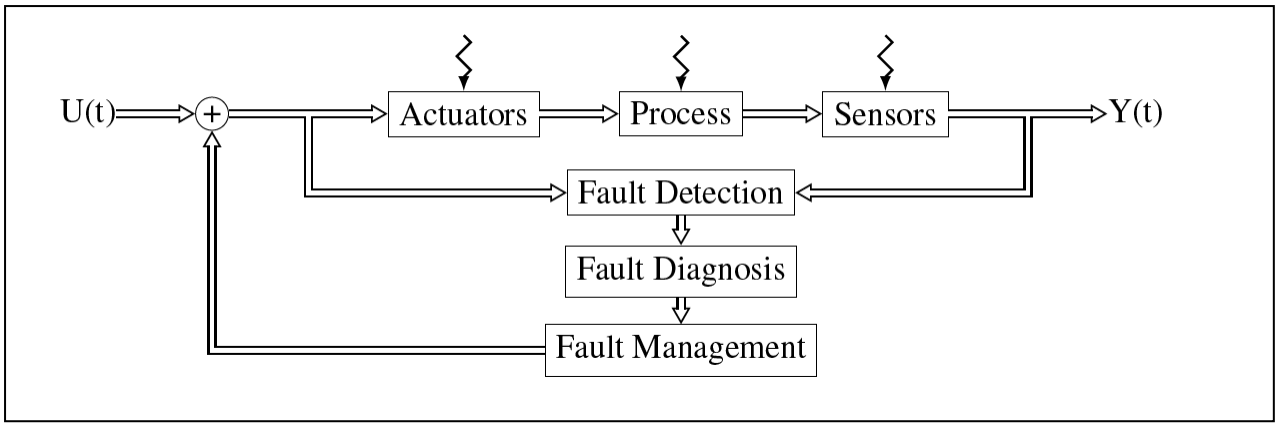

U(t)
+
Actuators
Process
Sensors
Y(t)
Fault Detection
Fault Diagnosis
Fault Management

Fig. 1.1

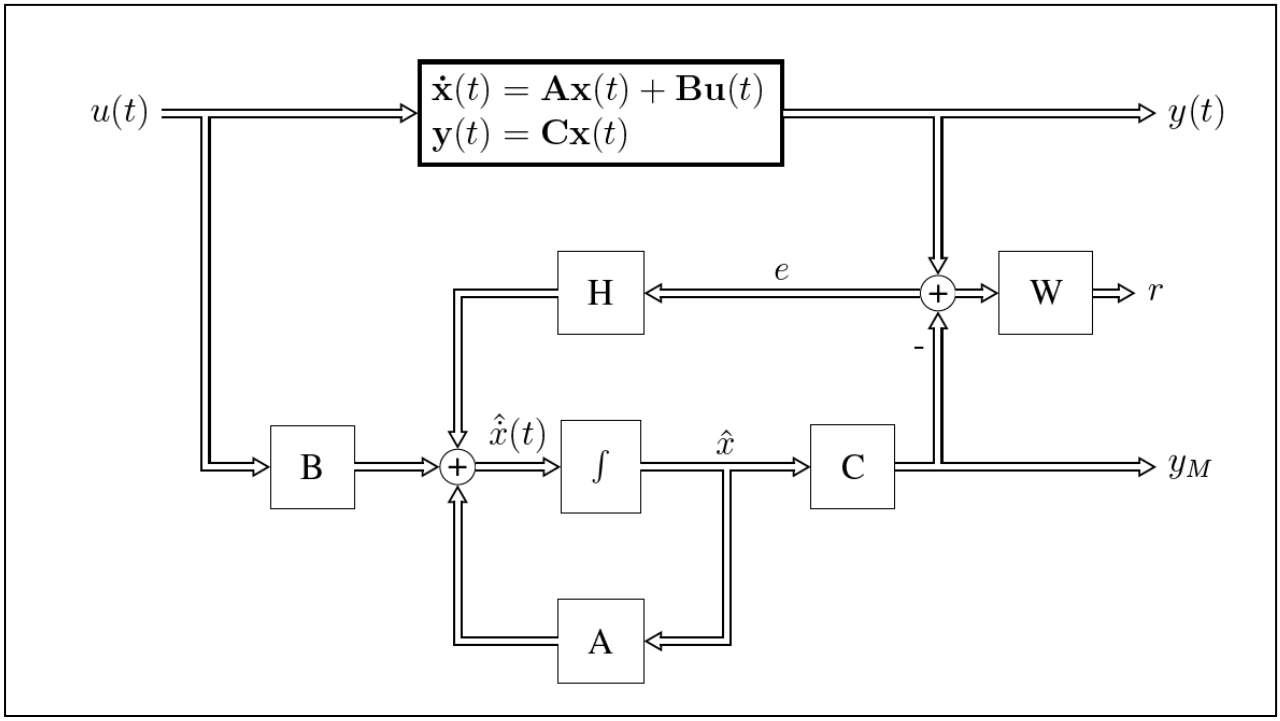

$u(t)$
$\dot{\mathbf{x}}(t) = \mathbf{A}\mathbf{x}(t) + \mathbf{B}\mathbf{u}(t)$
$\mathbf{y}(t) = \mathbf{C}\mathbf{x}(t)$
$y(t)$
H
e
+
W
r
-
B
+
$\dot{\hat{x}}(t)$
$\int$
$\hat{x}$
C
y_M
A

Fig. 1.2

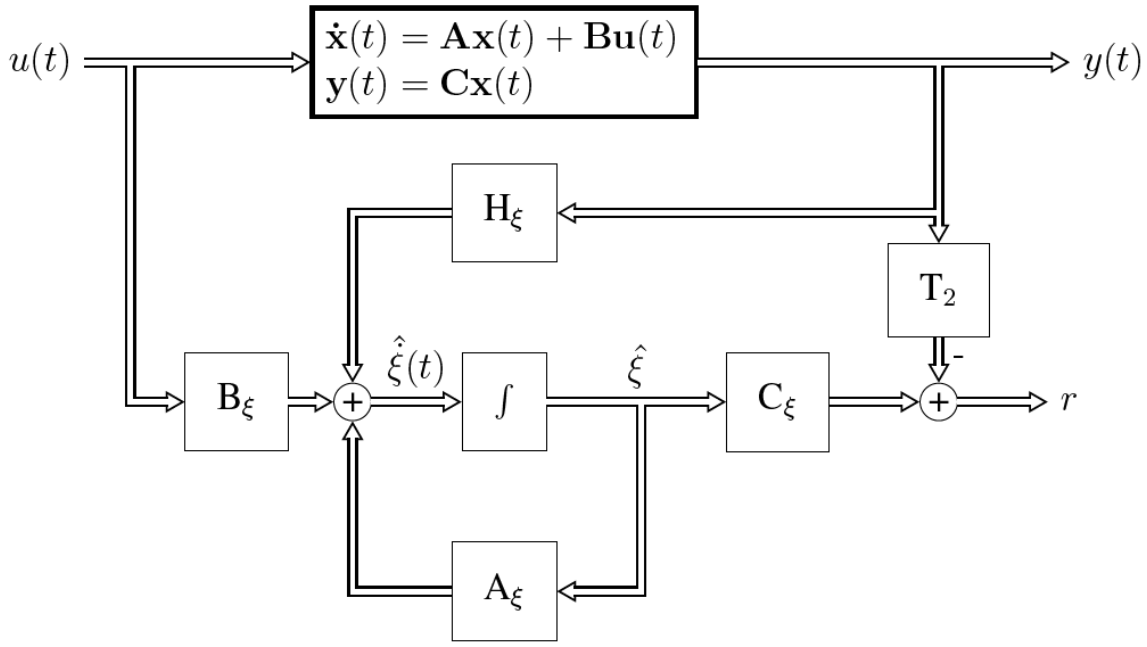

$u(t)$
$\dot{\mathbf{x}}(t) = \mathbf{A}\mathbf{x}(t) + \mathbf{B}\mathbf{u}(t)$
$\mathbf{y}(t) = \mathbf{C}\mathbf{x}(t)$
$y(t)$
H_ξ
T_2
B_ξ
$\hat{\dot{\xi}}(t)$
$\int$
$\hat{\xi}$
C_ξ
r
A_ξ

Fig. 1.3

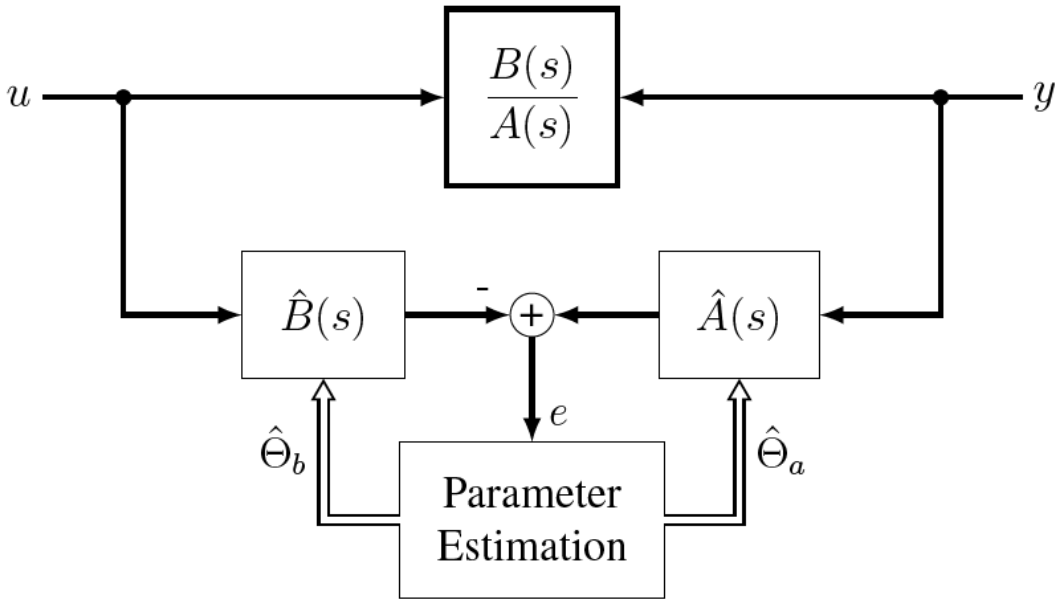

u
$\frac{B(s)}{A(s)}$
y
$\hat{B}(s)$
$\hat{A}(s)$
e
$\hat{\Theta}_b$
$\hat{\Theta}_a$
Parameter Estimation

Fig. 1.4

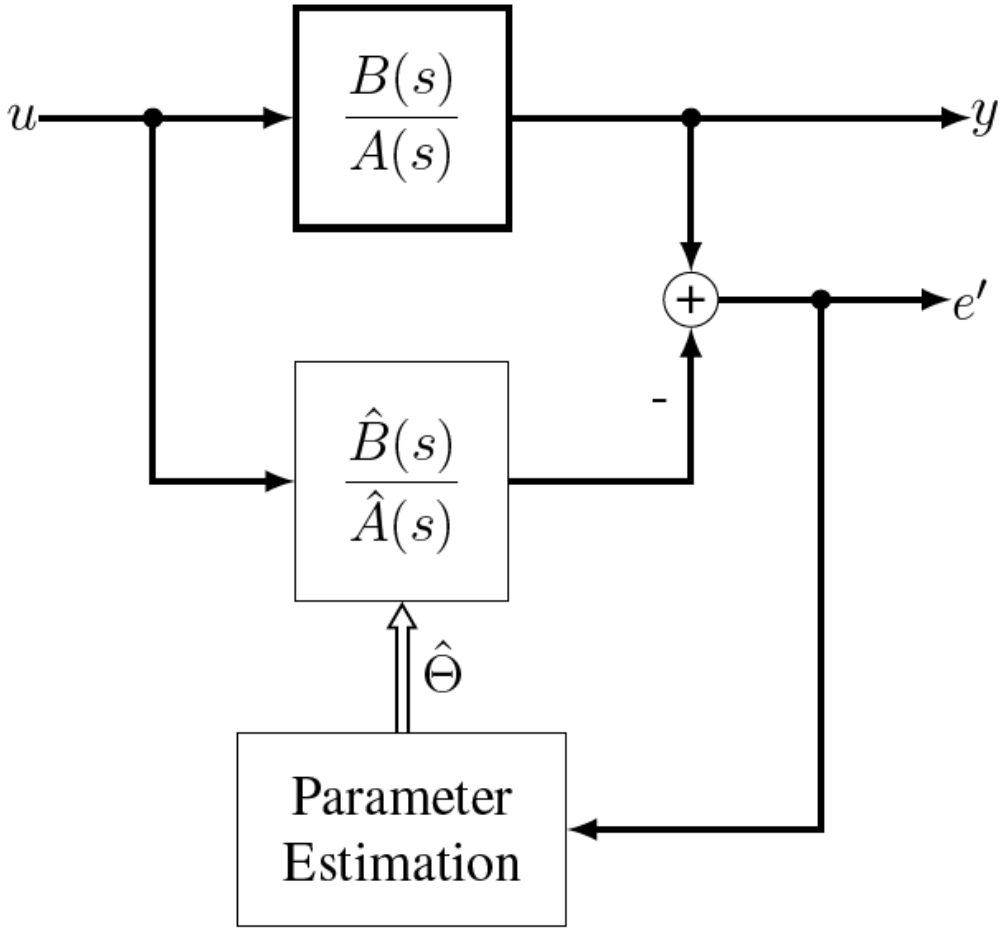

u
$\frac{B(s)}{A(s)}$
y
$+$
e'
$-$
$\frac{\hat{B}(s)}{\hat{A}(s)}$
$\hat{\Theta}$
Parameter Estimation

Fig.1.5

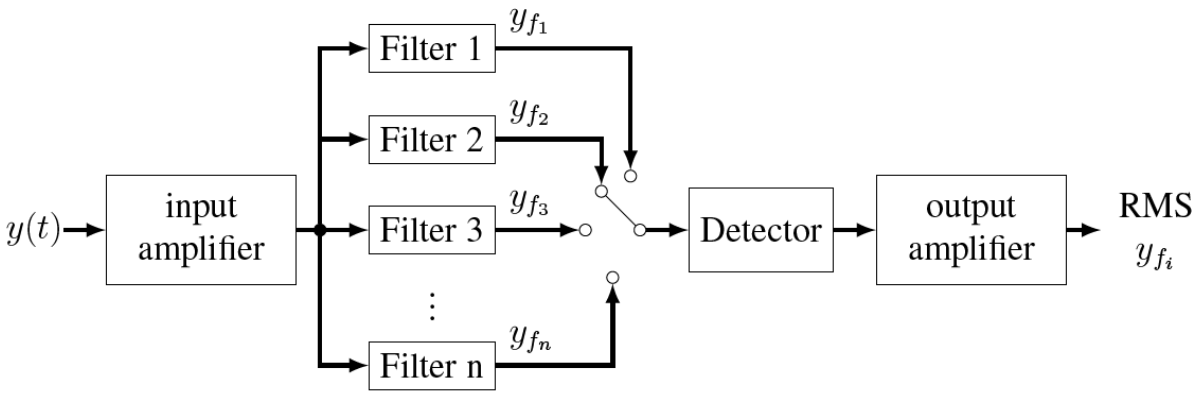

$y(t)$
input amplifier
Filter 1
Filter 2
Filter 3
Filter n
y_{f_1}
y_{f_2}
y_{f_3}
y_{f_n}
Detector
output amplifier
RMS
y_{f_i}

Fig. 1.6

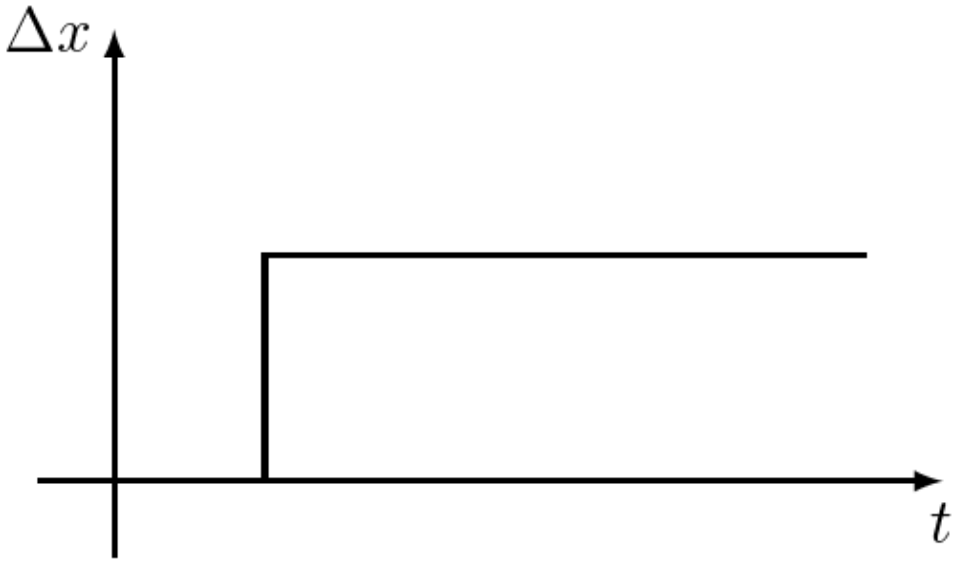


Fig. 2.1

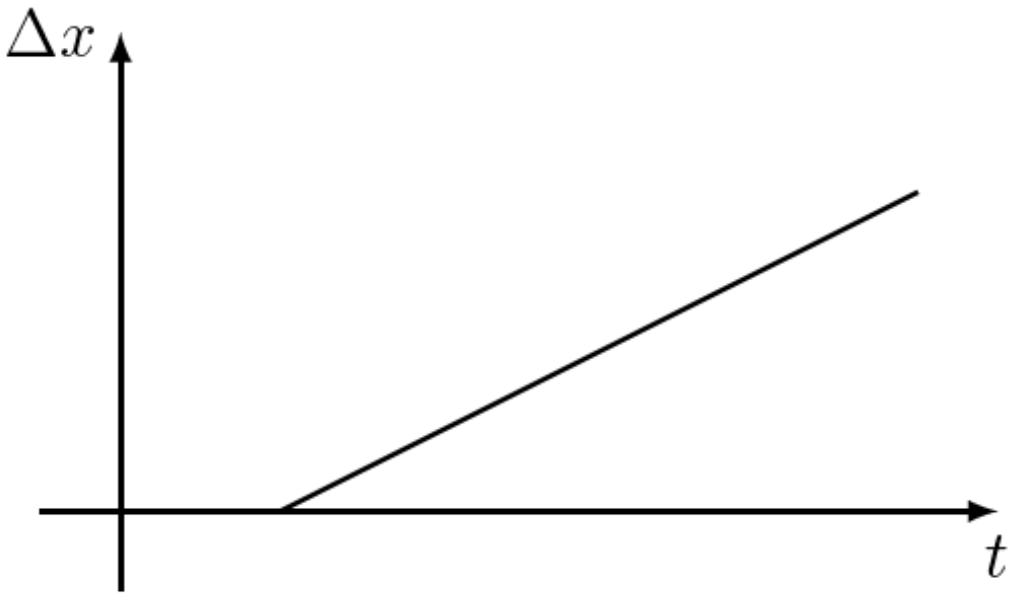


Fig. 2.2

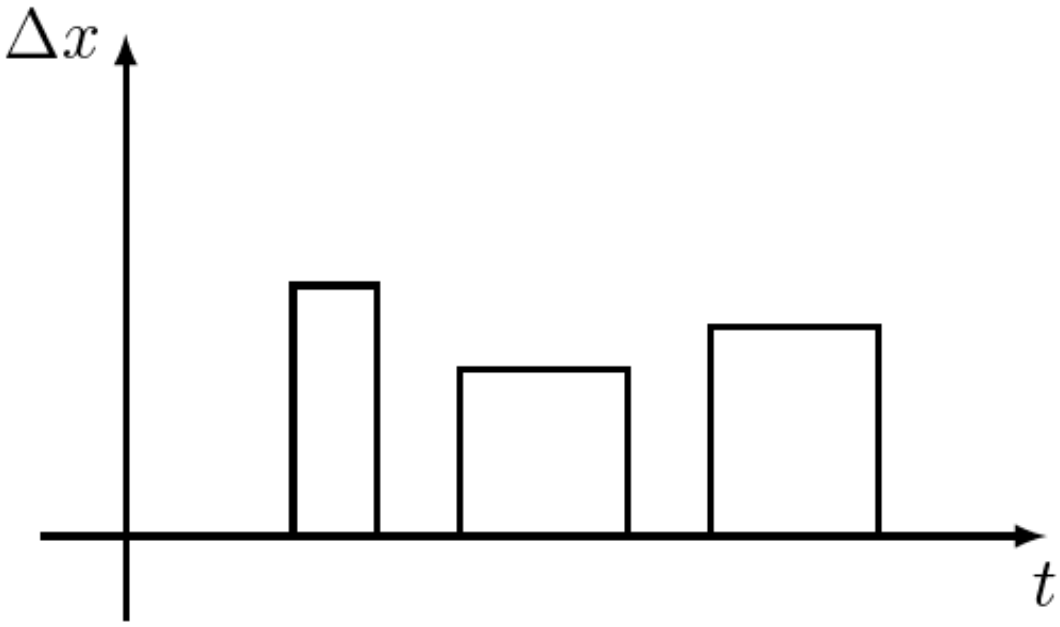

Δx
t

Fig. 2.3

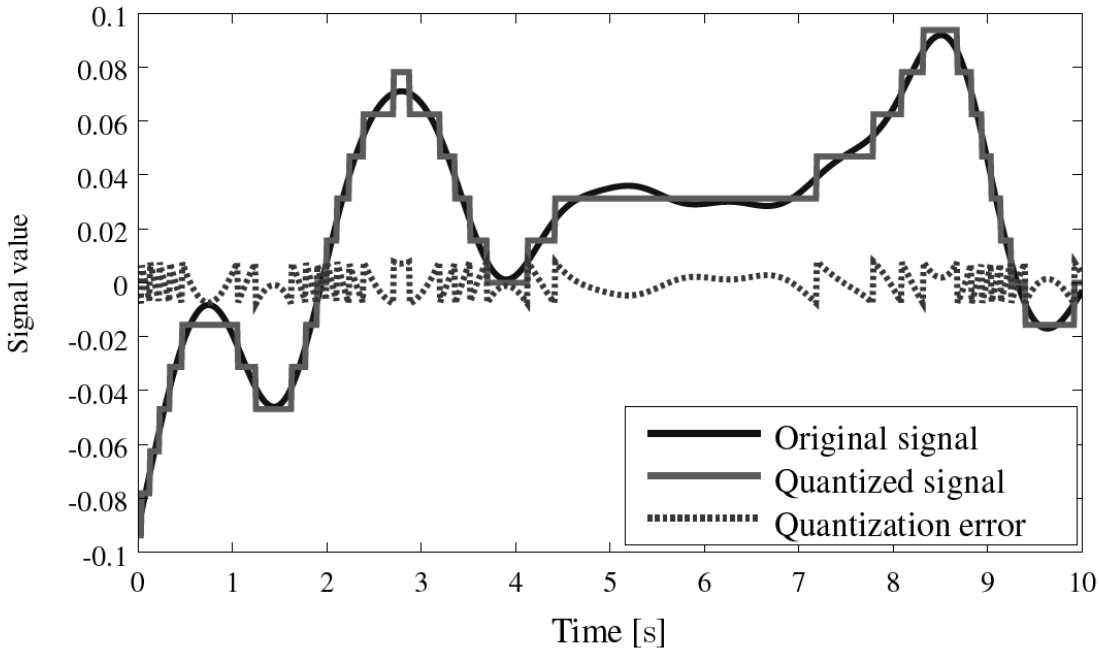

Signal value
Time [s]
Original signal
Quantized signal
Quantization error
0.1
0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
-0.1
0
1
2
3
4
5
6
7
8
9
10

Fig. 2.4

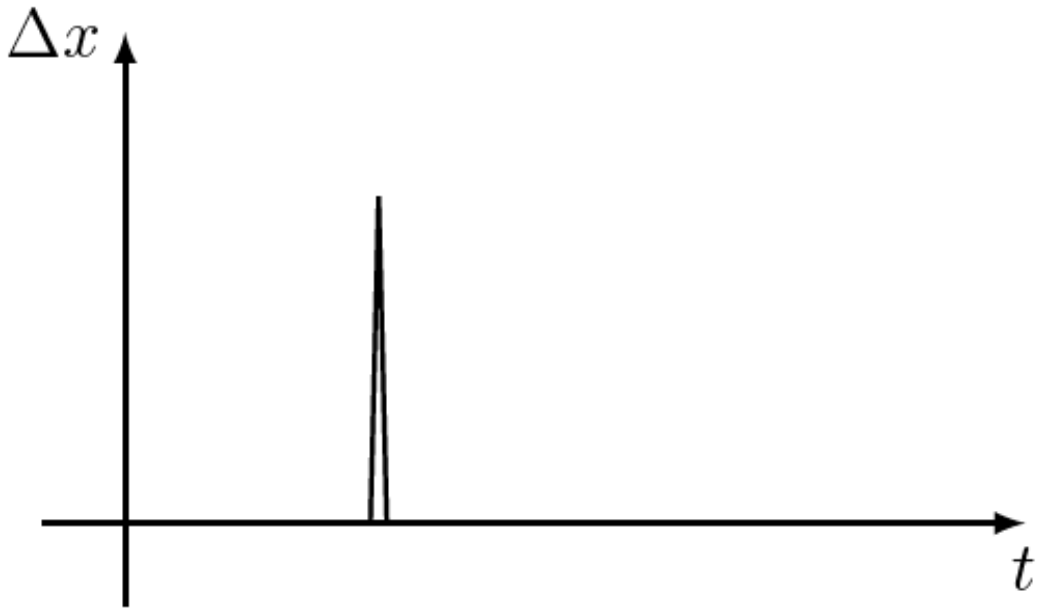


Fig. 2.5

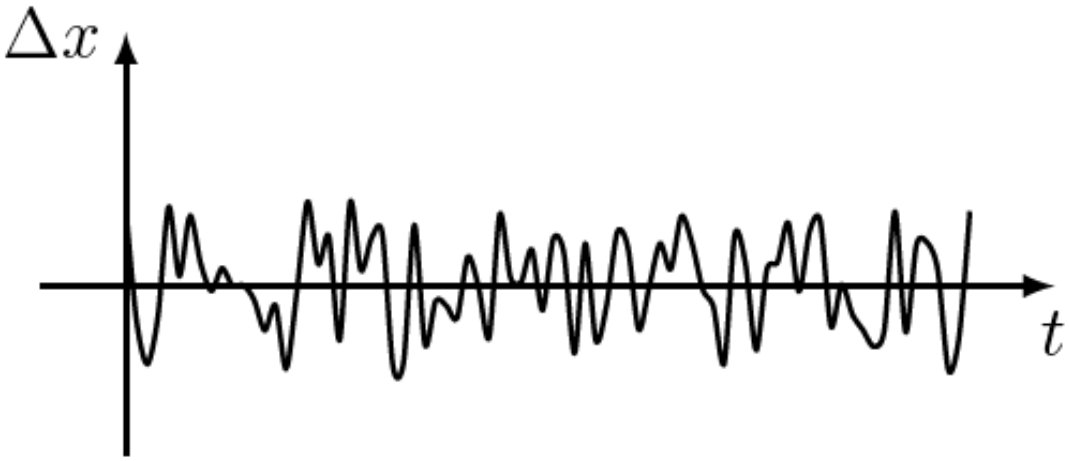


Fig. 2.6

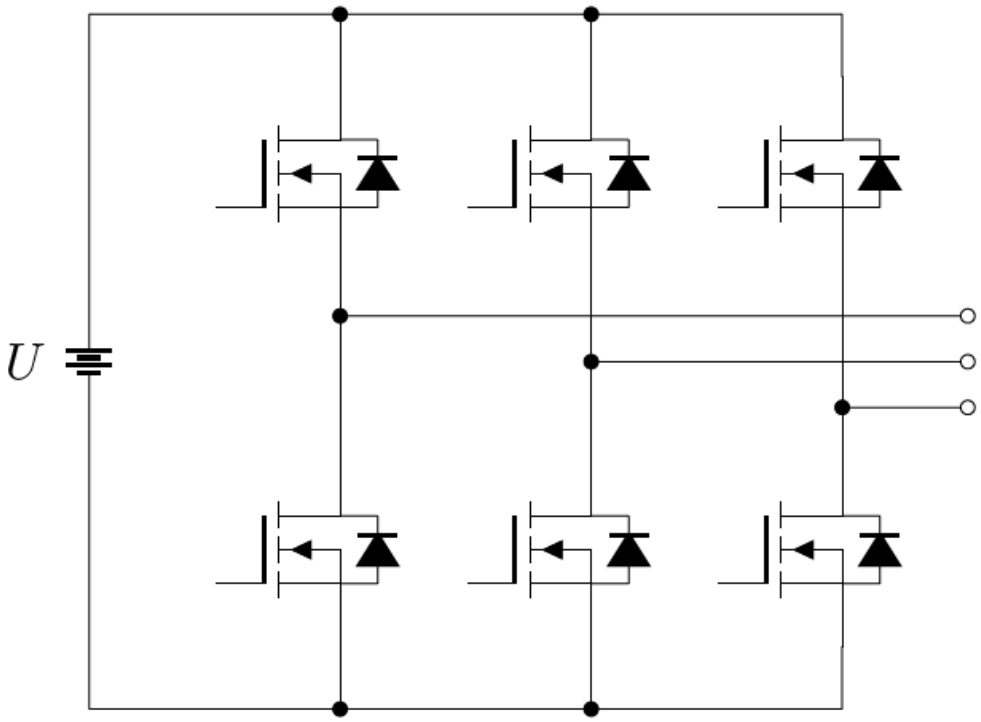


Fig. 2.7

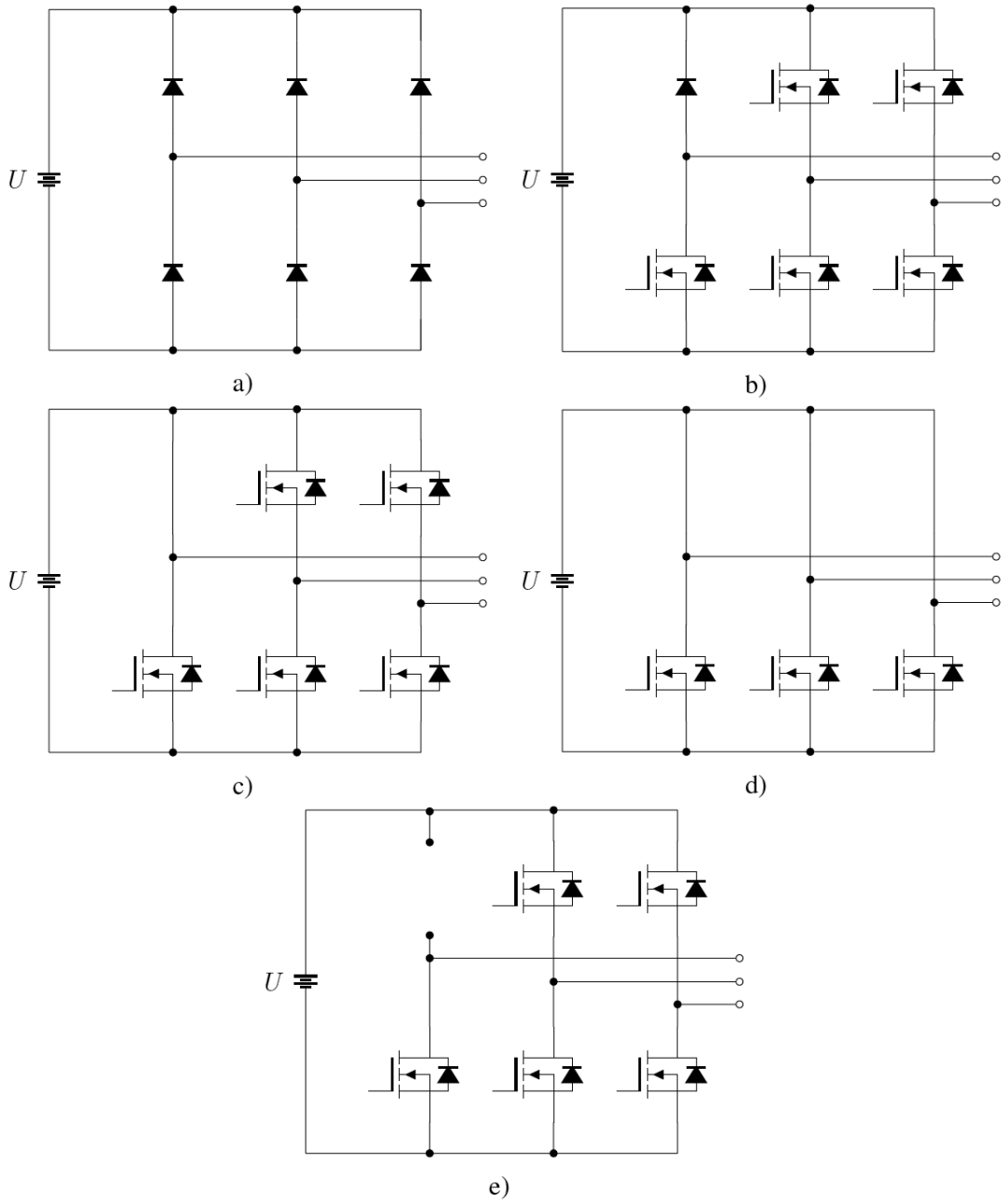


Fig. 2.8 a-e

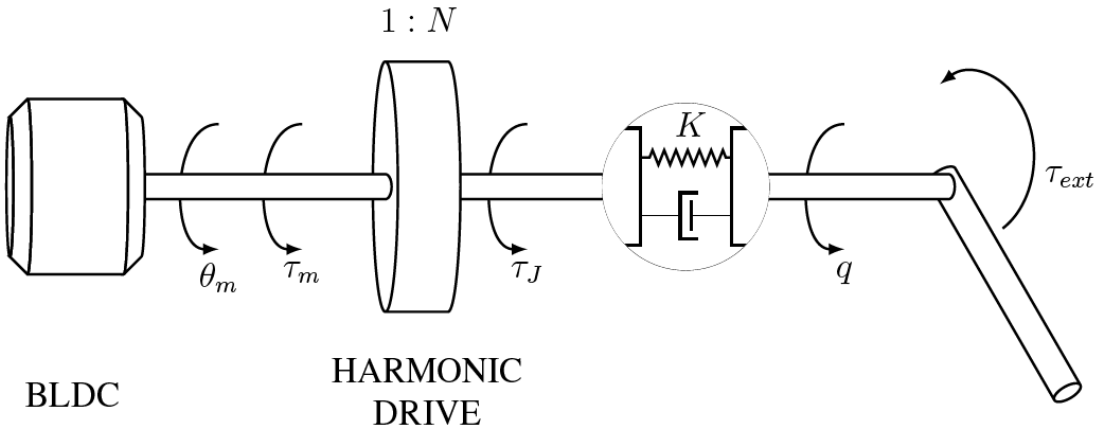

1 : N
K
τ_{ext}
θ_m
τ_m
τ_J
q
BLDC
HARMONIC
DRIVE

Fig. 3.1

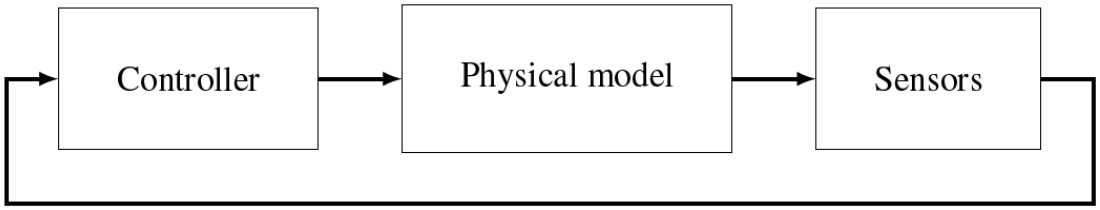

Controller
Physical model
Sensors

Fig. 3.2

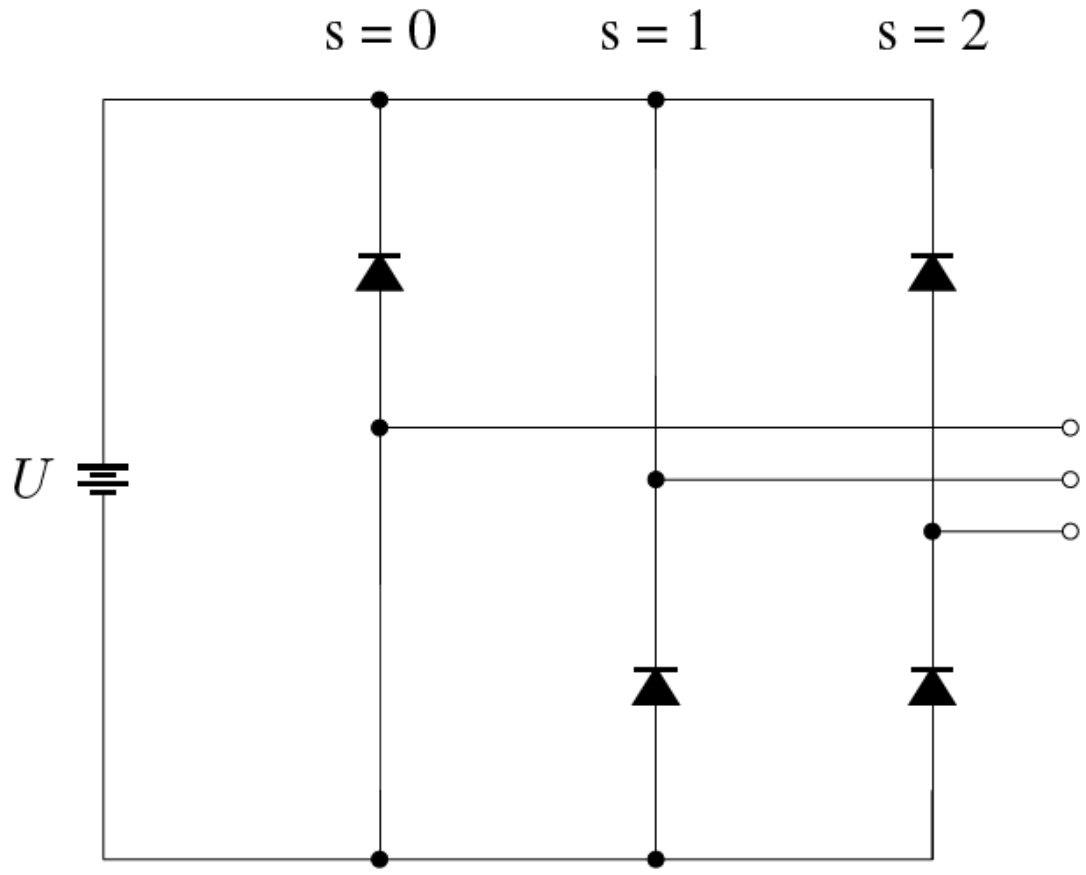


Fig. 3.3

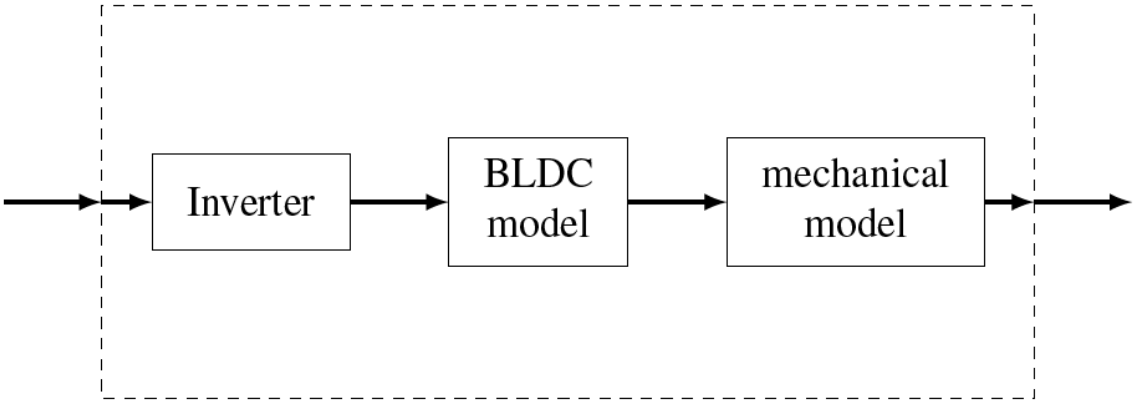


Fig. 3.4

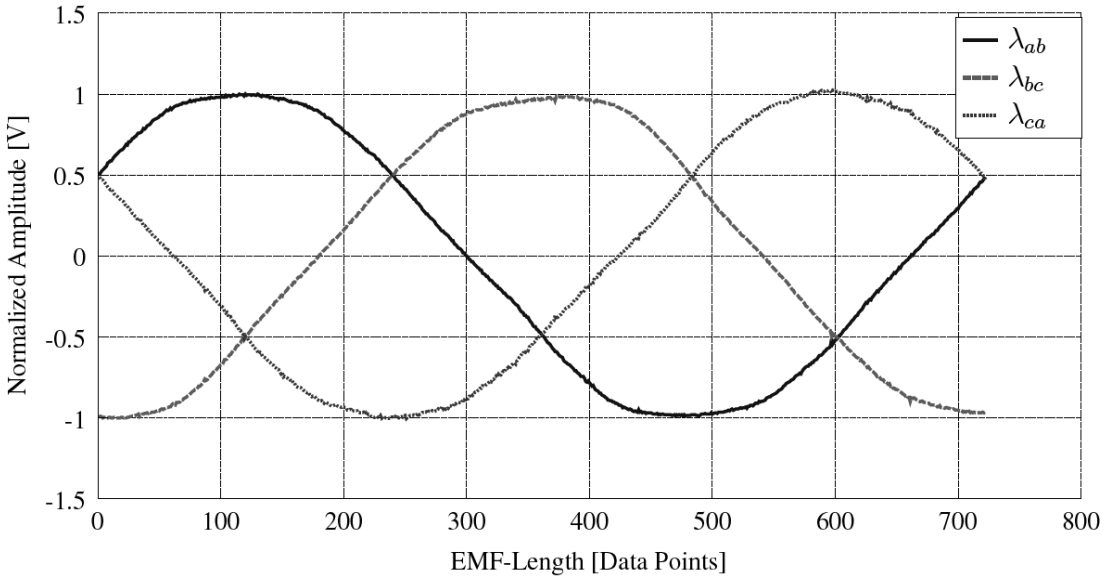

1.5
1
0.5
0
-0.5
-1
-1.5
0
100
200
300
400
500
600
700
800
Normalized Amplitude [V]
EMF-Length [Data Points]
λ_{ab}
λ_{bc}
λ_{ca}

Fig. 3.5

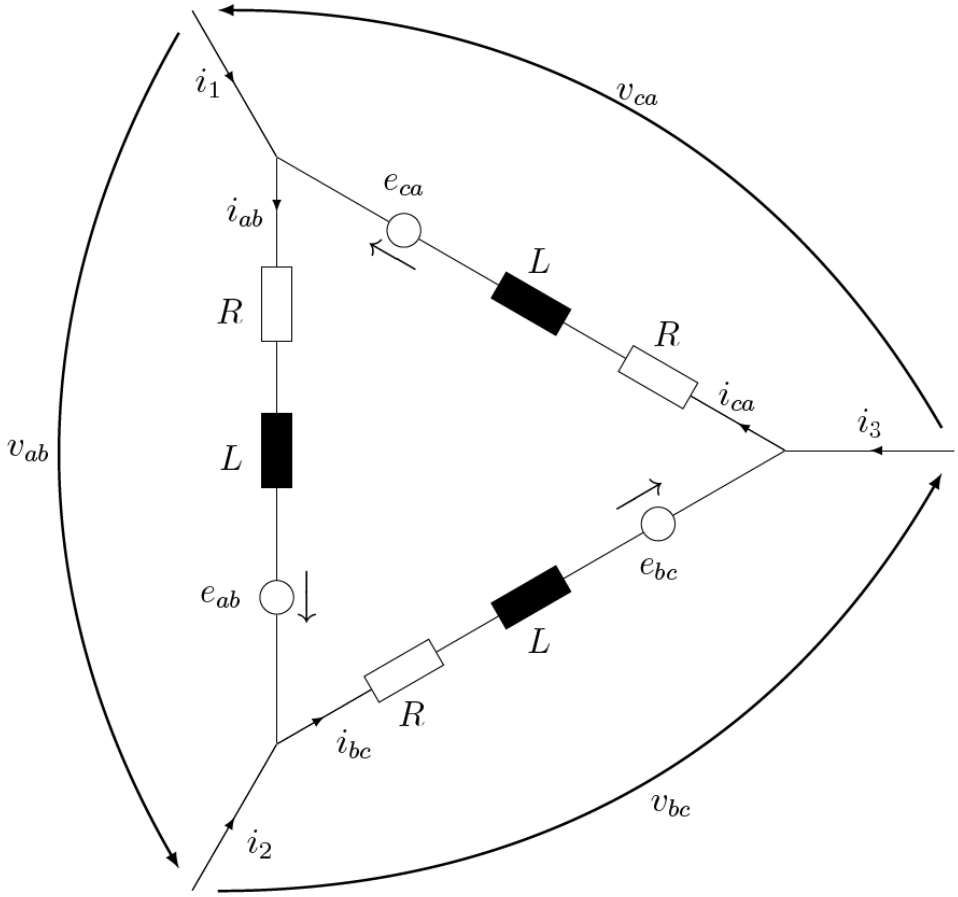

i_1
v_{ca}
e_{ca}
i_{ab}
L
R
R
i_{ca}
i_3
v_{ab}
L
e_{bc}
e_{ab}
L
R
i_{bc}
v_{bc}
i_2

Fig. 3.6

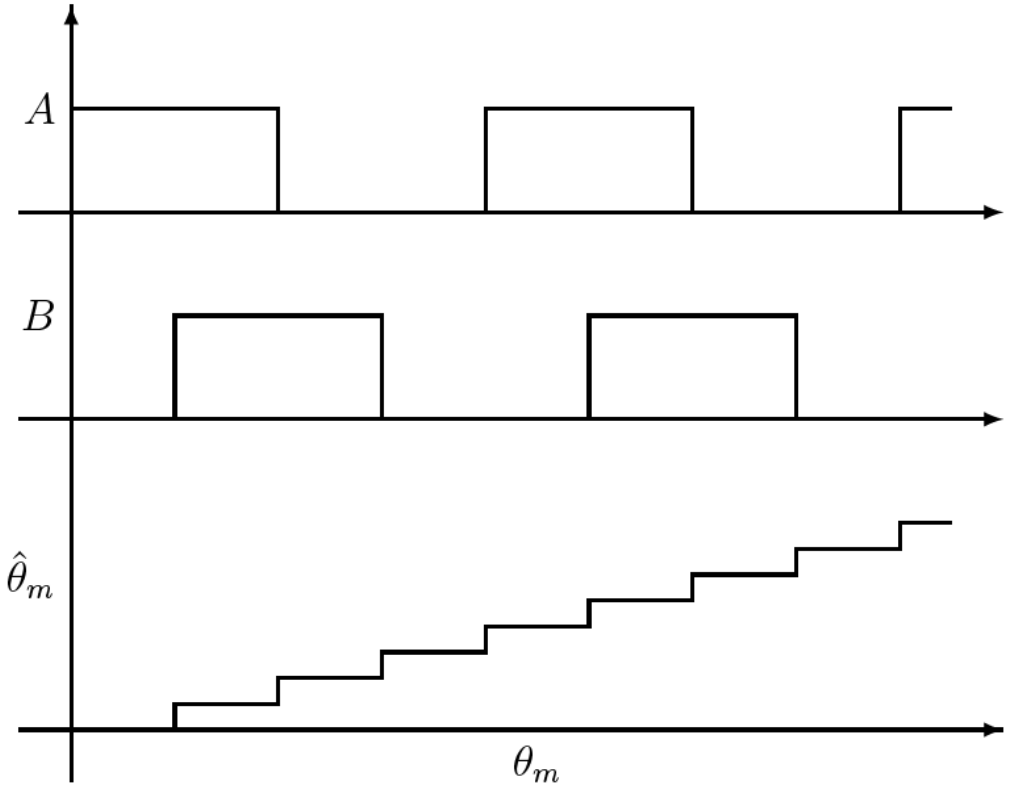

A
B
$\hat{\theta}_m$
θ_m

Fig. 3.7

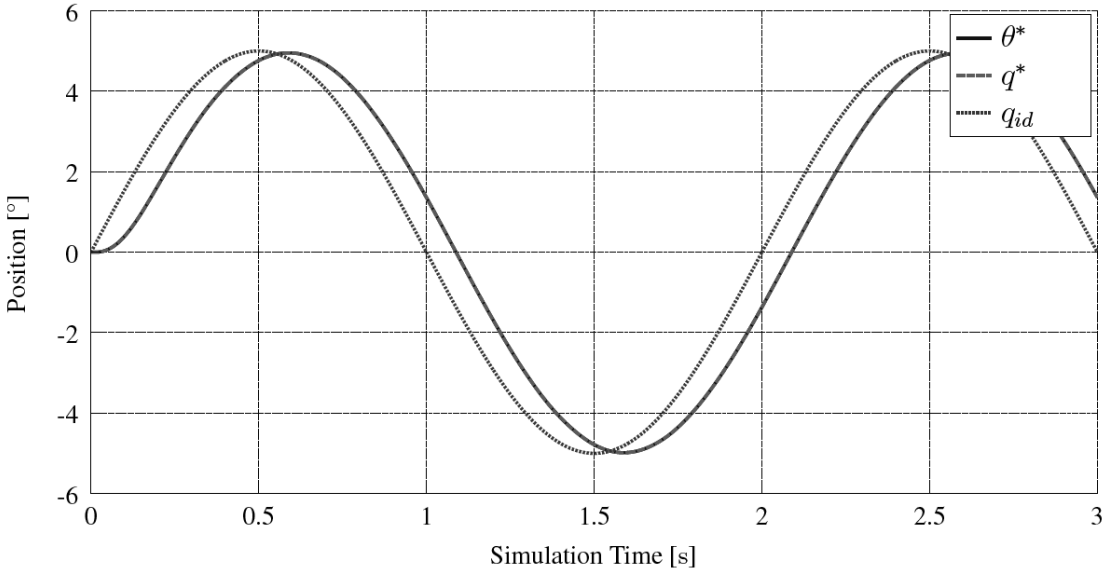

6
4
2
0
-2
-4
-6
0
0.5
1
1.5
2
2.5
3
Position [°]
Simulation Time [s]
θ^*
q^*
q_{id}

Fig. 3.8

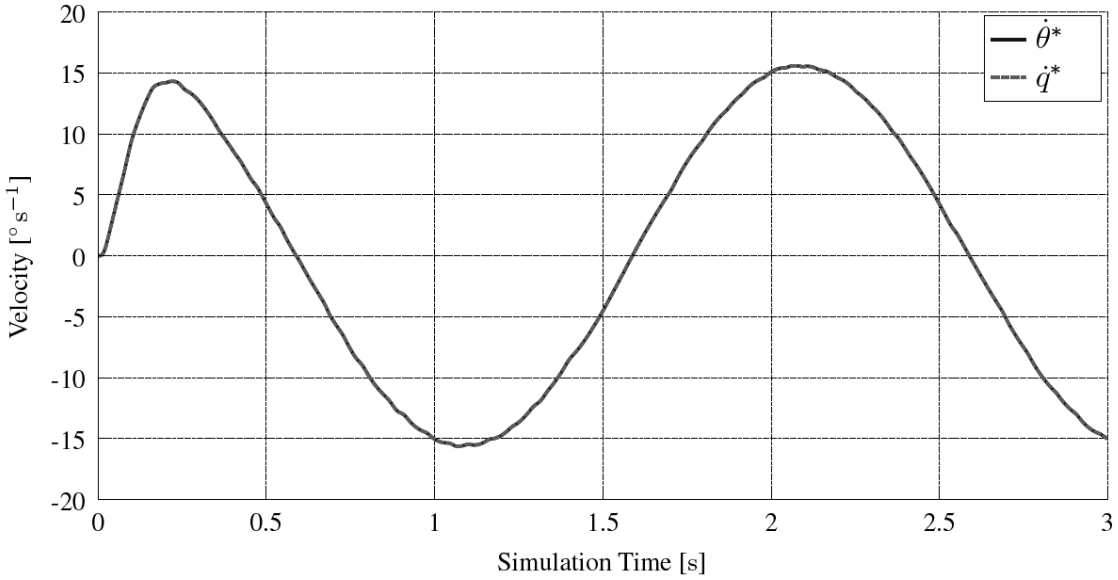


Fig. 3.9

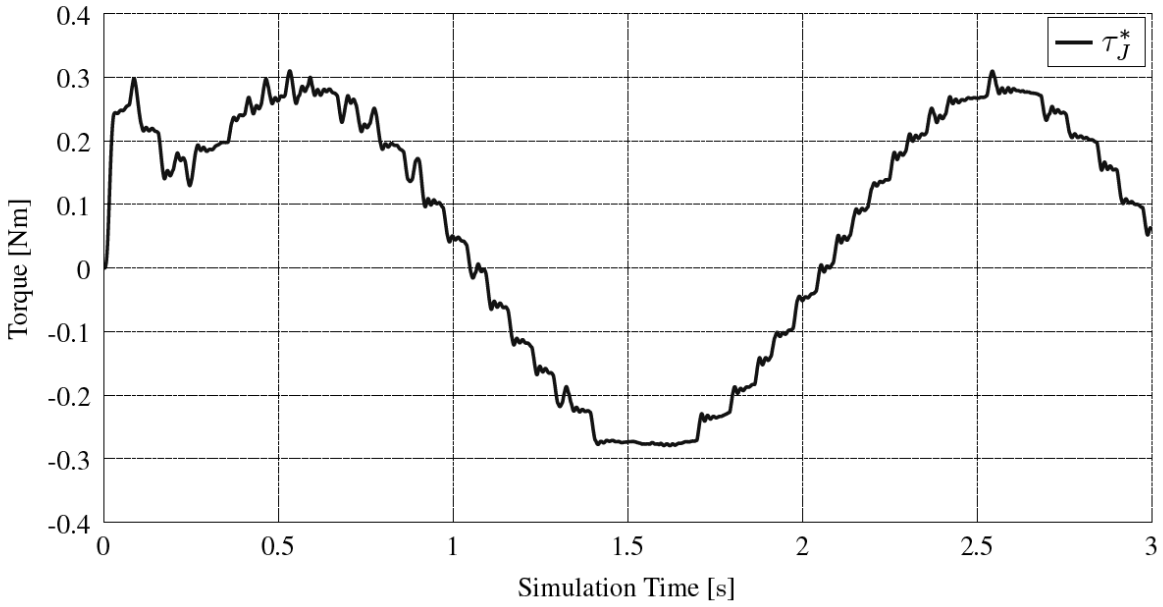


Fig. 3.10

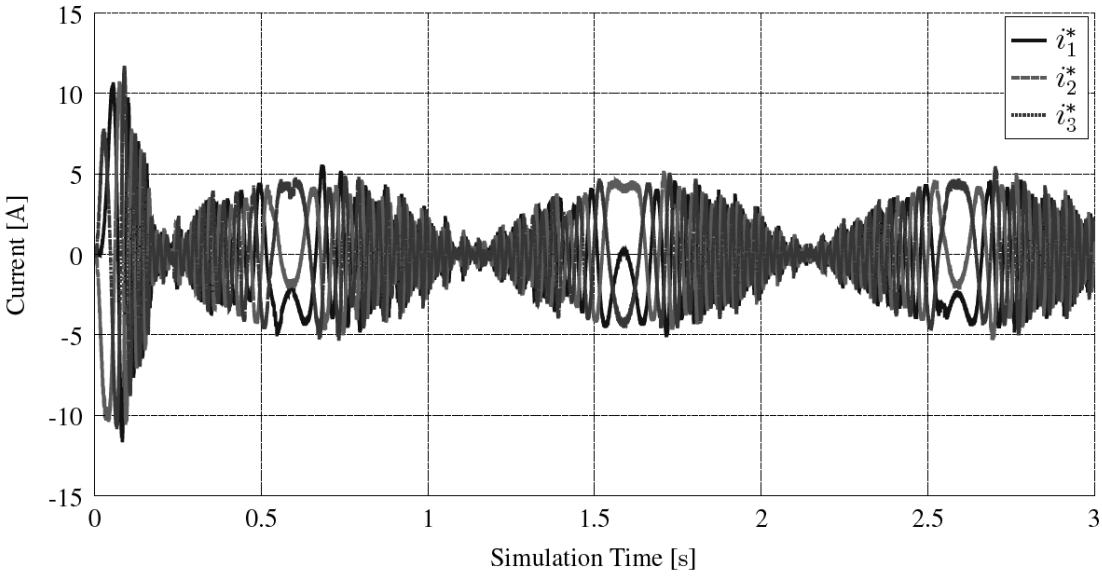


Fig. 3.11

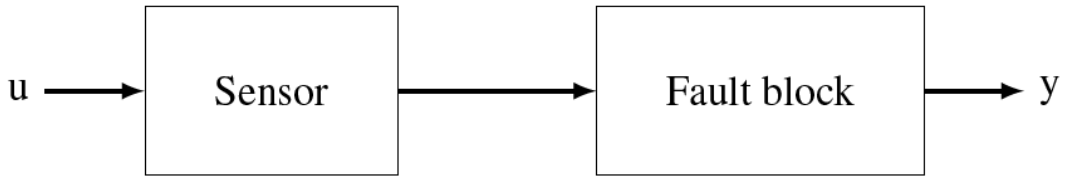


Fig. 3.12

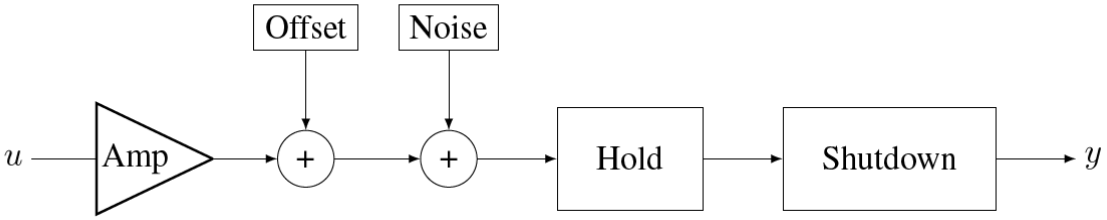


Fig. 3.13

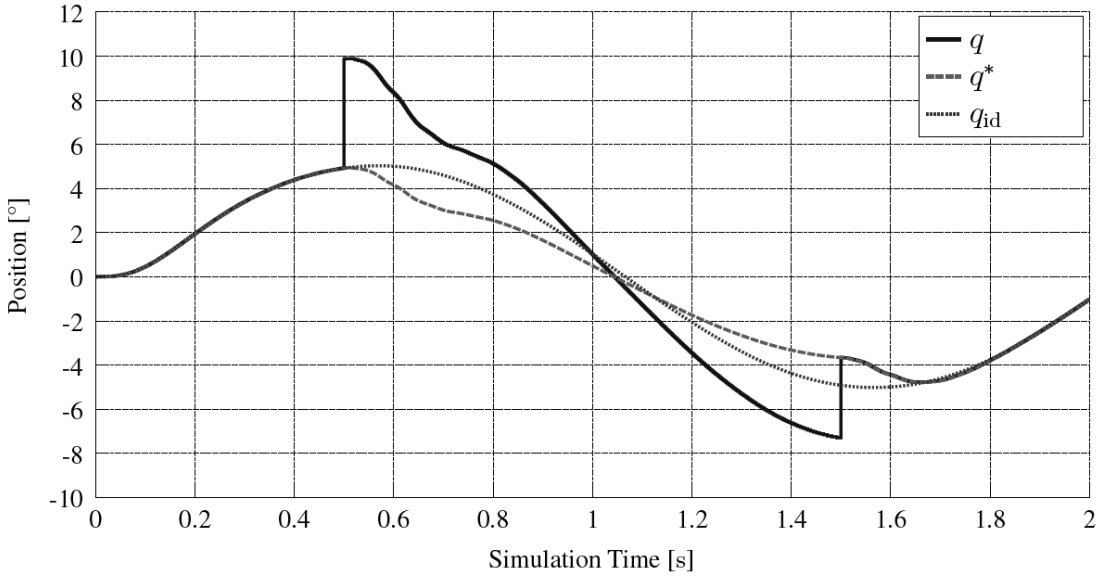


Fig. 3.14

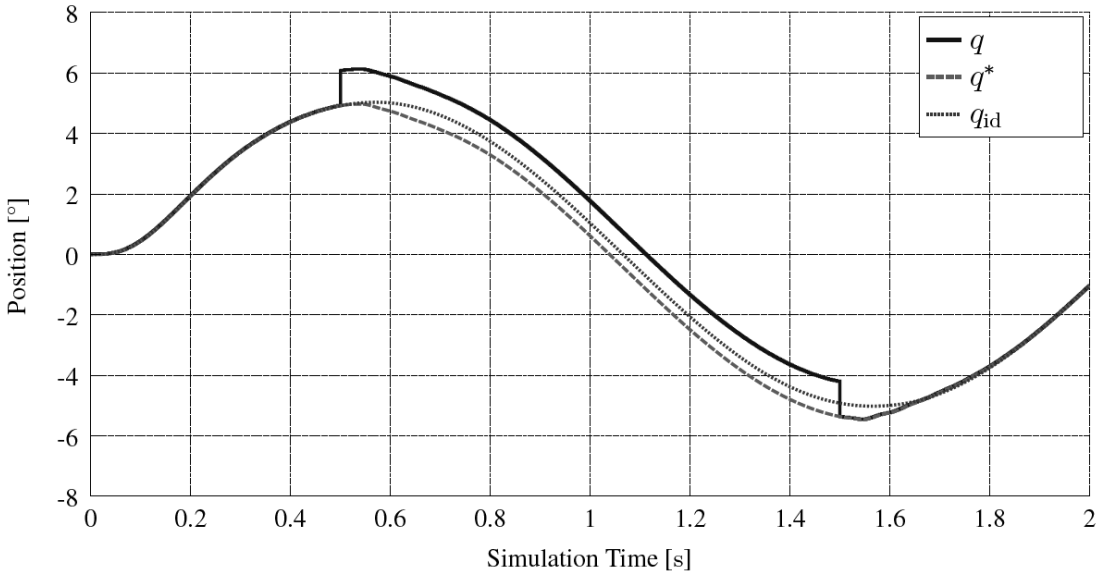


Fig. 3.15

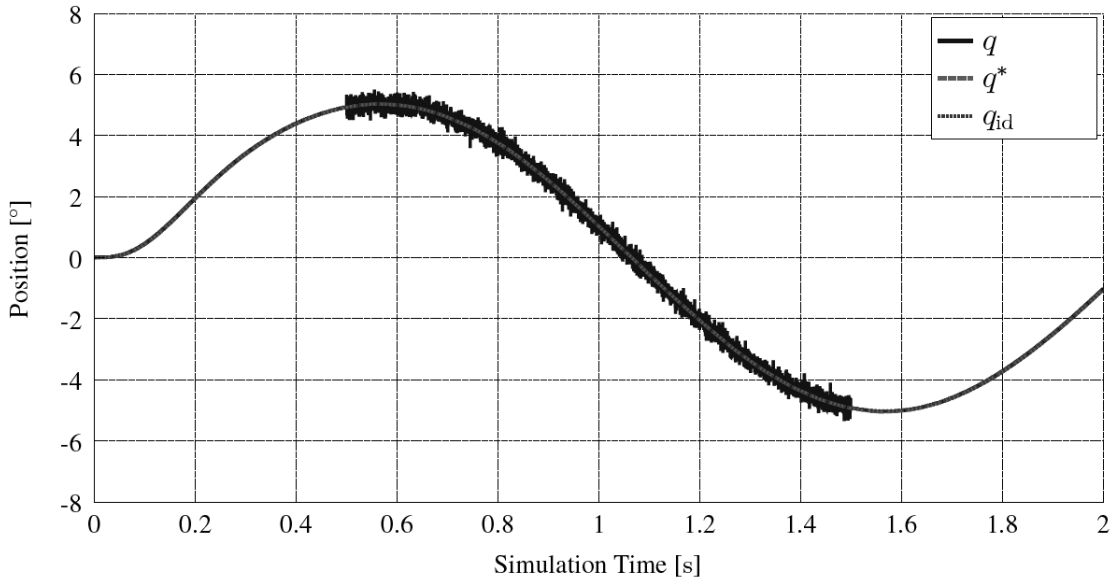


Fig. 3.16

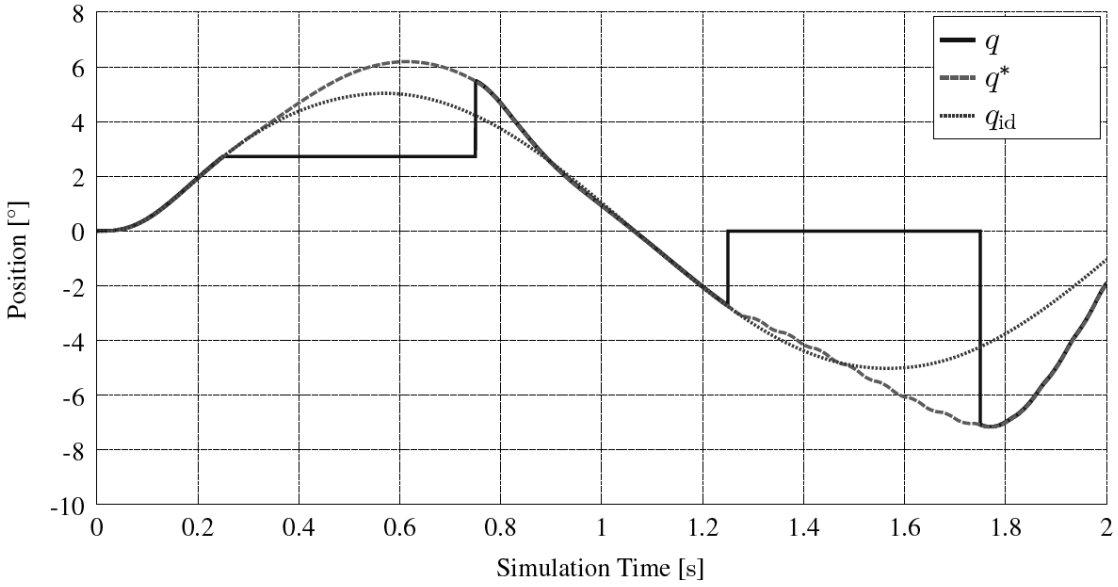


Fig. 3.17

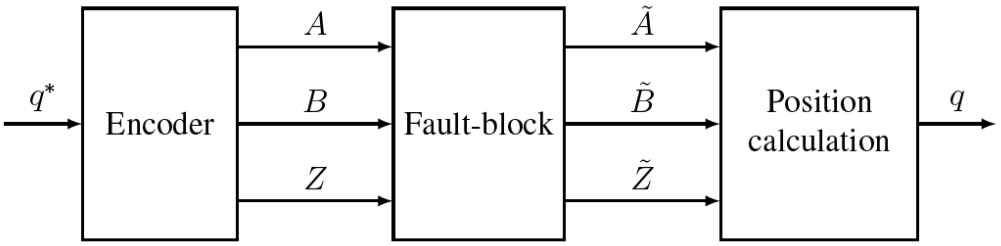


Fig. 3.19

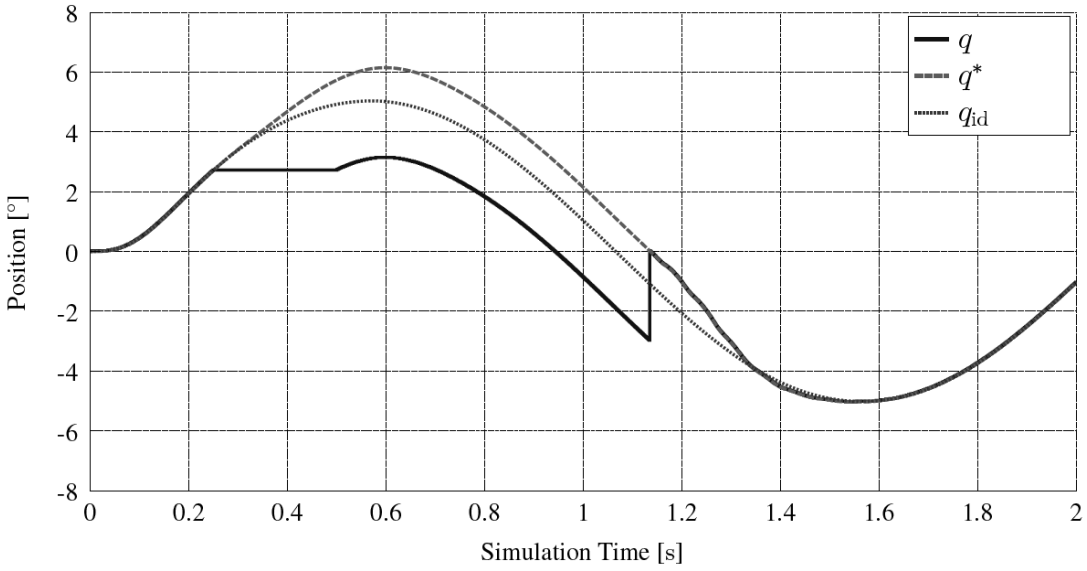


Fig. 3.18

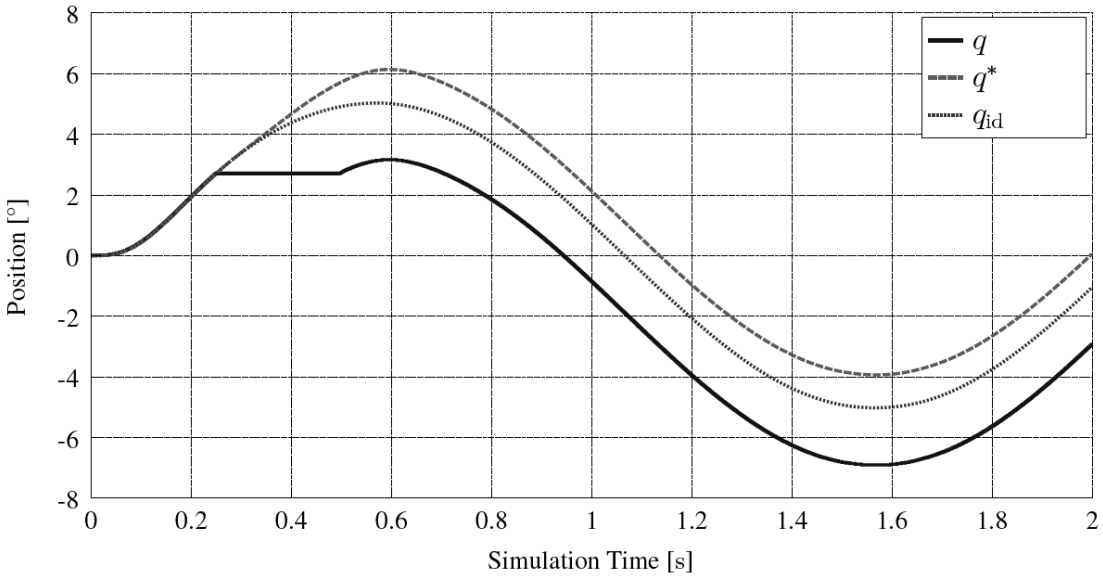


Fig. 3.20

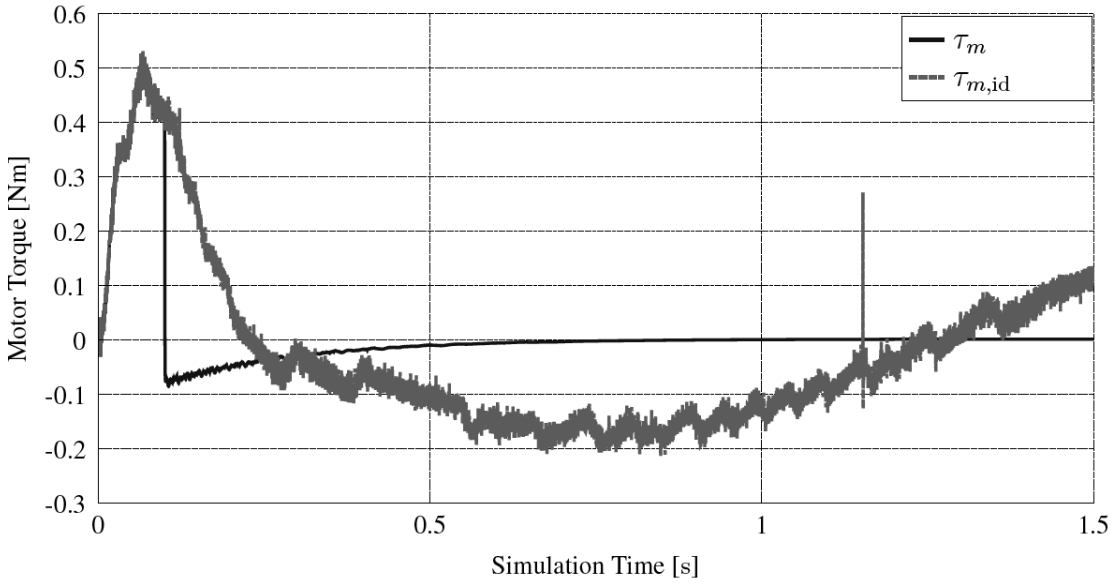


Fig. 3.21

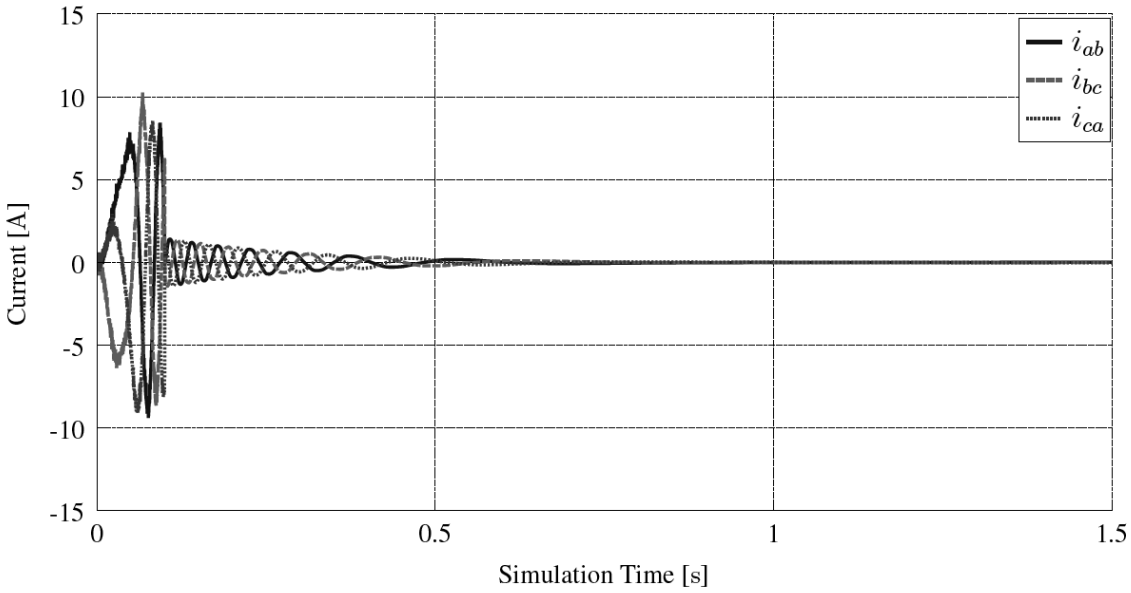


Fig. 3.22

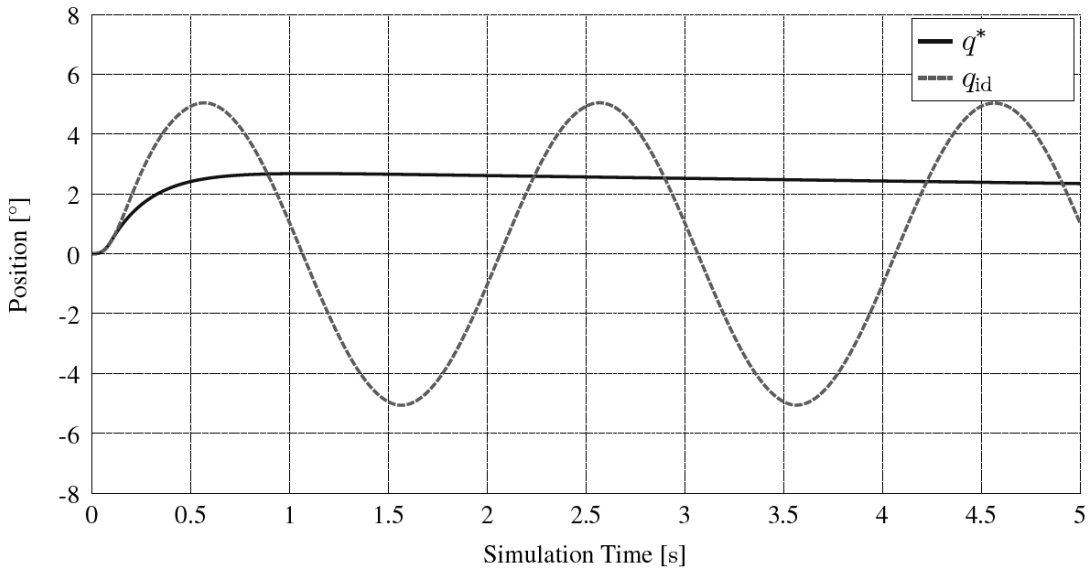


Fig. 3.23

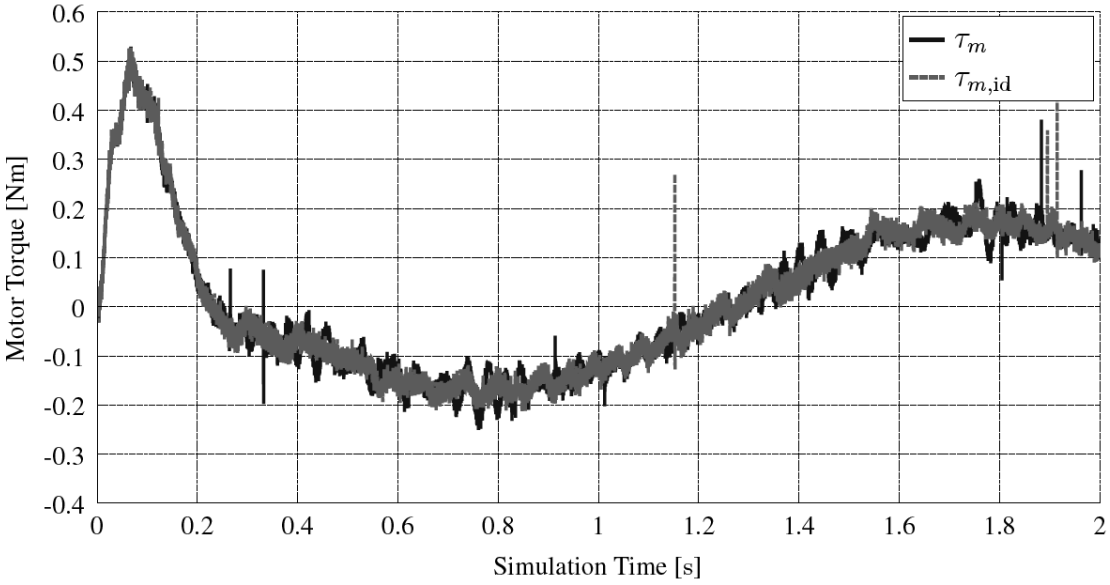


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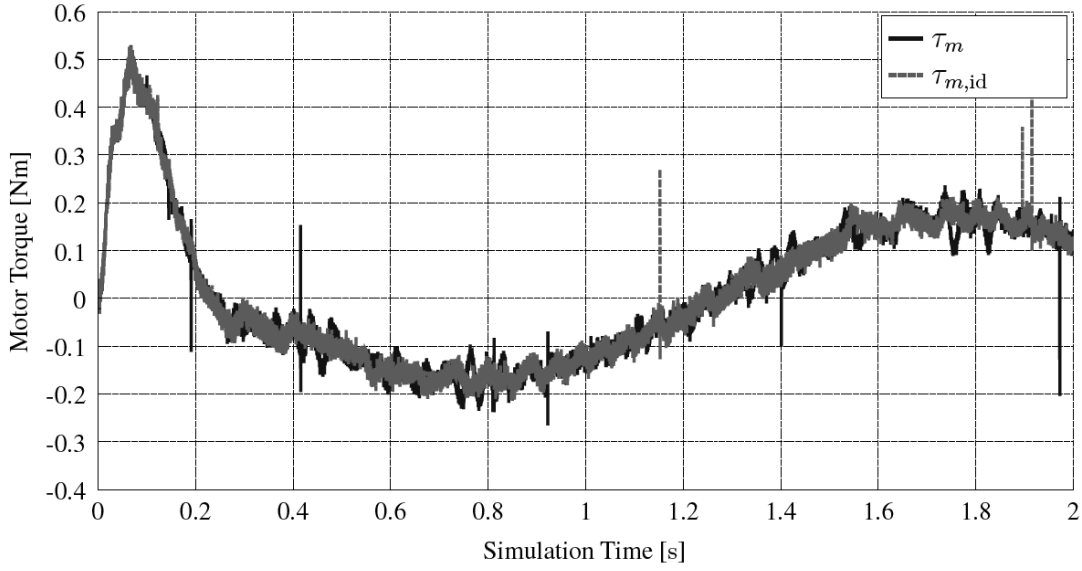


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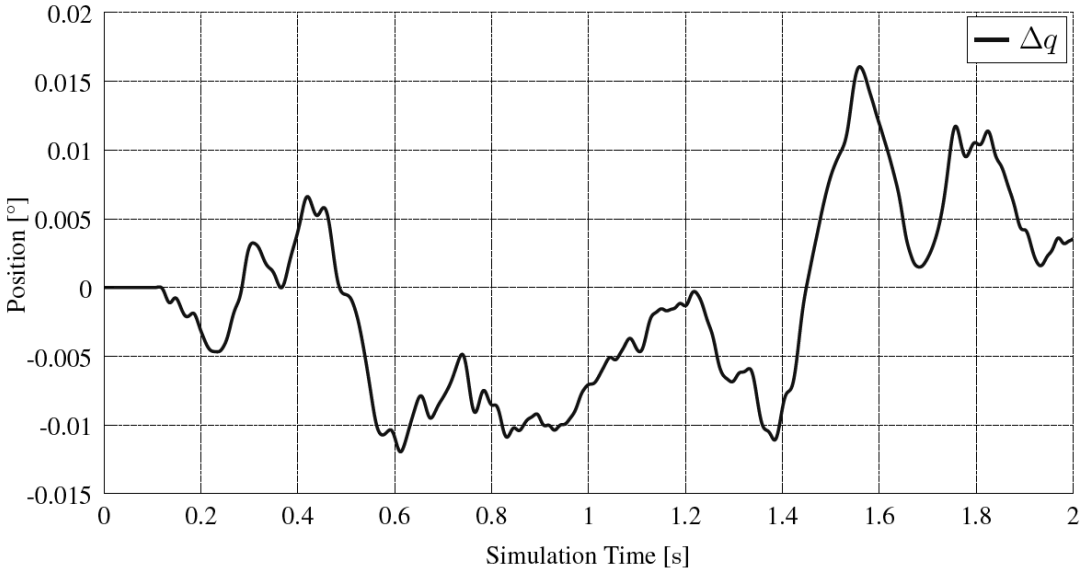


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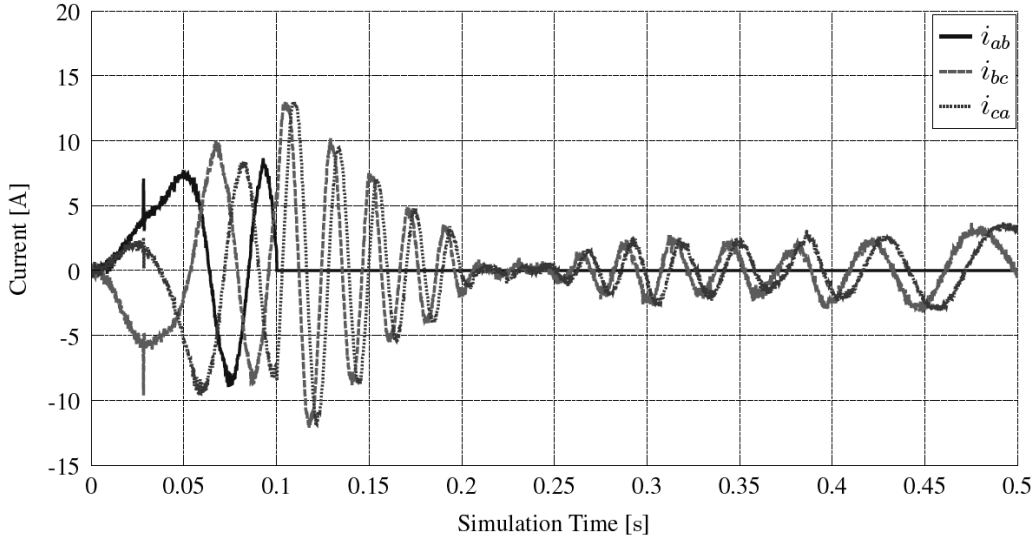


Fig. 3.27

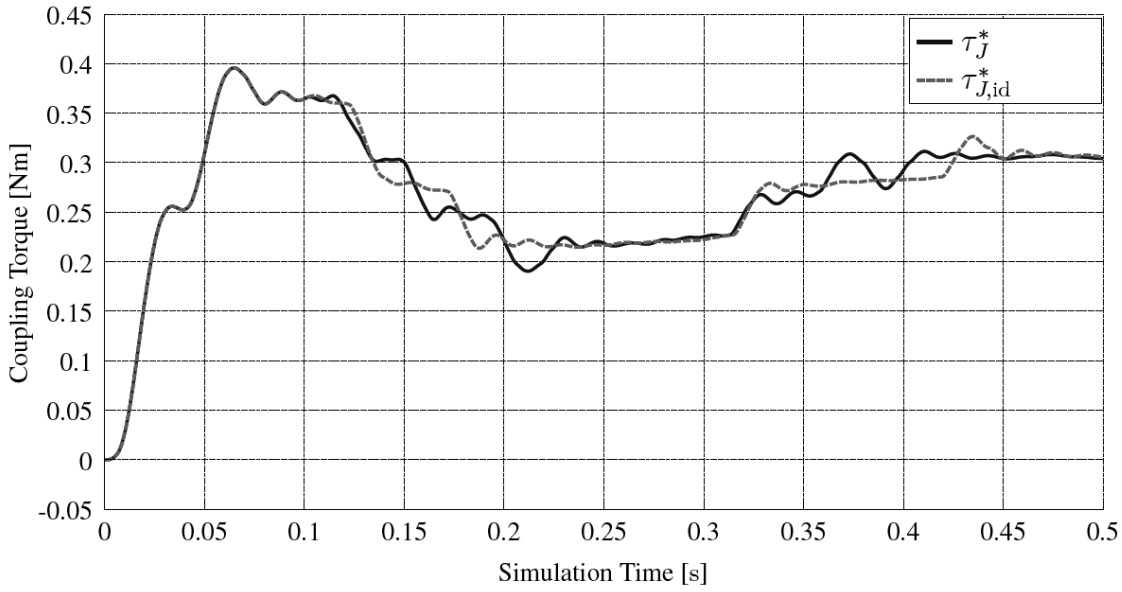


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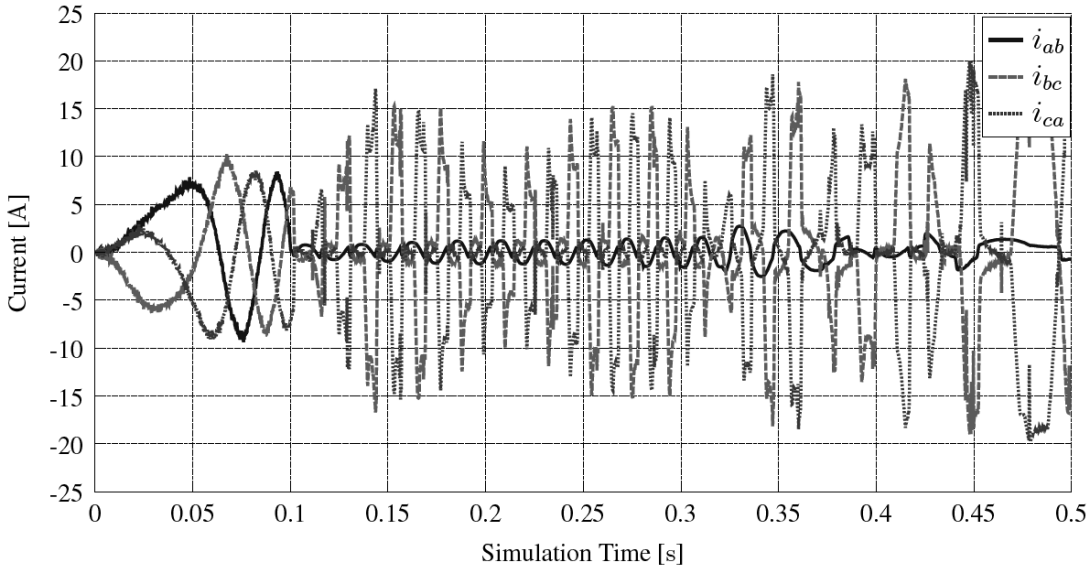


Fig. 3.29

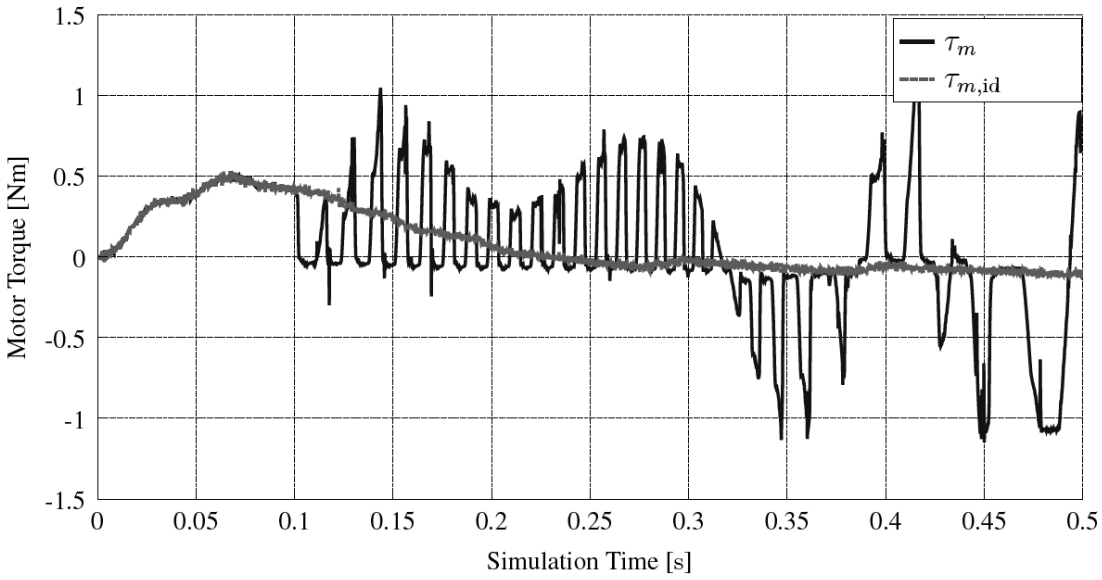


Fig. 3.30

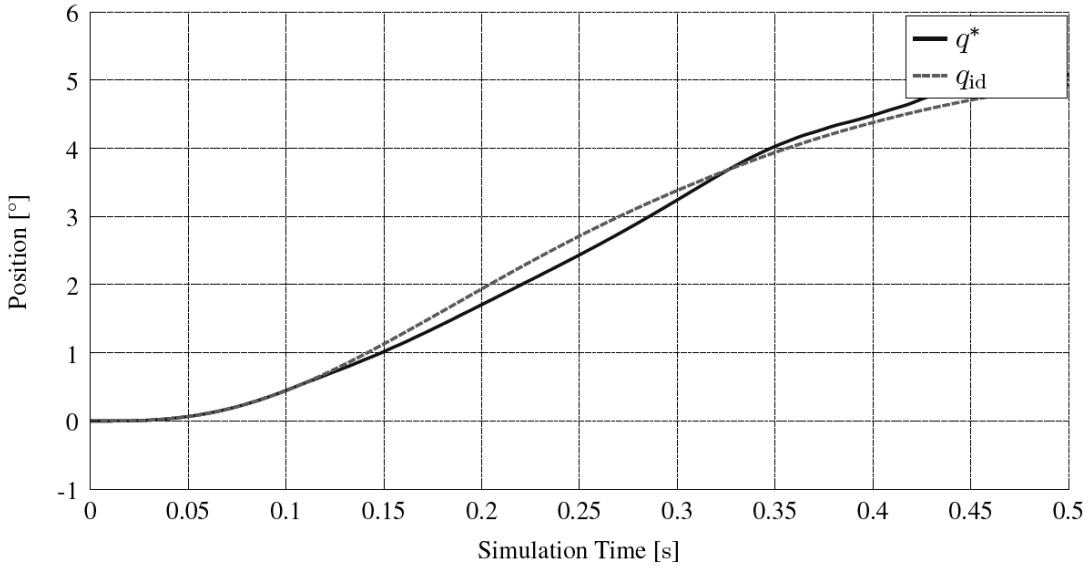


Fig. 3.31

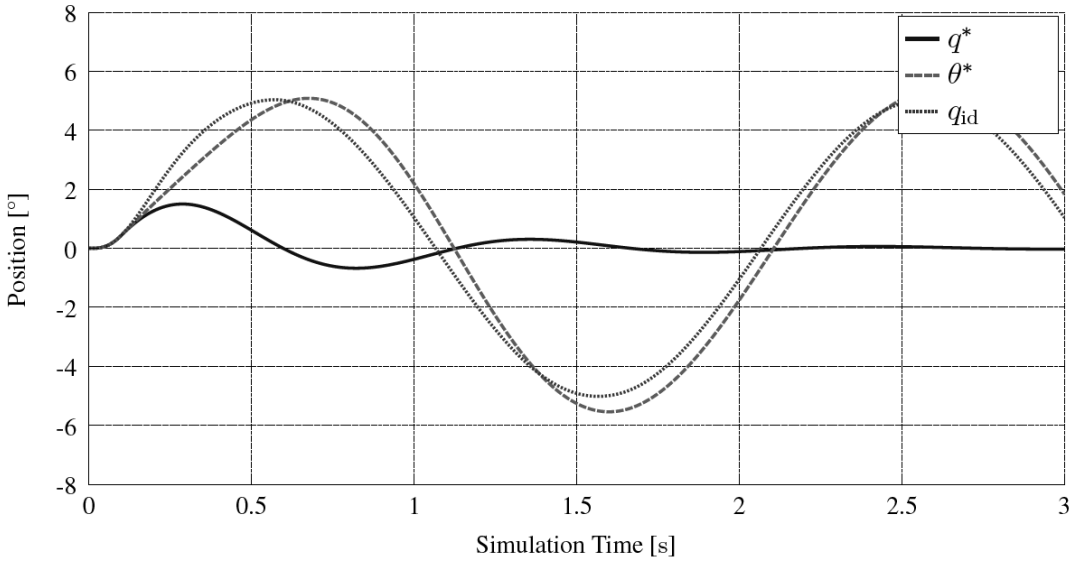


Fig. 3.32

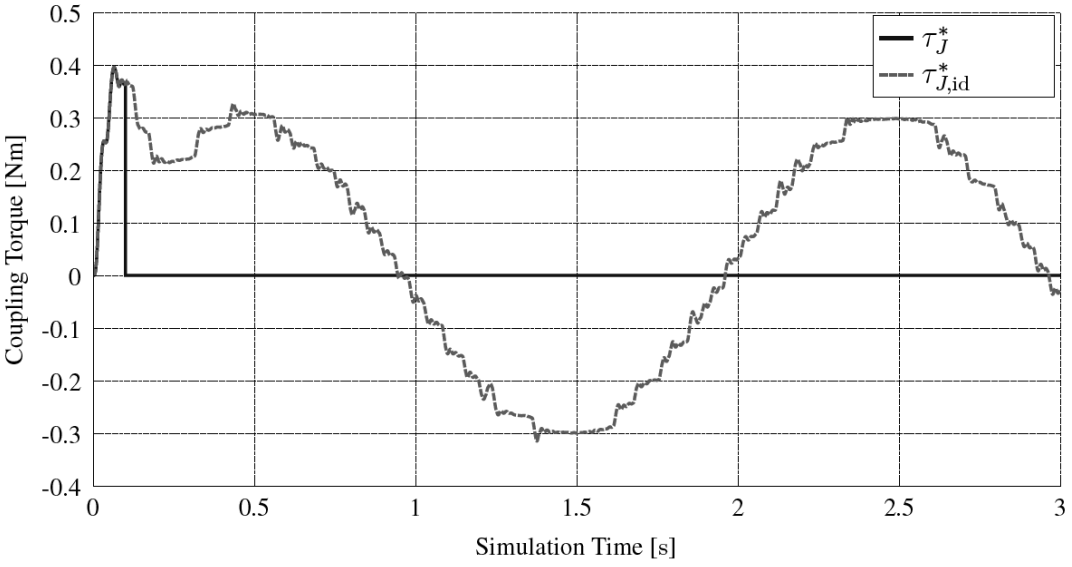


Fig. 3.33

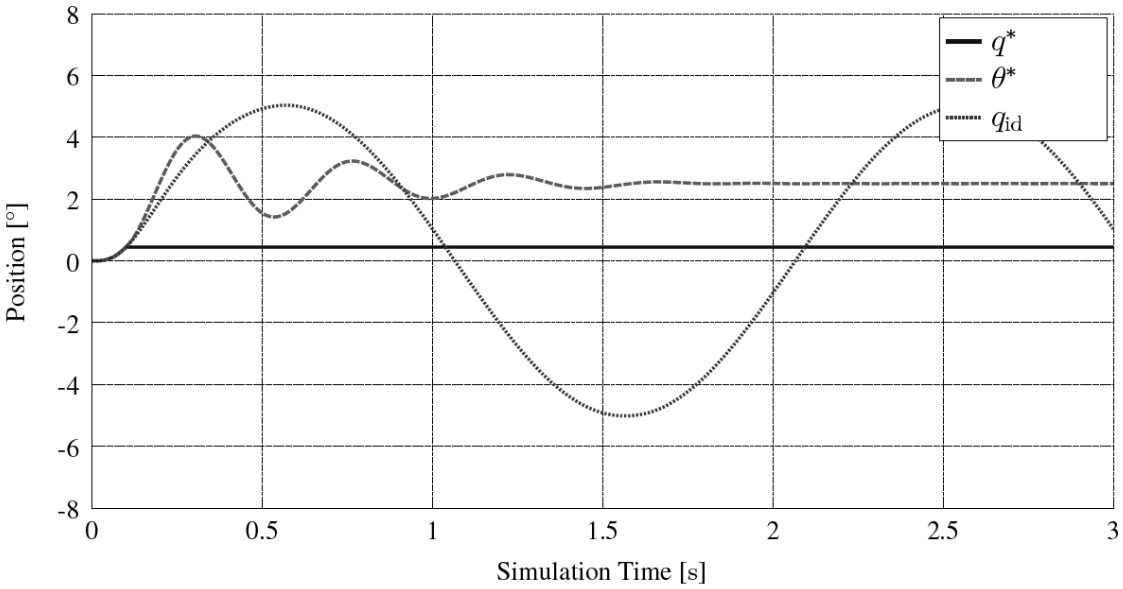


Fig. 3.34

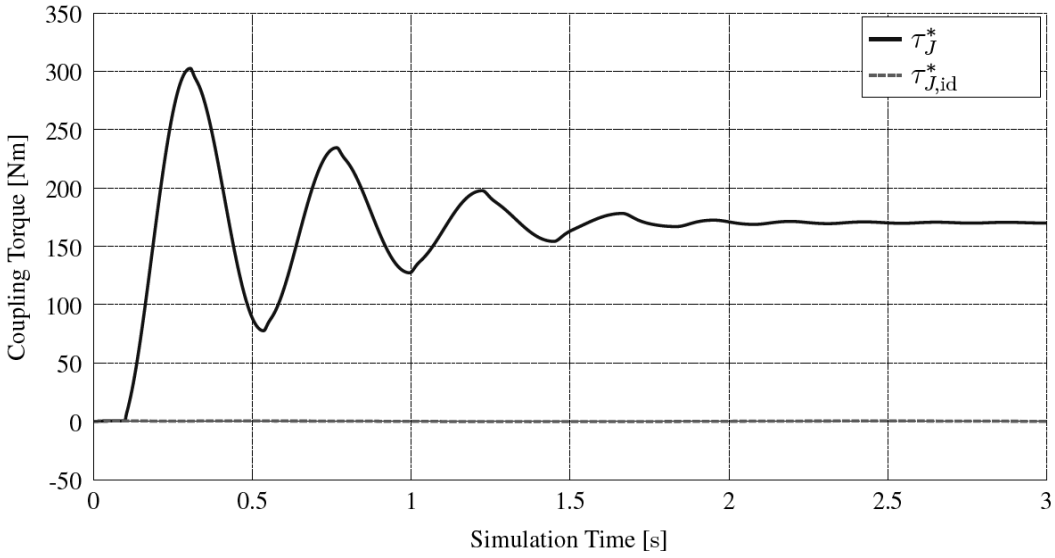


Fig. 3.35

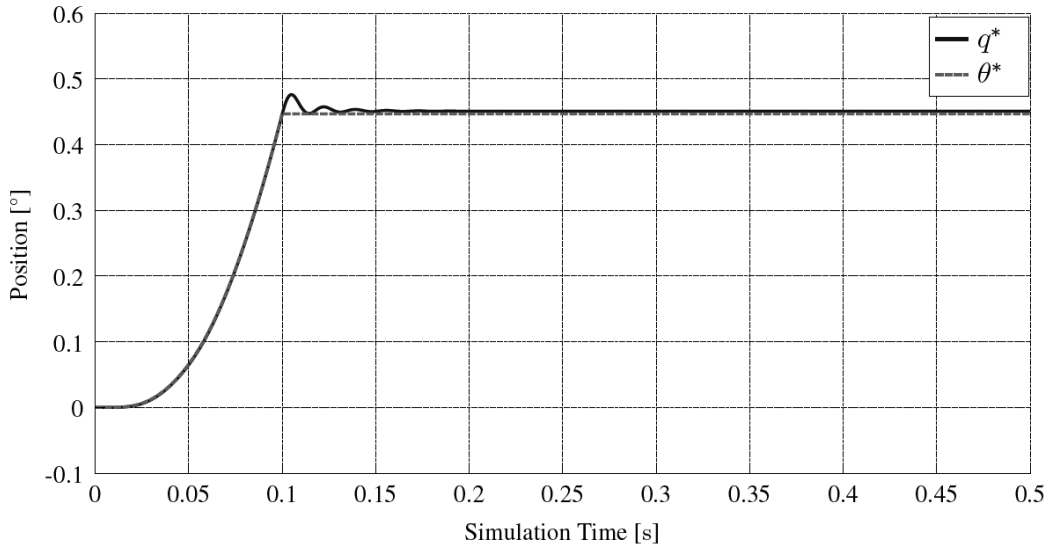


Fig. 3.36

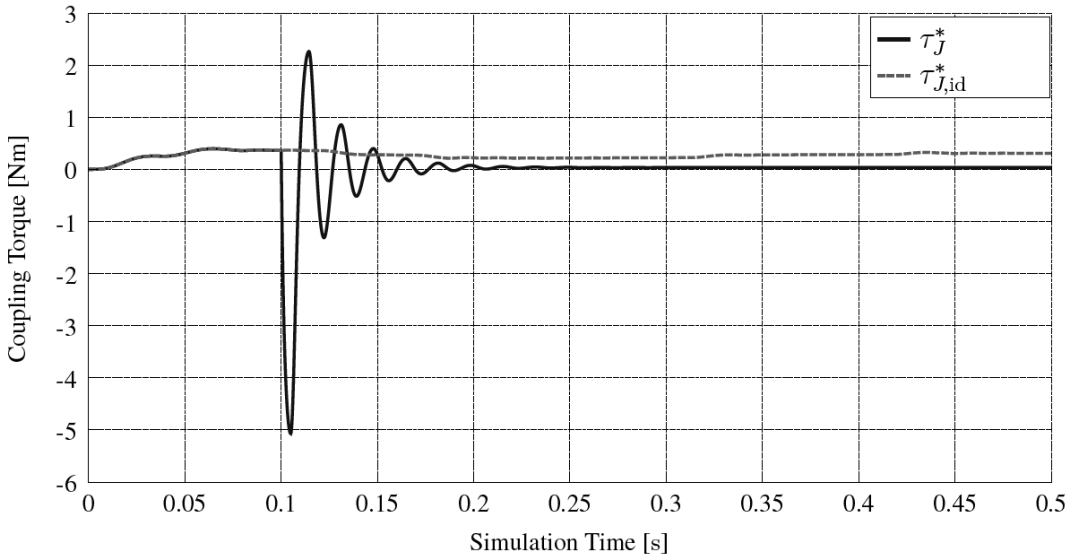


Fig. 3.37

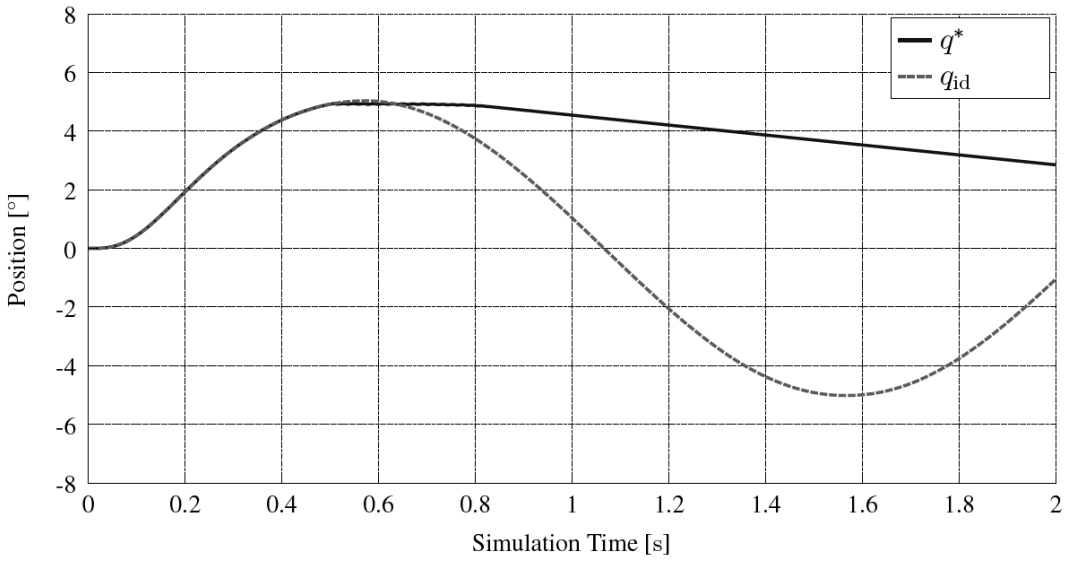


Fig. 3.38

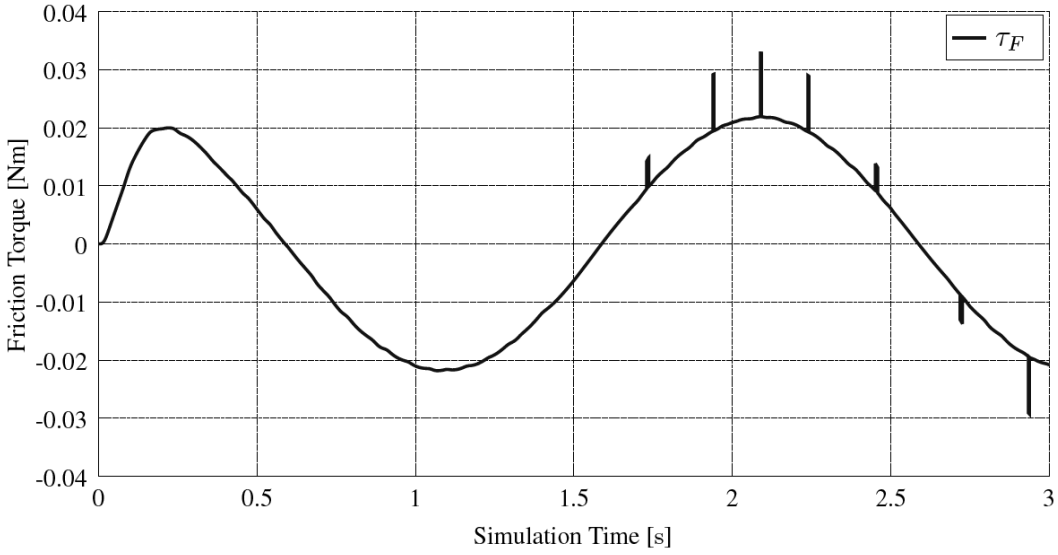


Fig. 3.39

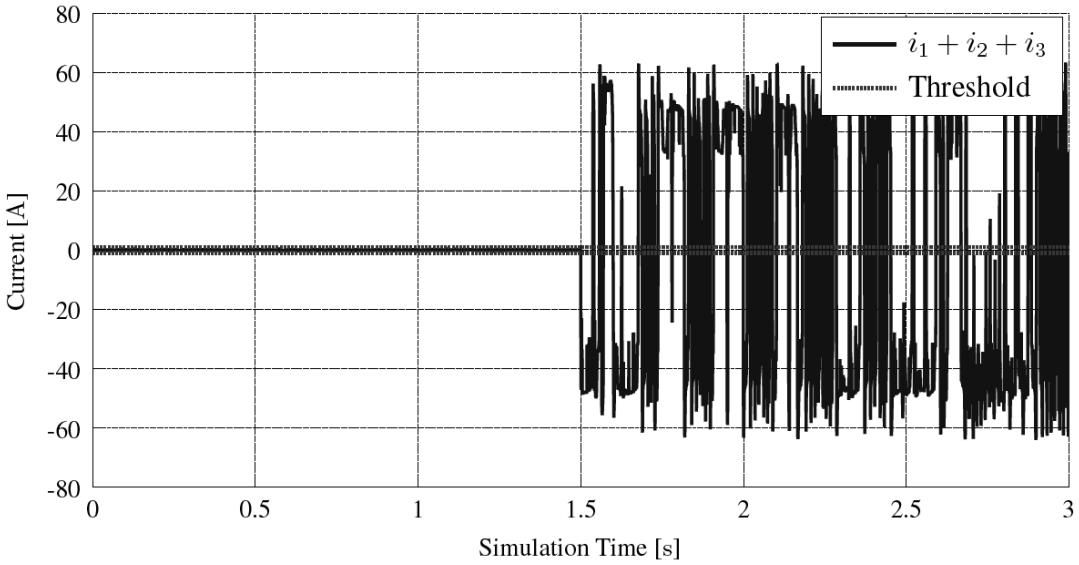

80
60
40
20
0
-20
-40
-60
-80
Current [A]
0
0.5
1
1.5
2
2.5
3
Simulation Time [s]
$i_1 + i_2 + i_3$
Threshold

Fig. 4.1

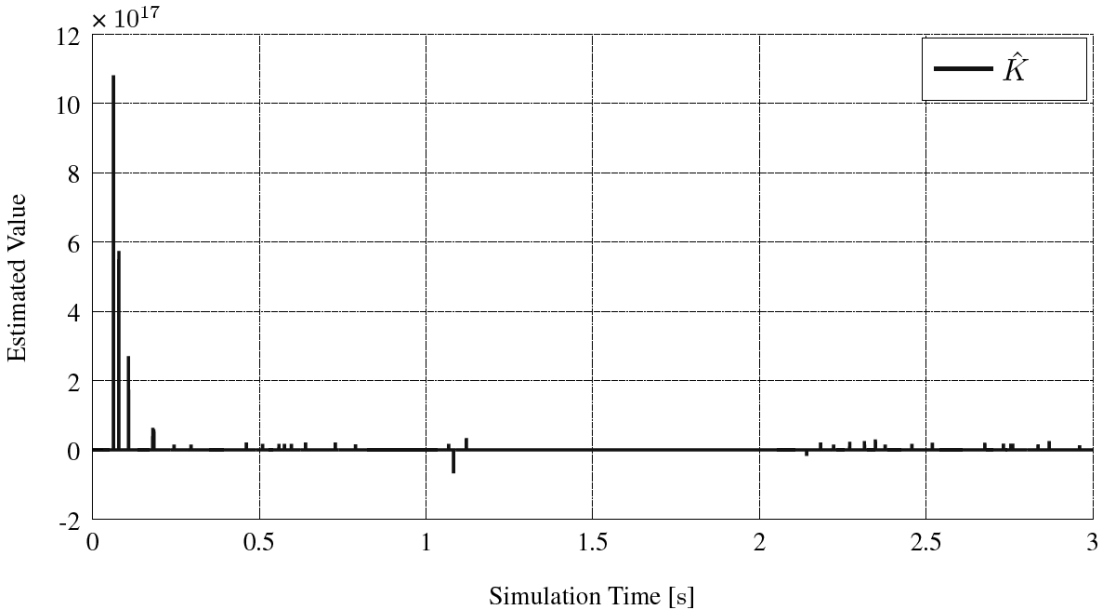

$\times 10^{17}$
12
10
8
6
4
2
0
-2
Estimated Value
0
0.5
1
1.5
2
2.5
3
Simulation Time [s]
$\hat{K}$

Fig. 4.2

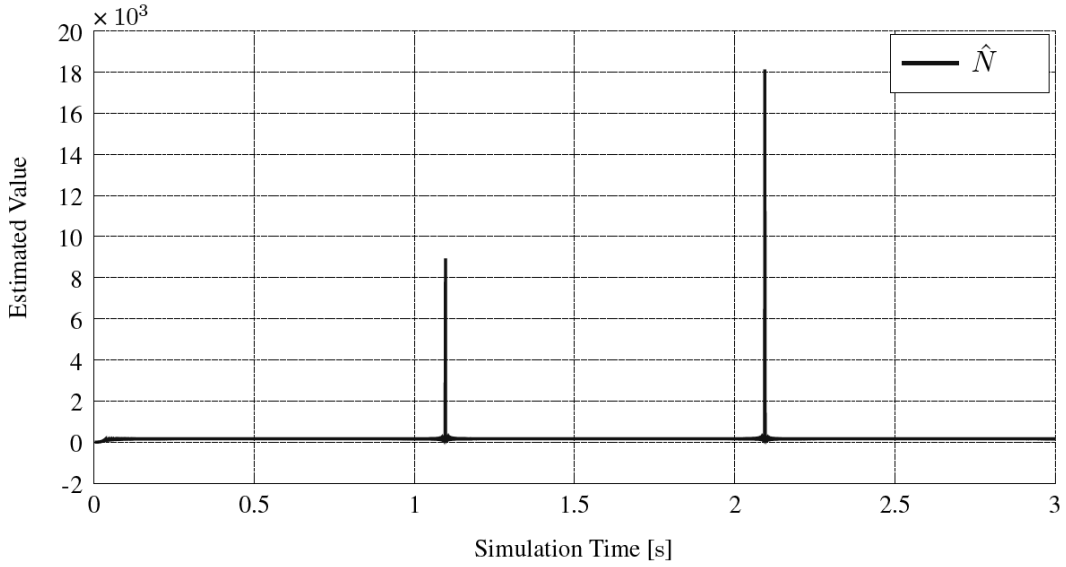

× 10^3
20
18
16
14
12
10
8
6
4
2
0
-2
Estimated Value
$\hat{N}$
0
0.5
1
1.5
2
2.5
3
Simulation Time [s]

Fig. 4.3

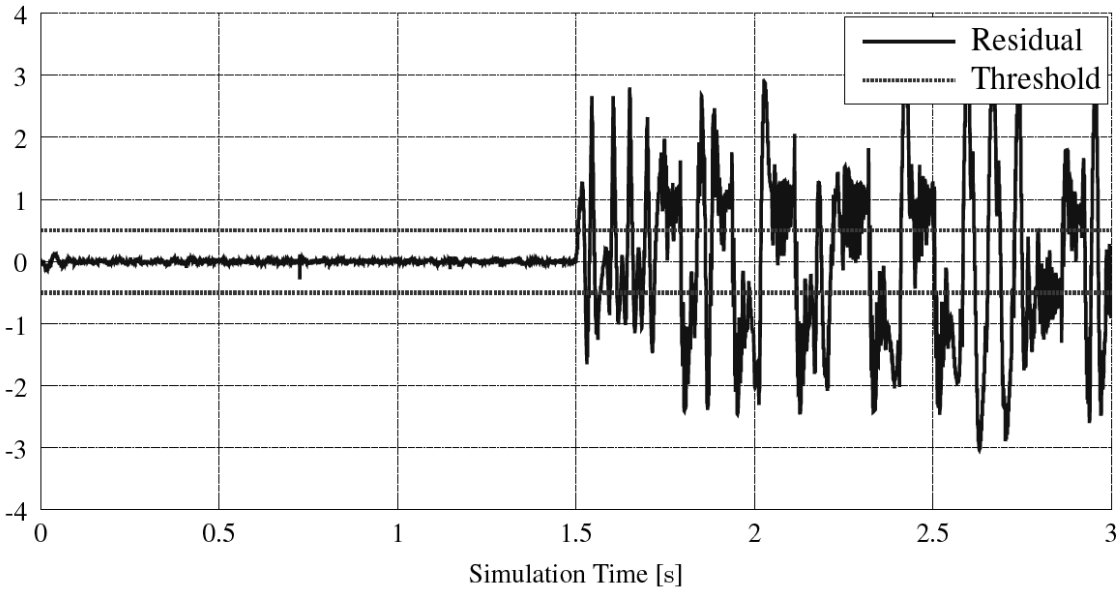

4
3
2
1
0
-1
-2
-3
-4
Residual
Threshold
0
0.5
1
1.5
2
2.5
3
Simulation Time [s]

Fig. 4.4

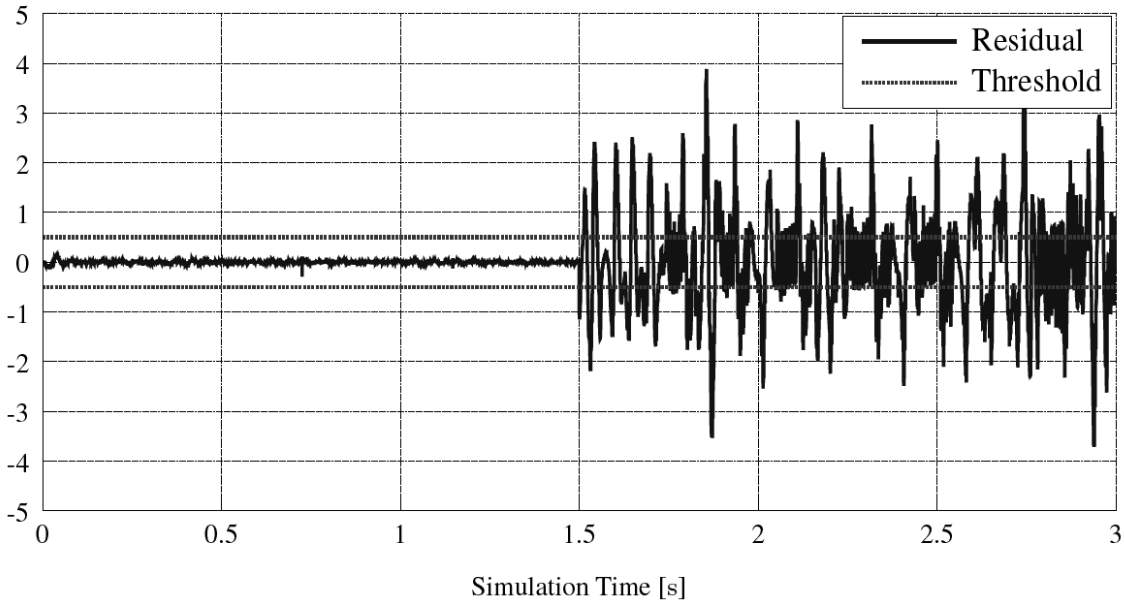

Residual
Threshold
5
4
3
2
1
0
-1
-2
-3
-4
-5
0
0.5
1
1.5
2
2.5
3
Simulation Time [s]

Fig. 4.5

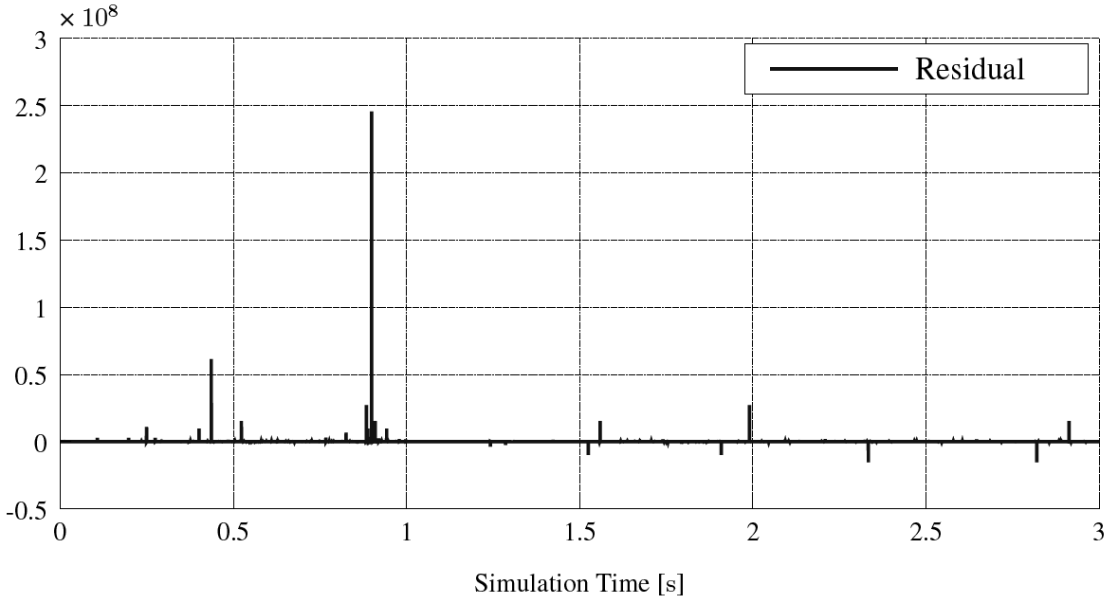

× 10^8
Residual
3
2.5
2
1.5
1
0.5
0
-0.5
0
0.5
1
1.5
2
2.5
3
Simulation Time [s]

Fig. 4.6

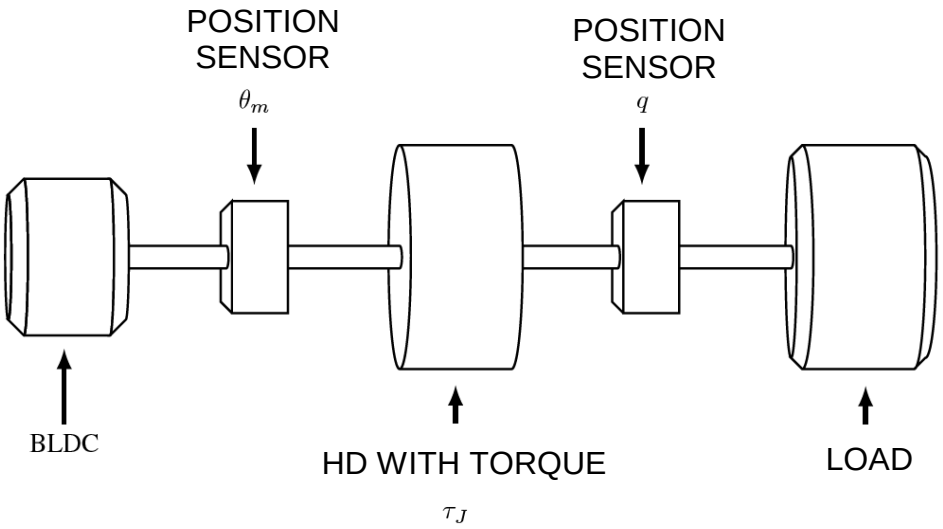


Fig. 5.1

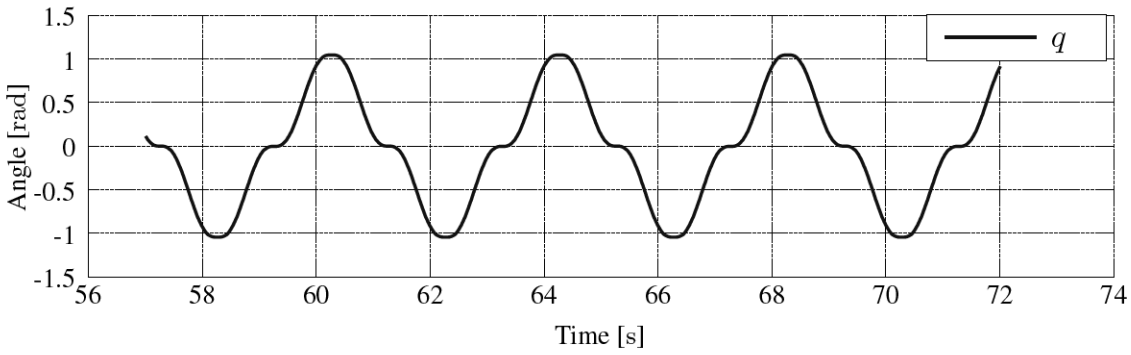


Fig. 5.2

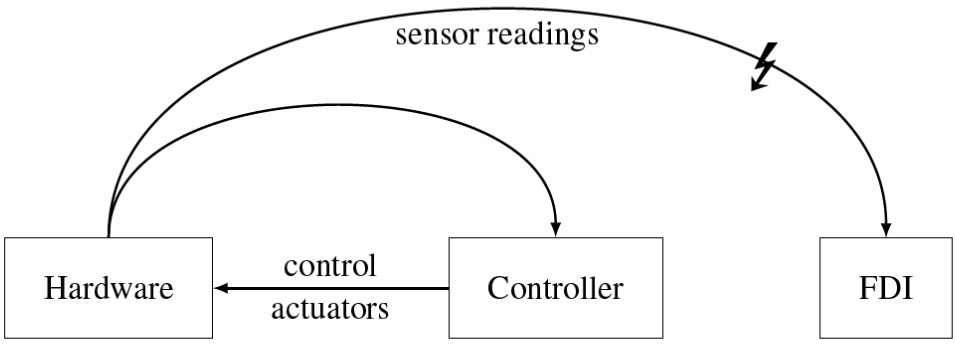


Figure 5.3: Diagram of the connection of the FDI to the test structure

Fig. 5.3

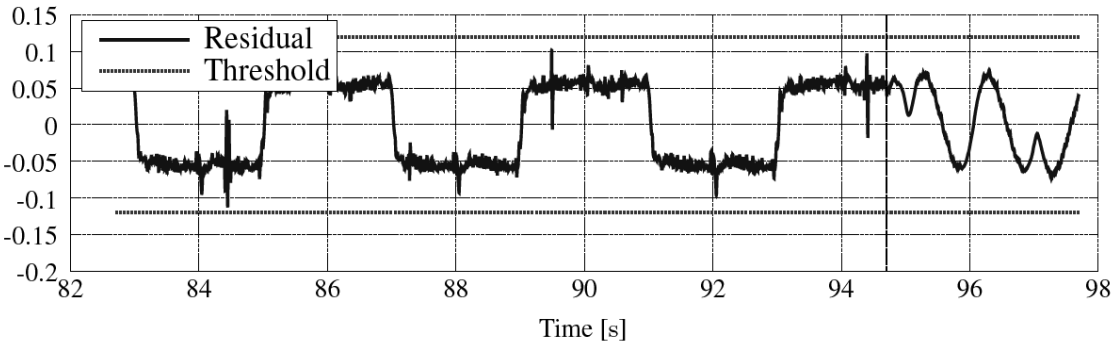


Fig. 5.4

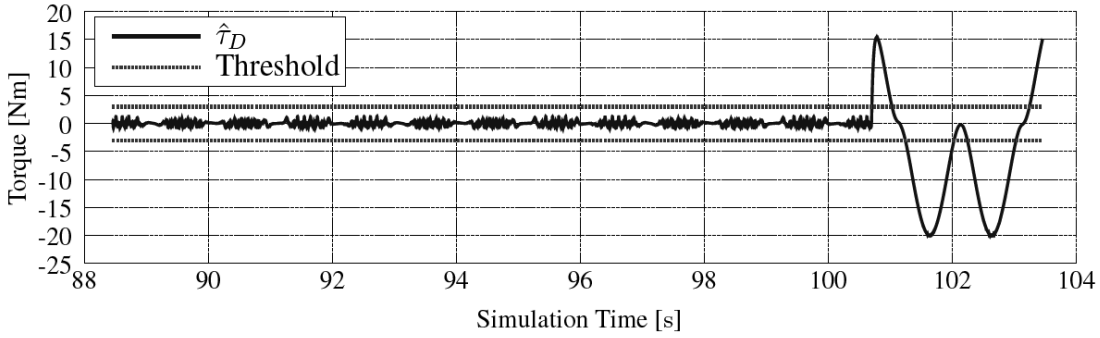


Fig. 5.5a

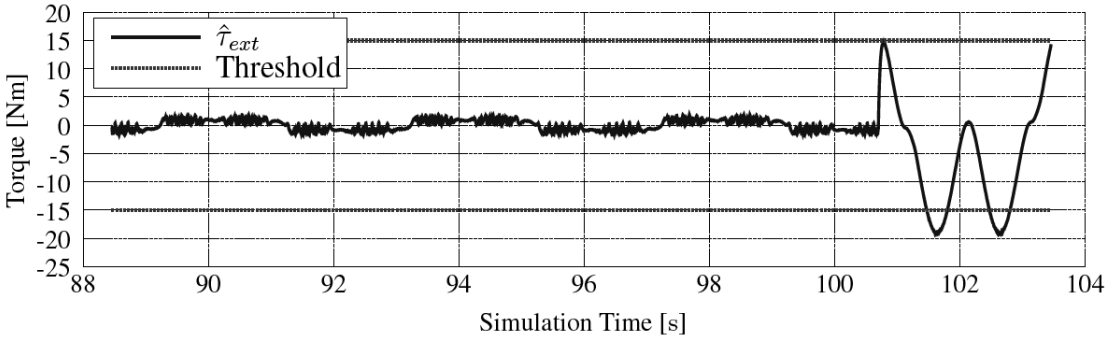


Fig. 5.5b

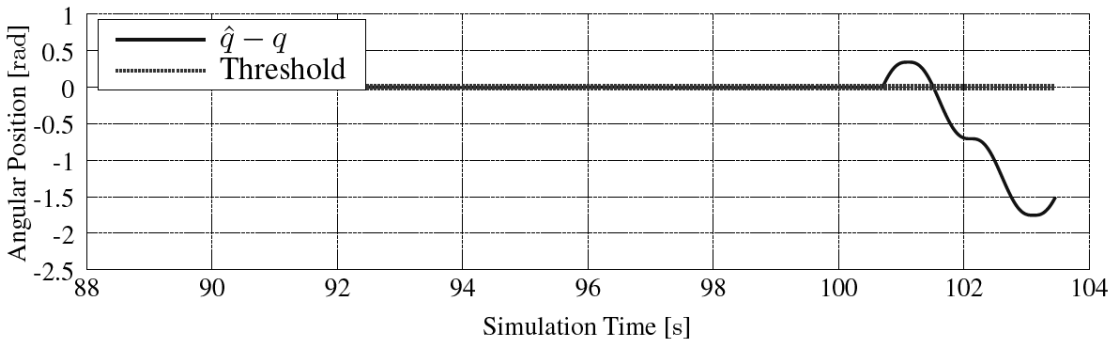


Fig. 5.5c

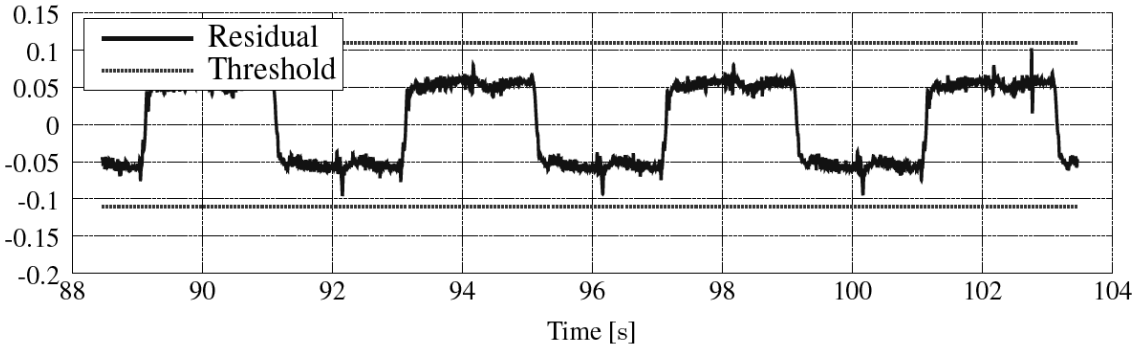


Fig. 5.6a

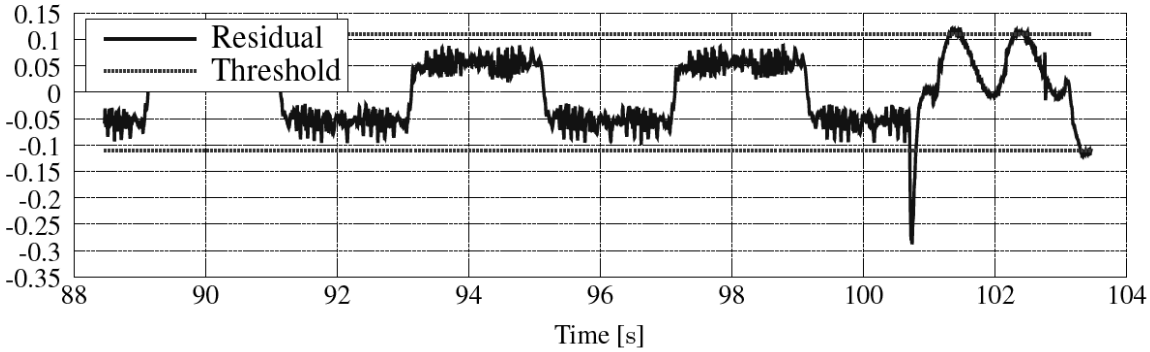


Fig. 5.6b

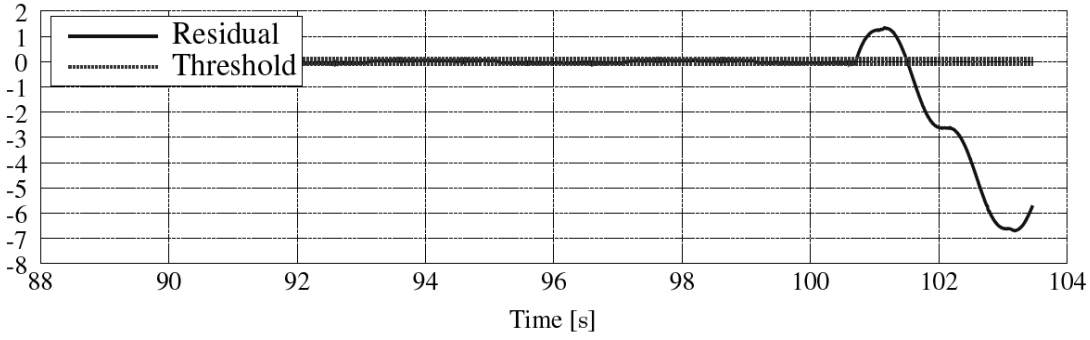


Fig. 5.6c

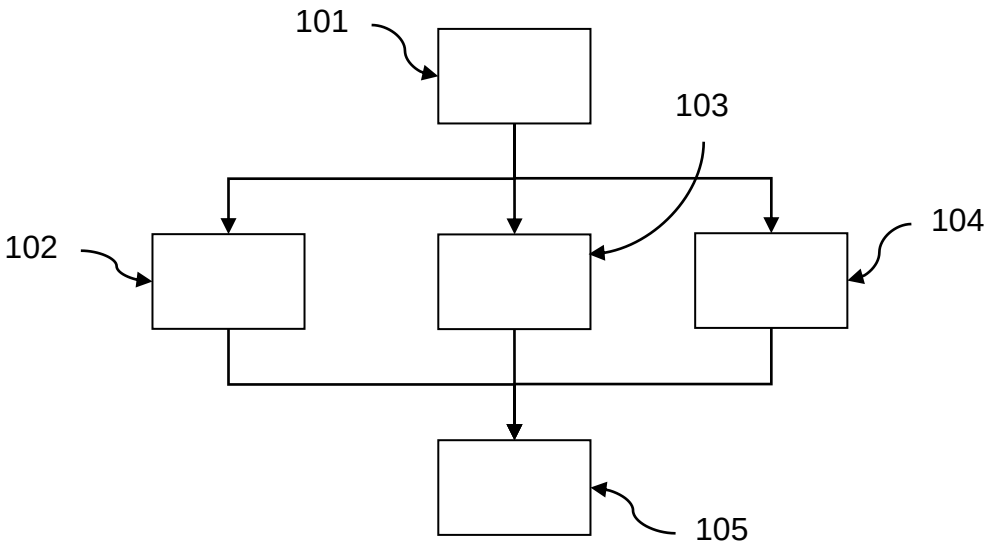


Fig. 6.1

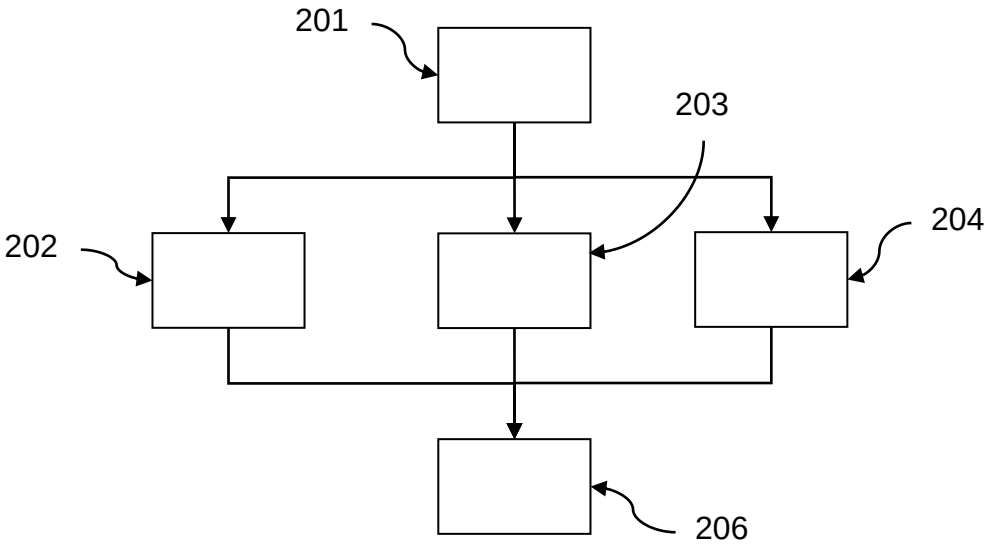


Fig. 6.2