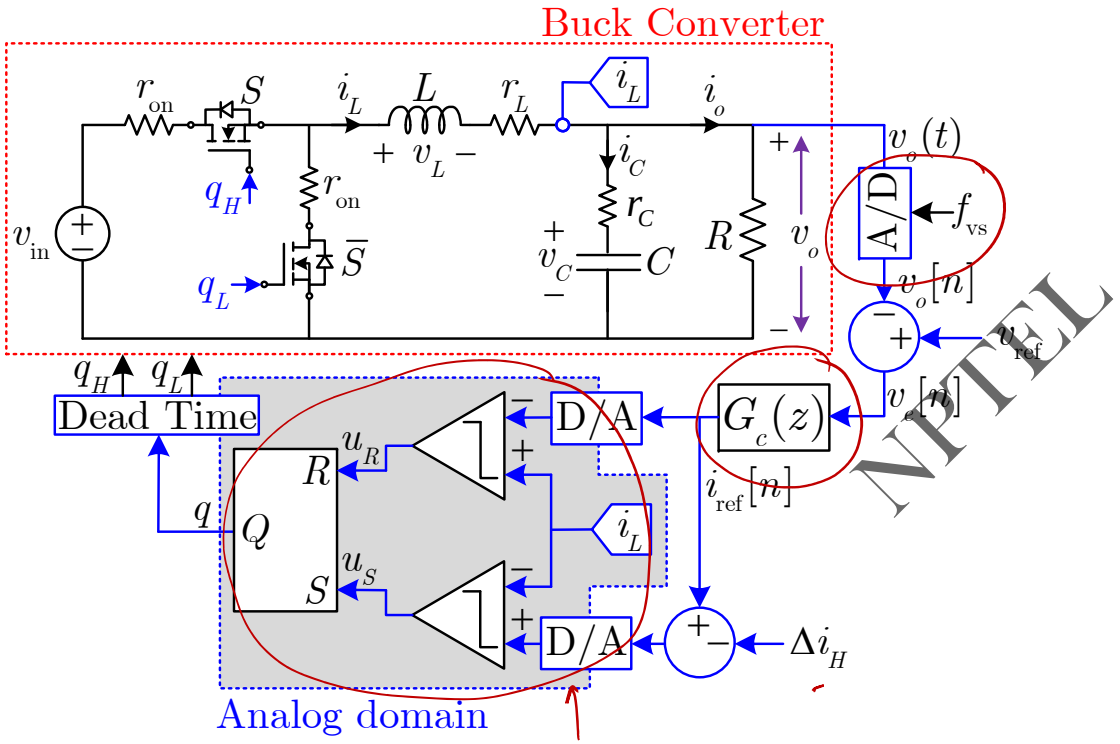
Module 03: MATLAB Custom Model Development under Digital Control

Lecture 30: MATLAB Model Development for Digital Current Hysteresis Control

CONCEPTS COVERED

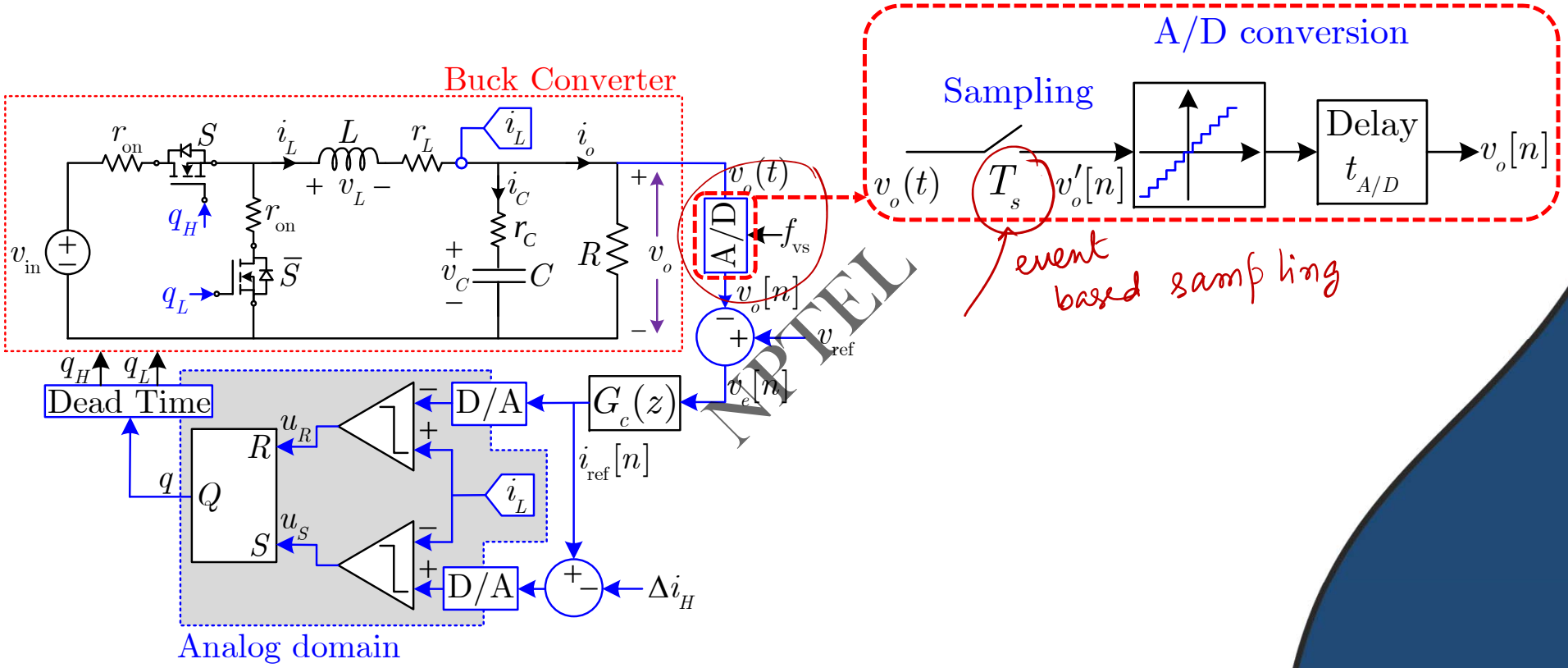
- Custom MATLAB model development for mixed-signal hysteresis CMC
- MATLAB simulation studies

Mixed-Signal Hysteresis CMC in a Buck Converter

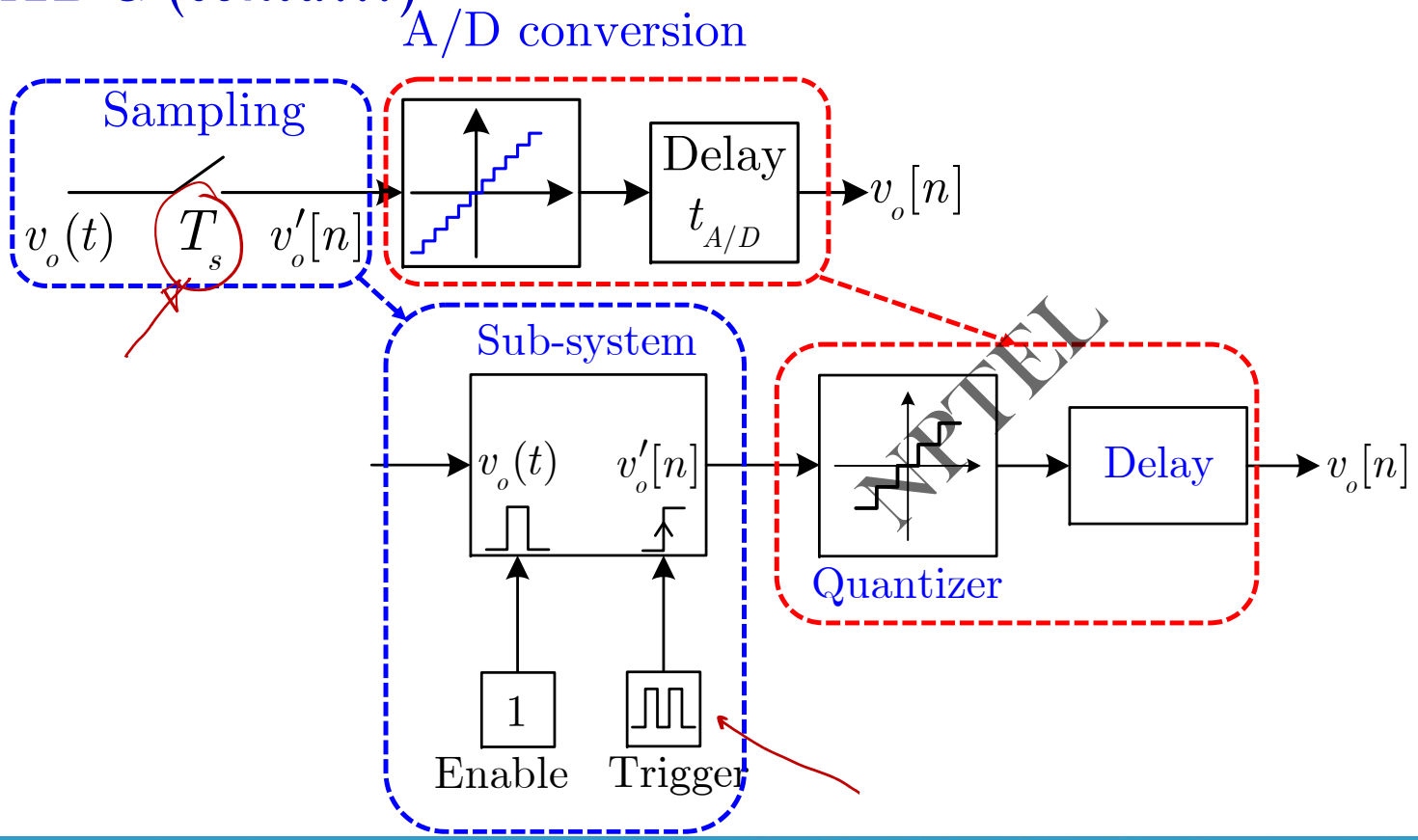


S. Kapat, "Parameter-Insensitive Mixed-Signal Hysteresis …", *IEEE TPEL*, vol. 32 (7), July 2017

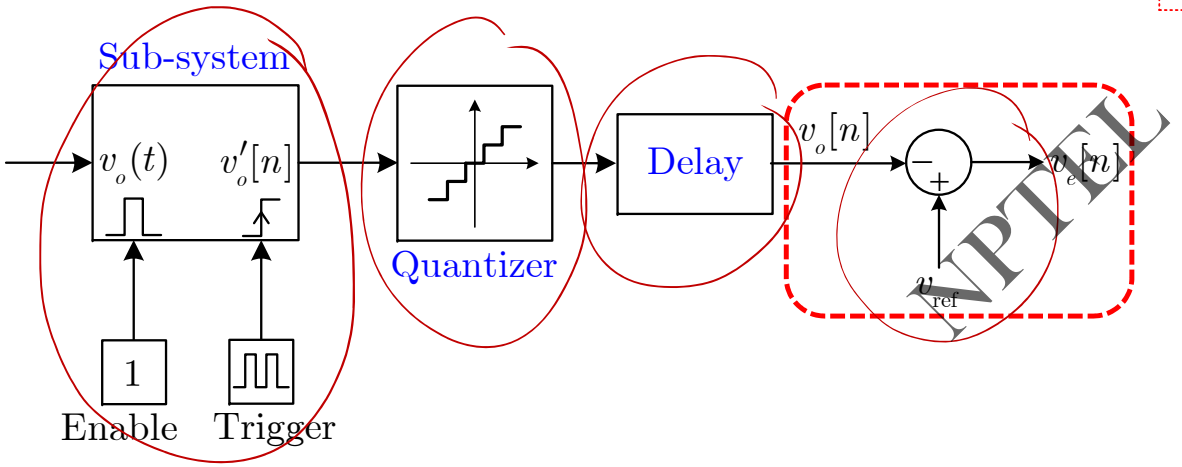
ADC

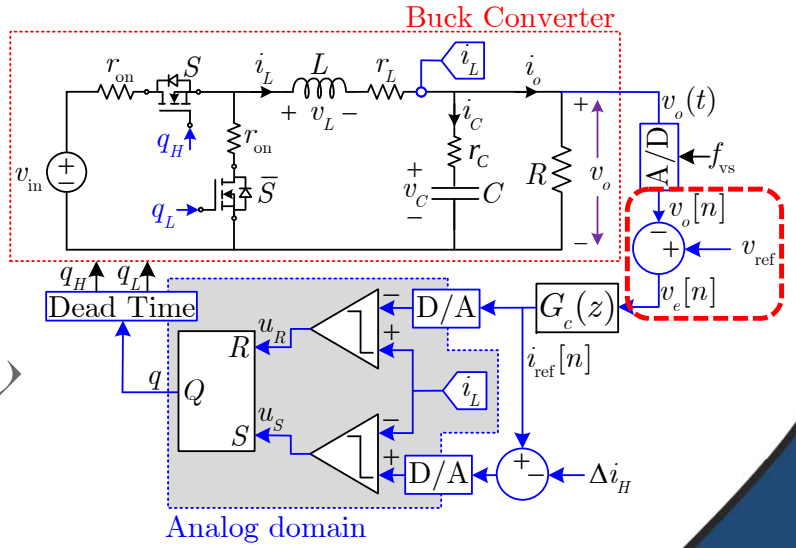

Buck Converter
A/D conversion
Sampling
Delay
$t_{A/D}$
$v_o[n]$
$v_o(t)$
T_s
$v_o'[n]$
event based sampling
r_{on}
S
i_L
L
r_L
i_o
i_C
r_C
C
R
v_o
v_{in}
q_H
q_L
$\bar{S}$
A/D
f_{vs}
v_{ref}
$v_e[n]$
$G_c(z)$
D/A
$i_{ref}[n]$
Δi_H
Dead Time
q
u_R
u_S
Analog domain

ADC (contd…)

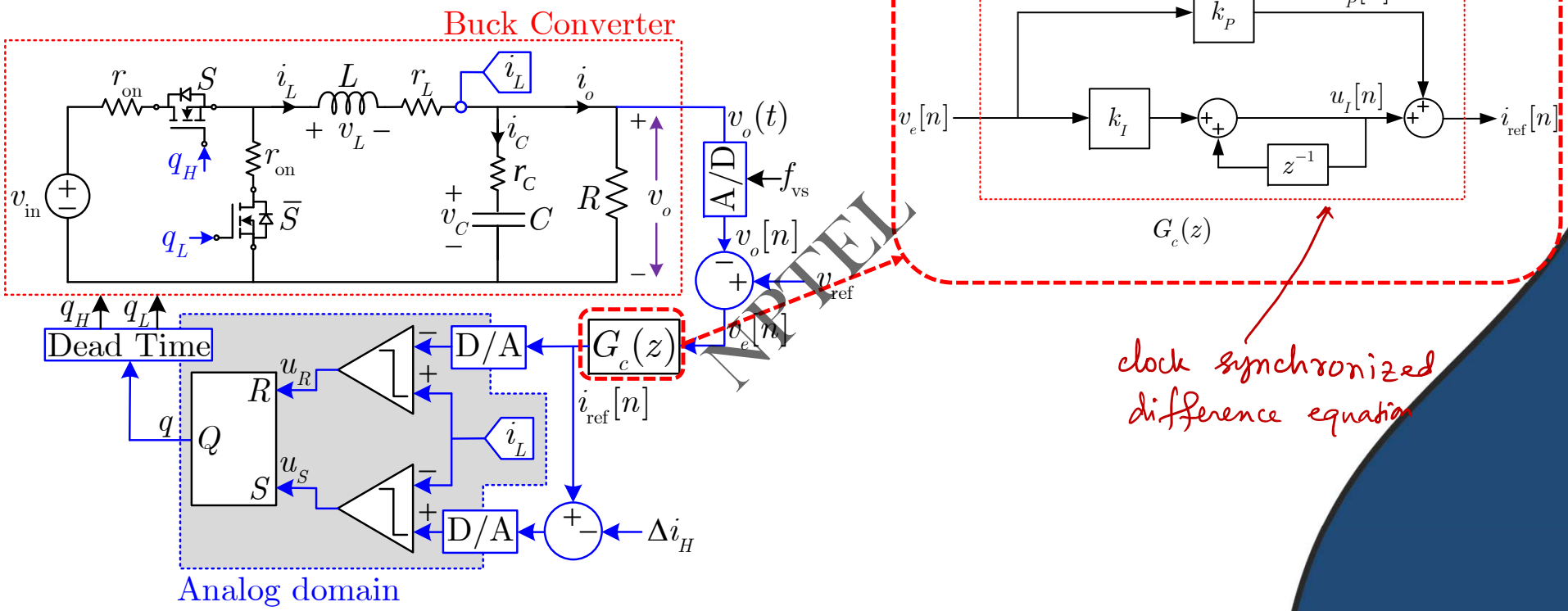


Voltage Error

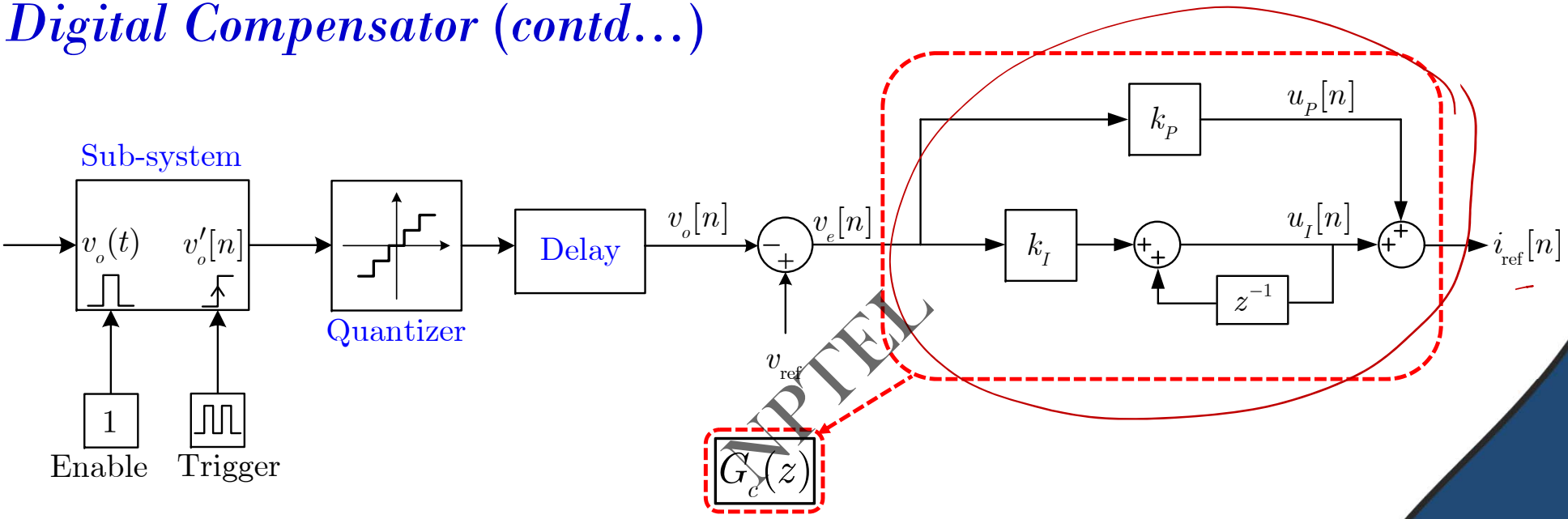




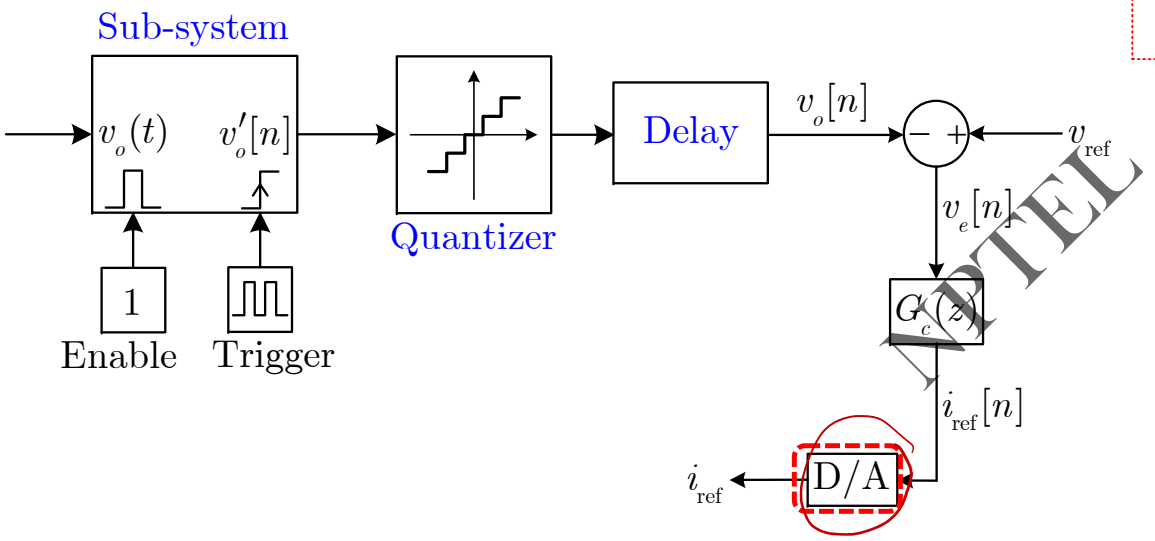
Digital Compensator

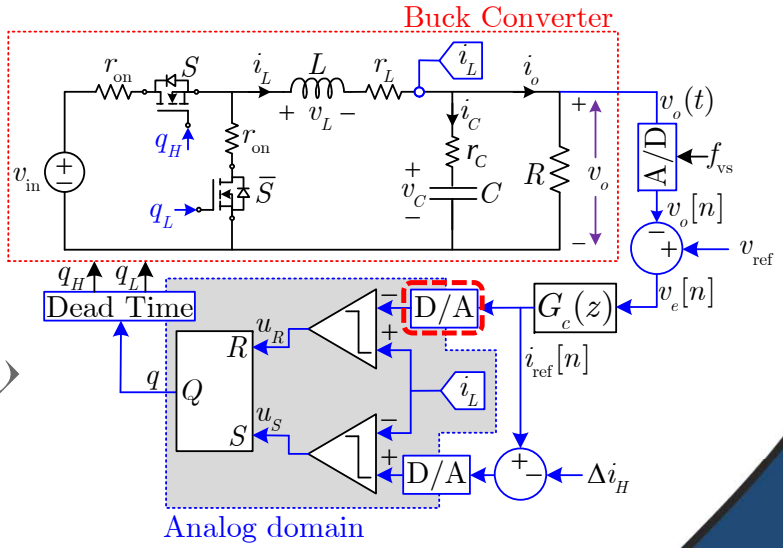


Digital Compensator (contd…)

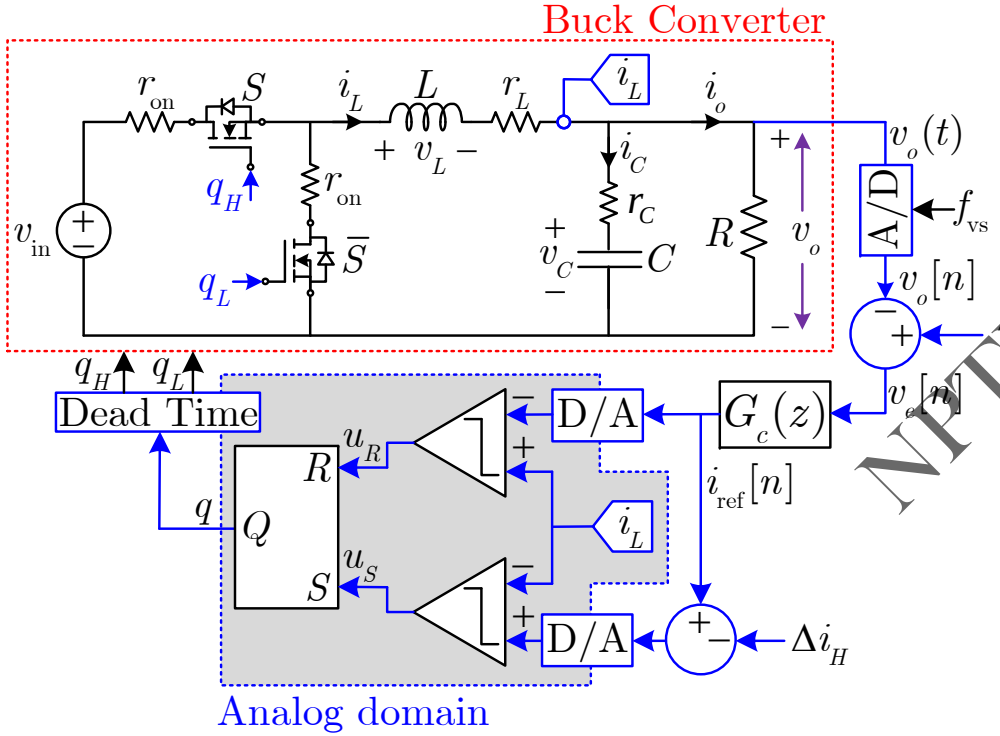


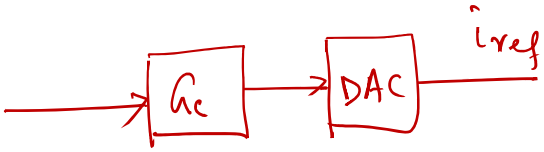
DAC

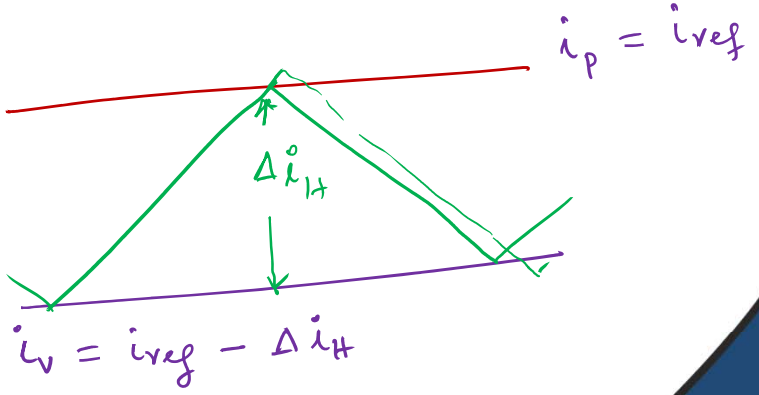

Sub-system
$v_o(t)$
$v_o'[n]$
1
Enable
Trigger
Quantizer
Delay
$v_o[n]$
v_{ref}
$v_e[n]$
$G_c(z)$
$i_{ref}[n]$
i_{ref}
D/A


Buck Converter
r_{on}
S
i_L
L
r_L
i_o
$v_o(t)$
q_H
r_{on}
i_C
r_C
R
v_o
A/D
f_{vs}
v_{in}
q_L
$\bar{S}$
v_C
C
$v_o[n]$
v_{ref}
q_H q_L
Dead Time
D/A
$G_c(z)$
$v_e[n]$
u_R
R
q
Q
S
u_S
i_L
$i_{ref}[n]$
D/A
Δi_H
Analog domain

Peak Current-Mode MSHCC







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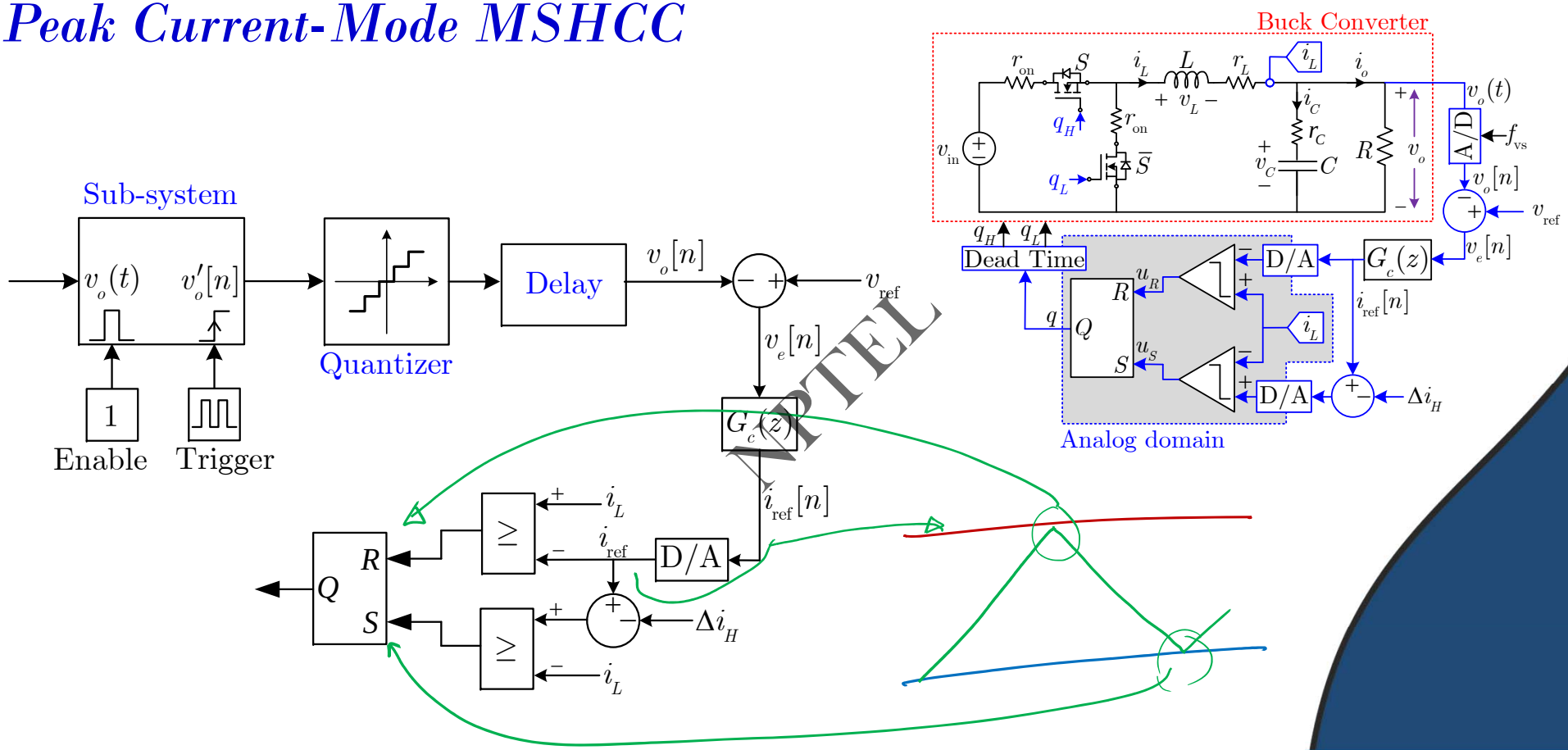
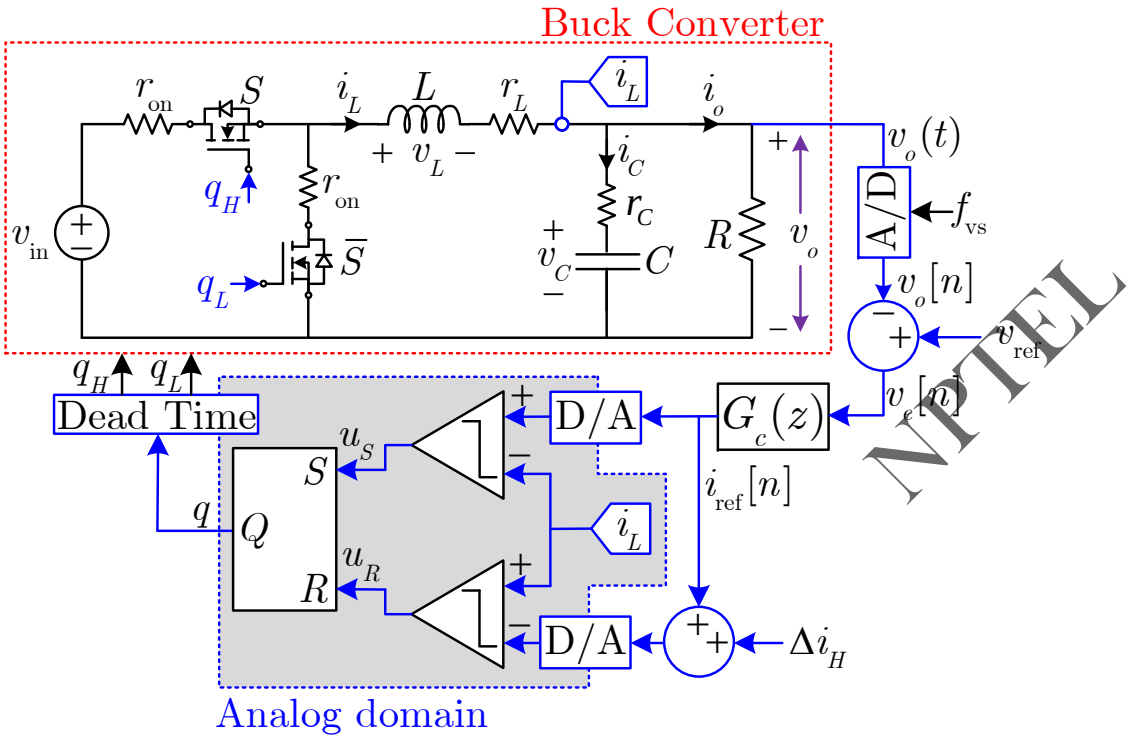
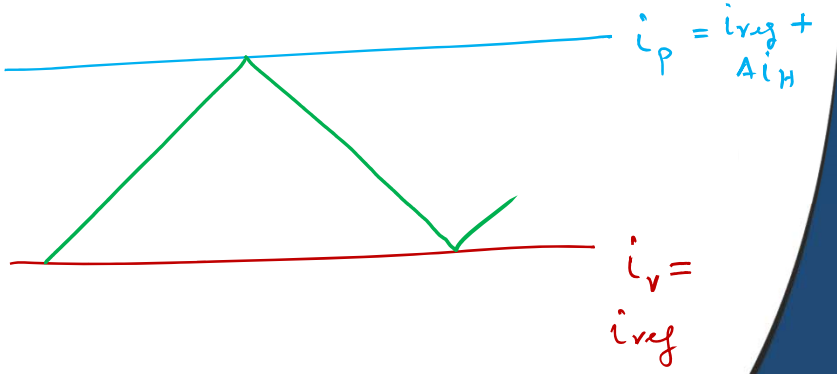
Peak Current-Mode MSHCC



Valley Current-Mode MSHCC





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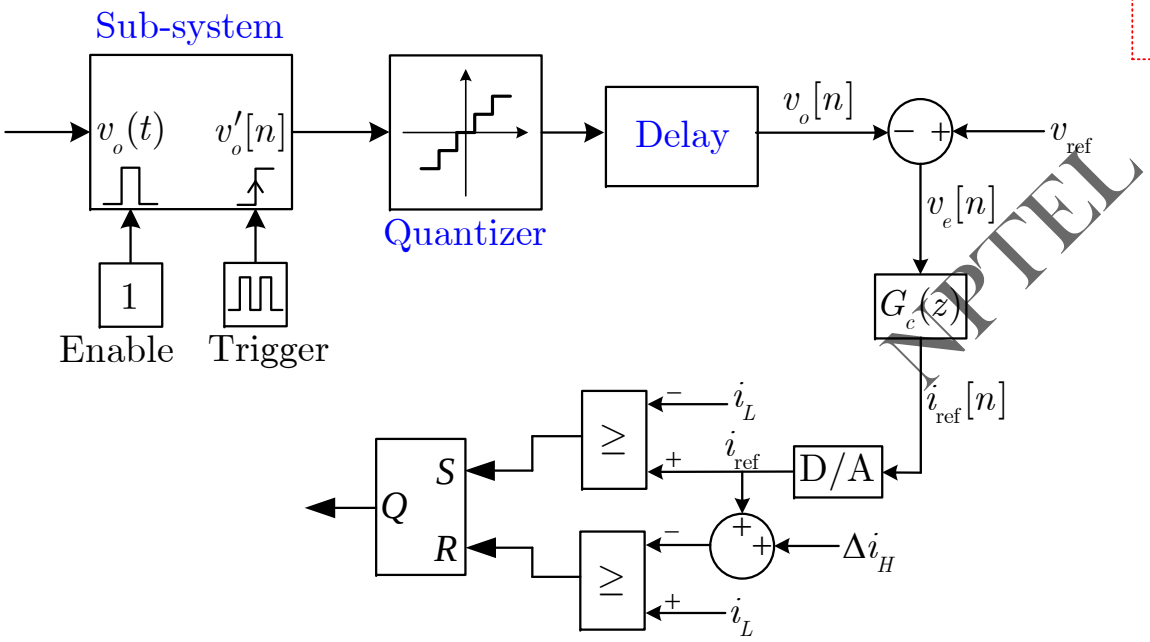
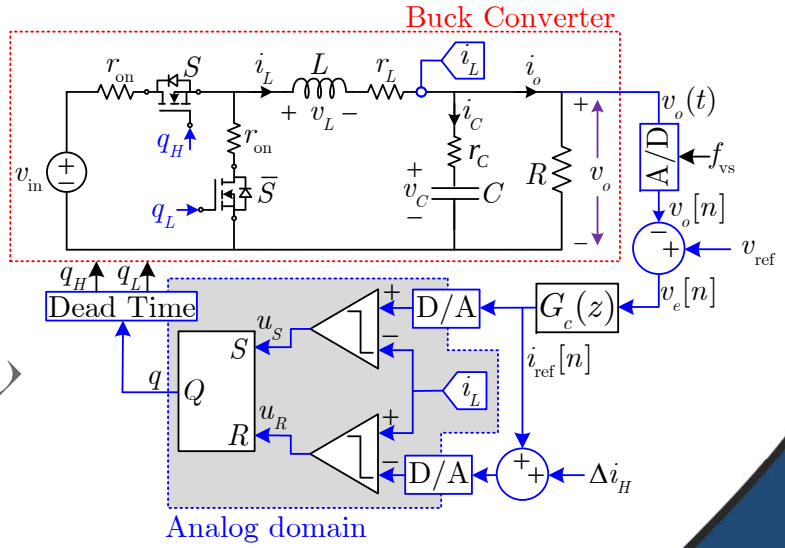
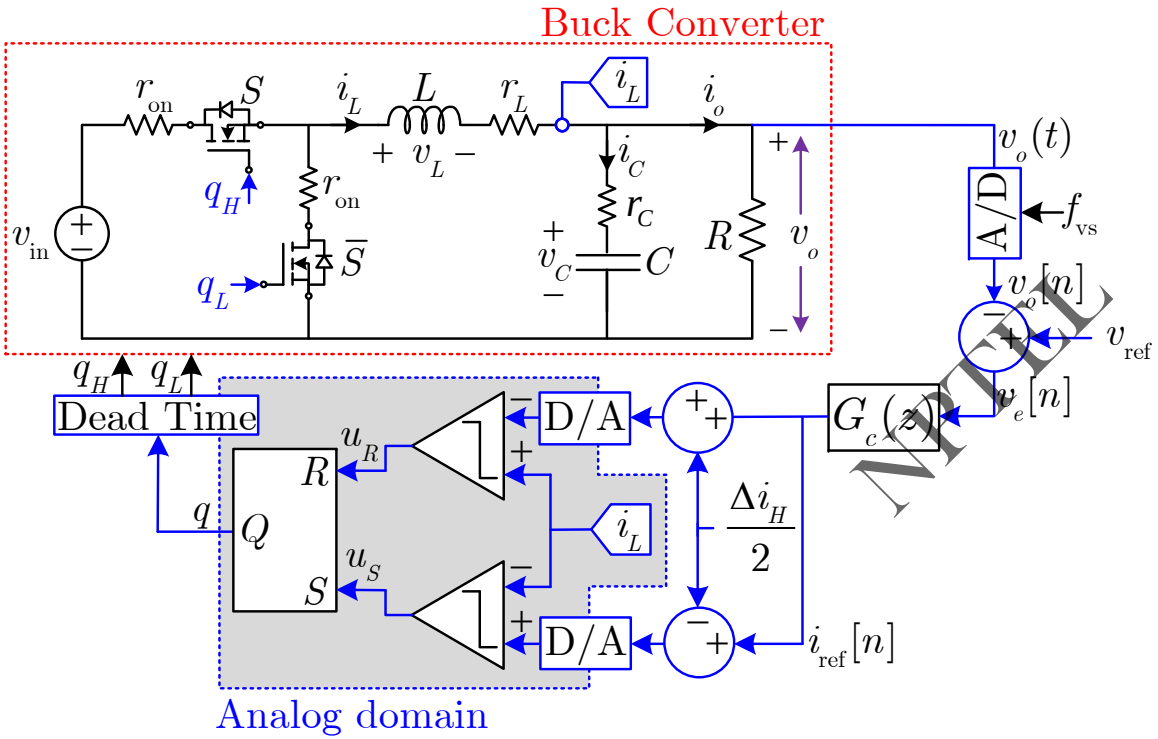
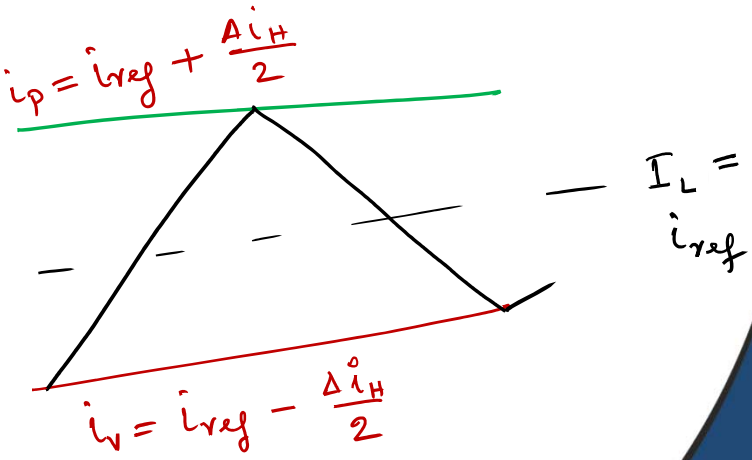
Valley Current-Mode MSHCC





Average Current-Mode MSHCC





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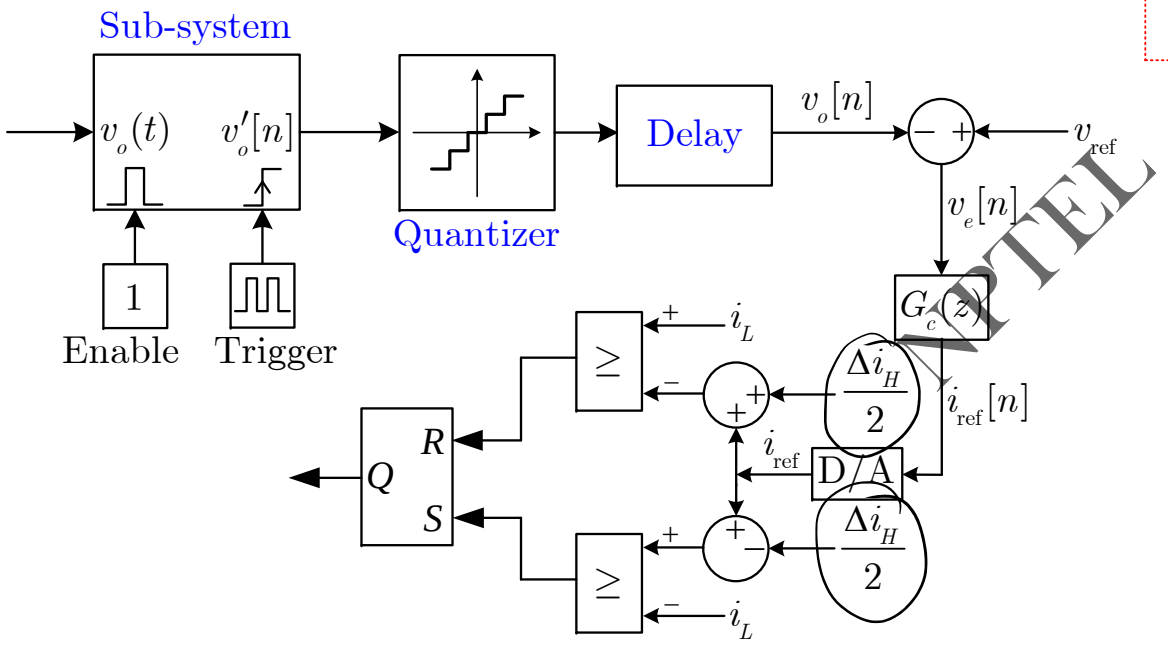
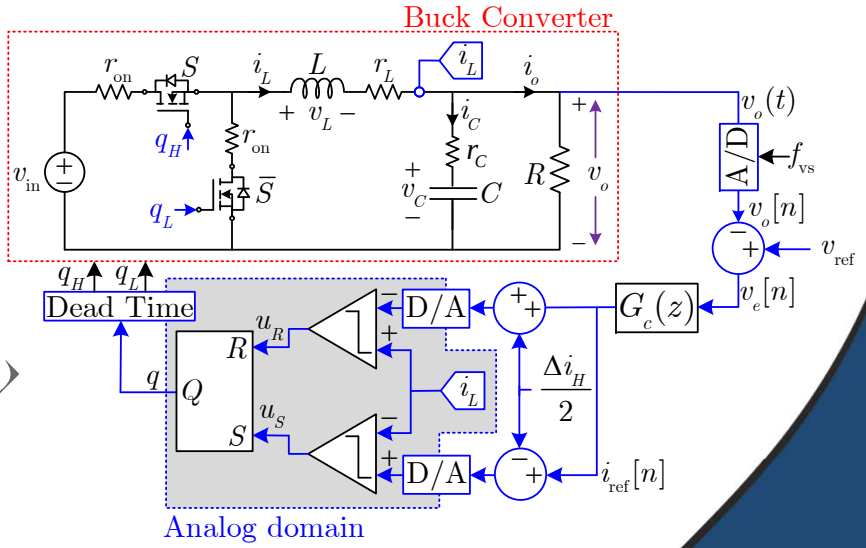
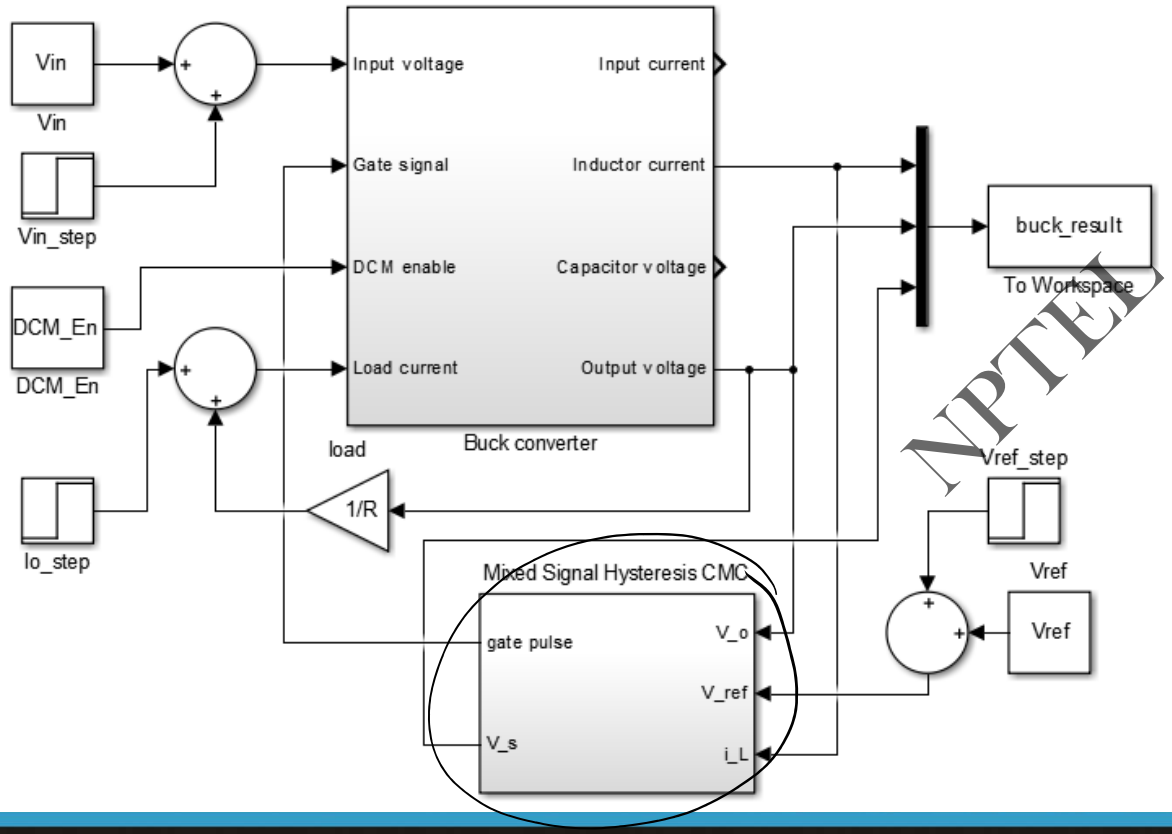
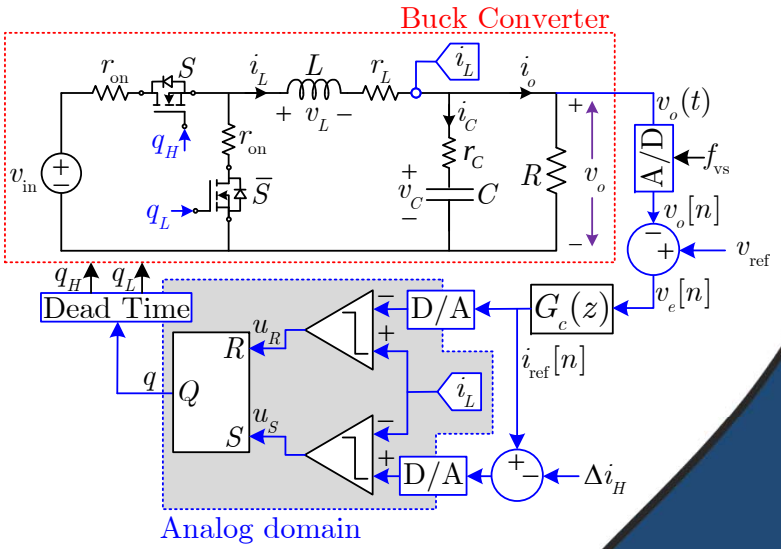
Average Current-Mode MSHCC



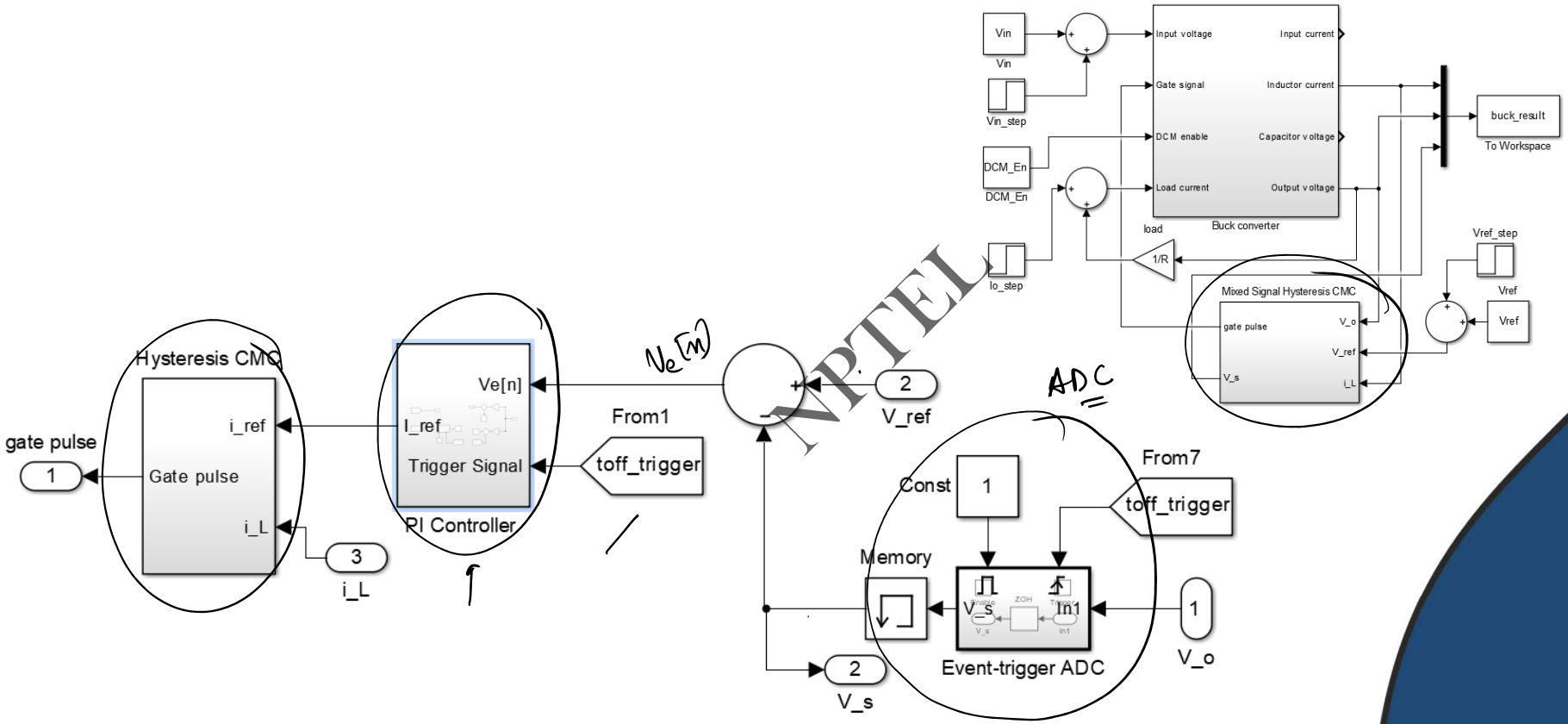


Peak Current-Mode MSHCC – MATLAB Model

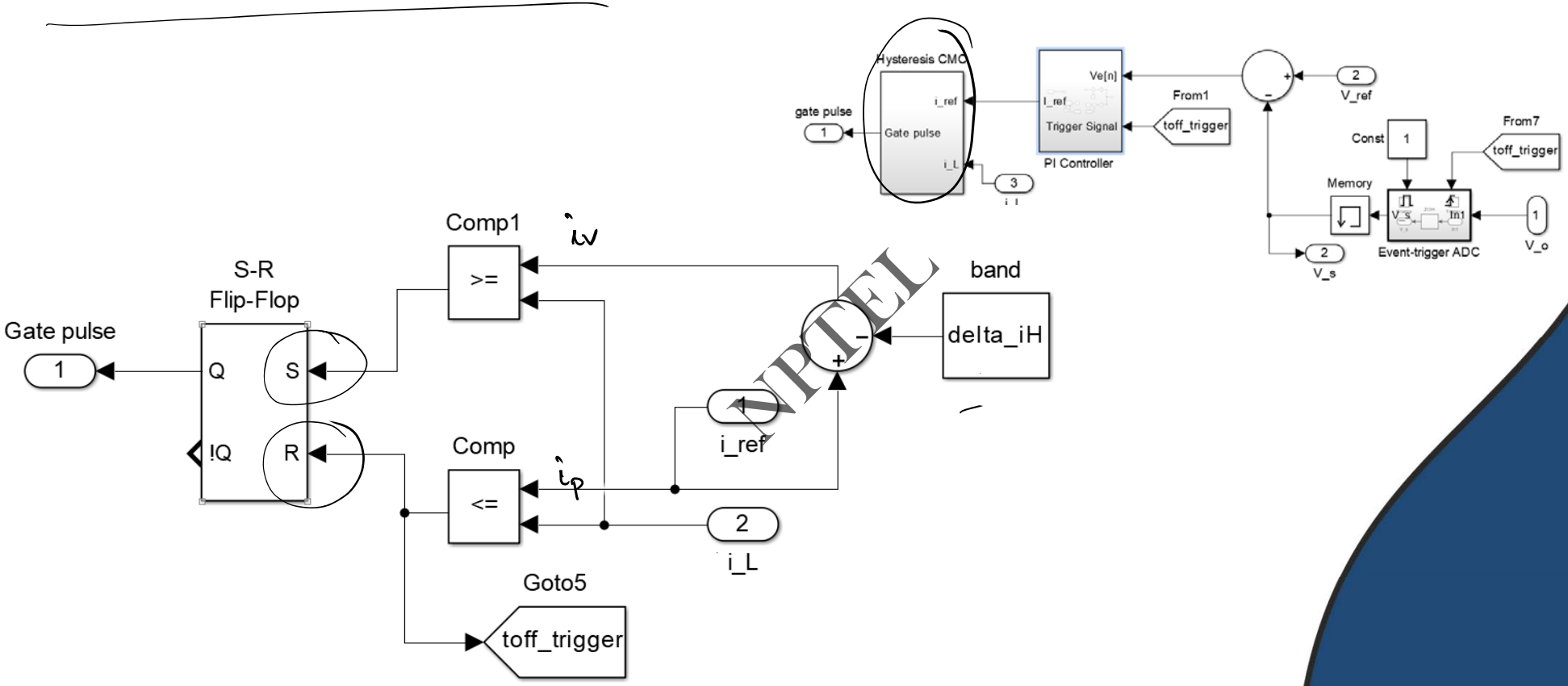




Peak Current-Mode MSHCC – MATLAB Model



Peak Current-Mode MSHCC – MATLAB Model



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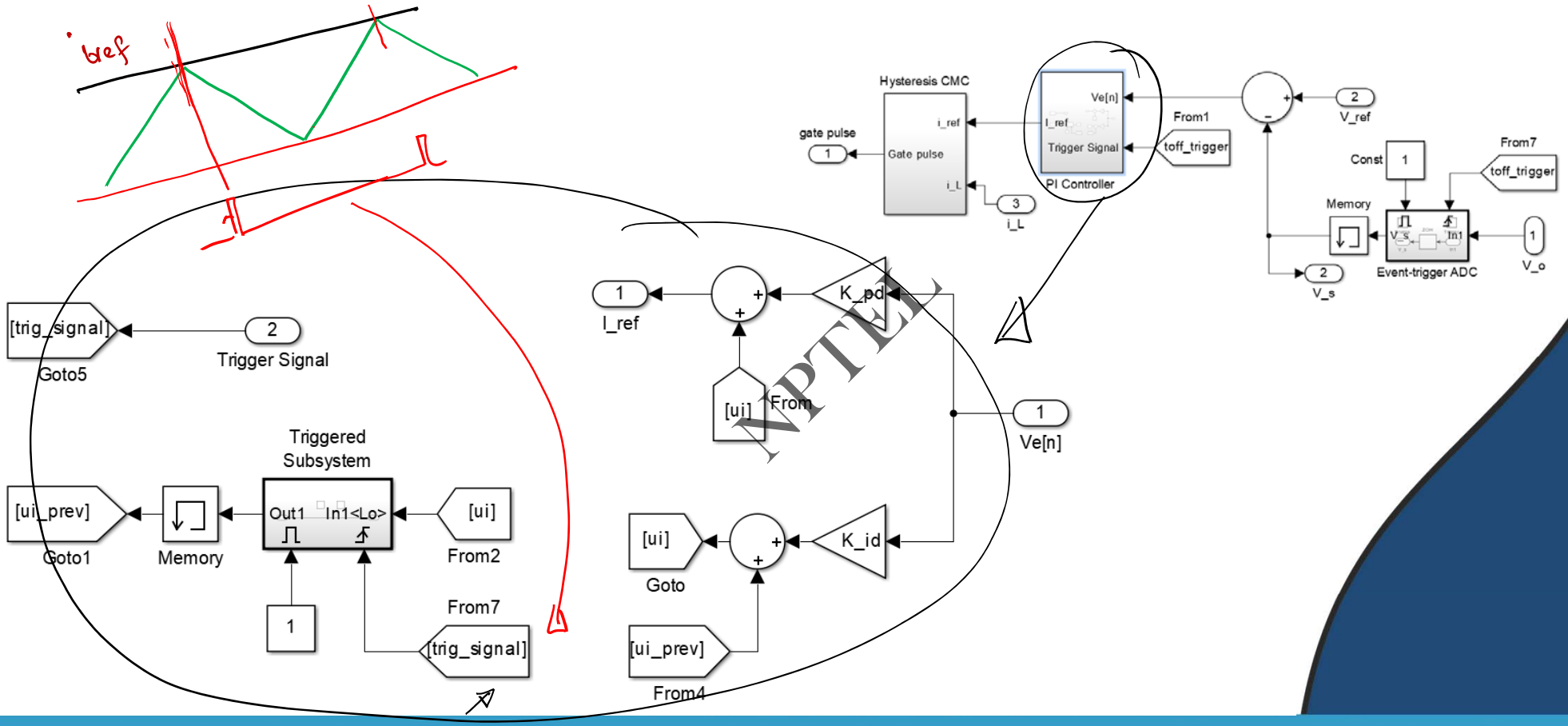

CONCLUSION

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- MATLAB simulation studies

THANK YOU !