In this document, the details of the plots in the Simulation section are explained.

Figure 2

Corresponding Code:

The data is collected in “Regulation MPC\Regulation MPC\main\_file.m”

The plotting code is in “Regulation MPC\effect of Q,R,N\Regulation\_QRN\_plots.m”

Parameter Details: (“Regulation MPC\Regulation MPC\main\_file.m”)

1. Data: x8.mat, x9.mat, .x10.mat, x11.mat, x12.mat *(line: 178-181)*

2. Control horizon N= 8, 15, 6, 4, 2  *(line: 46)*

3. Initial state X0=[0.02; -0.02; 0.1; 0.5] (in X\_f)  *(line: 118-123)*

4. stage cost weight Q1=diag(0.1, 5, 0.1, 5), R1 diag(0.0000001, 0.0000001); *(line: 59-60)*

5. Bump road disturbance: Road1: V=80, bump\_L=30, bump\_A=0.6, t0=1  *(line: 79-86)*

Figure 3

Corresponding Code:

“Regulation MPC\Regulation MPC\main\_file.m”

Parameter Details:

（a）In X\_f without bump road

1. Initial state X0=[0.04; -0.04; 0.01; 0.9] (in X\_f)  *(line: 118-123)*

2. Control horizon N=6;  *(line: 46)*

3. Stage cost weigh Q1, R1; *(line: 59-60)*

4. Bump road disturbance=0; *(line: 79-86)*

(b) In X\_N without bump road

1. Initial state X0=[0.05; -0.05; 0.015; 2] (outside X\_f and in X\_N) *(line: 118-123)*

2. Control horizon N=6; *(line: 46)*

3. Stage cost weigh Q1, R1; *(line: 59-60)*

4. Bump road disturbance=0; *(line: 79-86)*

(c) In X\_N with bump road

1. Initial state X0=[0.05; -0.05; 0.015; 2] (outside X\_f and in X\_N)  *(line: 118-123)*

2. Control horizon N=6; *(line: 46)*

3. stage cost weight Q1, R1; *(line: 59-60)*

4. Bump road disturbance: Road1; *(line: 79-86)*

Figure 4

Corresponding Code:

The data is collected in “Regulation MPC\Regulation MPC\main\_file.m”

The plotting code is in “Regulation MPC\effect of Q,R,N\Regulation\_QRN\_plots.m”

Parameter Details: (“Regulation MPC\Regulation MPC\main\_file.m”)

1. Data: x\_000.mat, x\_1.mat, x2.mat *(line: 178-181)*

2. Control horizon N= 6 *(line: 46)*

3. Initial state X0=[0.05; -0.05; 0.15; 2] (outside X\_f and in X\_N)  *(line: 118-123)*

4. Stage cost weight Q=Q1, Q1\*10,Q1\*100; *(line: 59)*

5. Stage cost weight R1; *(line: 60)*

6. Bump road disturbance: Road1 *(line: 79-86)*

Figure 5

Corresponding Code:

The data is collected in “Regulation MPC\Regulation MPC\main\_file.m”

The plotting code is in “Regulation MPC\effect of Q,R,N\Regulation\_QRN\_plots.m”

Parameter Details: (“Regulation MPC\Regulation MPC\main\_file.m”)

1. Data: x\_000.mat, x4.mat, x5.mat, x6.mat *(line: 178-181)*

2. Control horizon N= 6 *(line: 46)*

3. Initial state X0=[0.05; -0.05; 0.15; 2] (outside X\_f and in X\_N) *(line: 118-123)*

4. Stage cost weight Q1; *(line: 59)*

5. Stage cost weight R=R1, R1\*0.1, R1\*0.01, R1\*0.001 *(line: 60)*

6. Bump road disturbance: Road1 *(line: 79-86)*

Figure 6

Corresponding Code:

The data is collected in “Regulation MPC\Regulation MPC\main\_file.m”

The plotting code is in “Regulation MPC\effect of Q,R,N\Regulation\_QRN\_plots.m”

Parameter Details: (“Regulation MPC\Regulation MPC\main\_file.m”)

1. Data: u\_rec\_000.mat, u\_rec4.mat, u\_rec5.mat, u\_rec6.mat (read the first row of them) *(line: 178-181)*

2. Control horizon N= 6 *(line: 46)*

3. Initial state X0=[0.05; -0.05; 0.15; 2] (outside X\_f and in X\_N)  *(line: 118-123)*

4. Stage cost weight Q1; *(line: 59)*

5. Stage cost weight R=R1, R1\*0.1, R1\*0.01, R1\*0.001 *(line: 60)*

6. Bump road disturbance: Road1 *(line: 79-86)*

Figure 7

Corresponding Code:

“output MPC\ main\_file.m”

Parameter Details:

Details: 1. Control horizon N=6 *(line: 67)*

2. Stage cost weight Q=diag(1,1,1,1), R=diag(0.0001, 0.0001), P=DARE solution

*(line: 70-72)*

3. Disturbance weight: LTI.Cd=[ 0.001 0; 0 0.01; 0.00001 0];

LTI.Bd=[ 0.01 0; 0 0.01; 0 0.001; 0 0.01];

LTI.d=[0.1;0.1] *(line: 56-59)*

4. Initial state x0=[0;0;0;0], xehat=[x\_hat;d\_hat]=[0.1;0;0;0.5;0;0]; *(line: 41, 117)*

5. Bump road disturbance: V=40, bump\_L=15, bump\_A=0.4, t0=0.5; *(line: 43-50)*

Figure 8

Corresponding Code:

The data is collected in “Adaptive MPC/Adaptive MPC (used in report)/main\_file.m”

Parameter Details: (“main\_file.m”)

1. Control horizon N= 3 *(line: 46)*

2. Initial state X0=[0; 0; 0; 0]  *(line: 92)*

3. Stage cost weight Q:

V = 30 km/hr :Q= [0.0001 0 0;0 0 0;0 0 10] *(line:76)*

V = 60 km/hr :Q= [0.0001 0 0;0 0 0;0 0 1] *(line:103)*

4. Stage cost weight R=eye(2) *(line:77)*

5. Bump road disturbance: Road1 *(line: 70)*

Figure 9

Corresponding Code:

The data is collected in “Adaptive MPC/Adaptive MPC (used in report)/main\_file.m”

Parameter Details: (“main\_file.m”)

1. Control horizon N= 3 *(line: 46)*

2. Initial state X0=[0; 0; 0; 0]  *(line: 92)*

3. Bump road disturbance: Road1 *(line: 70)*