Institut Supérieur des Etudes Technologiques de Nabeul

Département Génie Electrique

Classe : AII32

Parcours :

ATELIER REGULATION INDUSTRIELLE

TP1 : analyse et réglage d'un régulateur PID analogique

Réaliser par :

Houcein Aidi

Ala Garbaya

Wissem Kouki

Issa Haoua

Deuxième partie : analyse fréquentielle du régulateur PID

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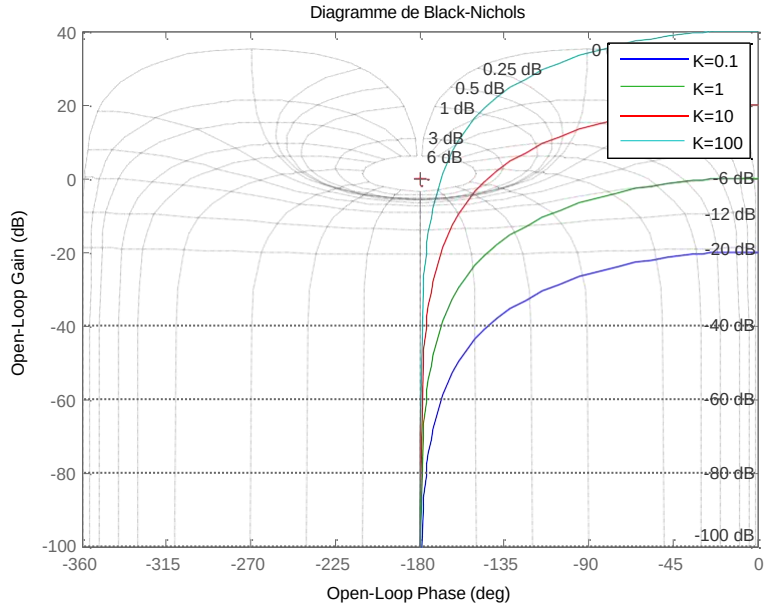
% I) Analuse du regulateur P
g1 = tf([20], [1 9 20]);
g01 = tf([2], [1 9 20]);
g10 = tf([200], [1 9 20]);
g100 = tf([2000], [1 9 20]);
% 1) Diagramme de Black-Nichols
figure;
nichols(g01, g1, g10, g100);
title('Diagramme de Black-Nichols');
legend('K=0.1', 'K=1', 'K=10', 'K=100');

% 2) Diagramme de Bode
figure;
bode(g01, g1, g10, g100);
title('Diagramme de Bode');
legend('K=0.1', 'K=1', 'K=10', 'K=100');

% 3) R?ponse ? un ?chelon
figure;
step(g01, g1, g10, g100);
title('R?ponse ? un ?chelon unitaire');
legend('K=0.1', 'K=1', 'K=10', 'K=100');
```



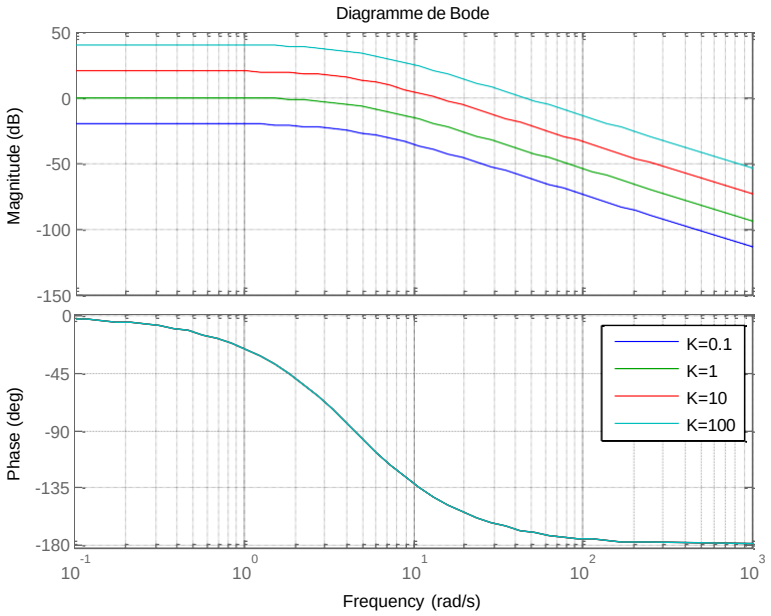
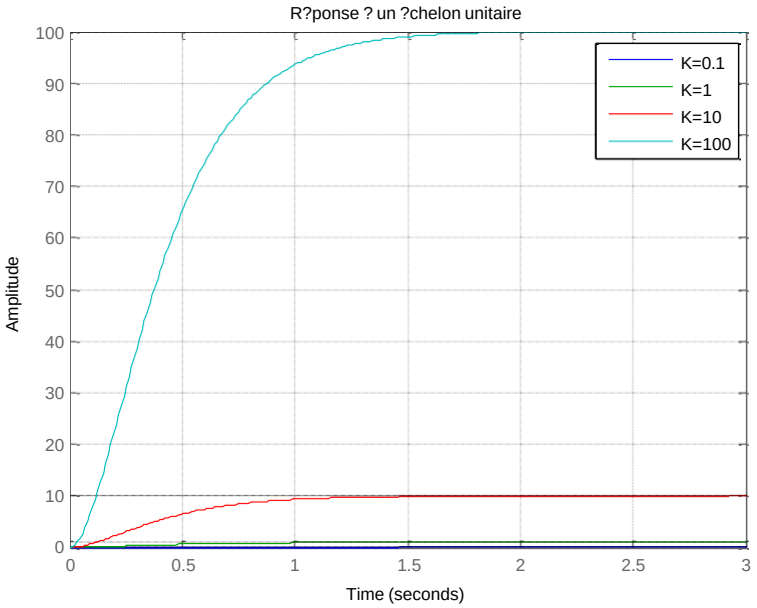


Diagramme de Bode
Magnitude (dB)
50
0
-50
-100
-150
Phase (deg)
0
-45
-90
-135
-180
10^-1
10^0
10^1
10^2
10^3
Frequency (rad/s)
K=0.1
K=1
K=10
K=100


R?ponse ? un ?chelon unitaire
Amplitude
100
90
80
70
60
50
40
30
20
10
0
0
0.5
1
1.5
2
2.5
3
Time (seconds)
K=0.1
K=1
K=10
K=100

```
% II) Analuse du regulateur PI

% Initialisation
Ti_values = [0.01, 0.1, 1, 10]; % Valeurs de Ti pour le r?gulateur PI
K = 1; % Gain fixe pour le r?gulateur PI
G = tf([20], [1 9 20]); % Fonction de transfert du processus

% Regulateurs PI pour chaque valeur de Ti
PI1 = K * (1 + tf(1, [Ti_values(1), 0]));
PI2 = K * (1 + tf(1, [Ti_values(2), 0]));
PI3 = K * (1 + tf(1, [Ti_values(3), 0]));
PI4 = K * (1 + tf(1, [Ti_values(4), 0]));

% Boucles ouvertes
G_open1 = series(PI1, G);
G_open2 = series(PI2, G);
G_open3 = series(PI3, G);
G_open4 = series(PI4, G);

% Boucles ferm?es
G_closed1 = feedback(G_open1, 1);
G_closed2 = feedback(G_open2, 1);
G_closed3 = feedback(G_open3, 1);
G_closed4 = feedback(G_open4, 1);

% 1) Diagramme de Black-Nichols
figure;
nichols(G_open1, G_open2, G_open3, G_open4);
title('Diagramme de Black pour diff?rentes valeurs de Ti (K = 1)');
legend('Ti = 0.01', 'Ti = 0.1', 'Ti = 1', 'Ti = 10');

% 2) Diagramme de Bode
figure;
bode(G_closed1, G_closed2, G_closed3, G_closed4);
title('Diagramme de Bode pour diff?rentes valeurs de Ti (K = 1)');
legend('Ti = 0.01', 'Ti = 0.1', 'Ti = 1', 'Ti = 10');

% 3) Réponse à un échelon
figure;
step(G_closed1, G_closed2, G_closed3, G_closed4);
title('R?ponse ? un ?chelon pour diff?rentes valeurs de Ti (K = 1)');
legend('Ti = 0.01', 'Ti = 0.1', 'Ti = 1', 'Ti = 10');
```

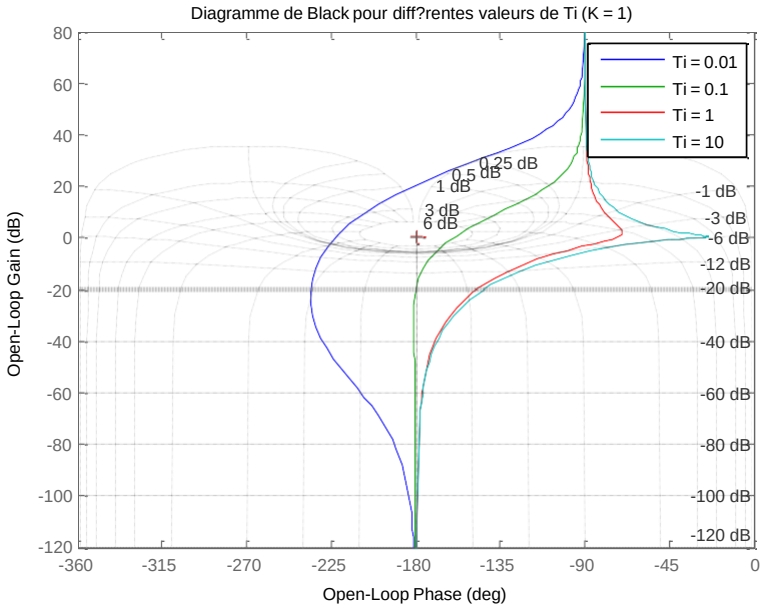


Diagramme de Black pour diff?rentes valeurs de Ti (K = 1)
Open-Loop Gain (dB)
Open-Loop Phase (deg)
Ti = 0.01
Ti = 0.1
Ti = 1
Ti = 10
0.25 dB
0.5 dB
1 dB
3 dB
6 dB
-1 dB
-3 dB
-6 dB
-12 dB
-20 dB
-40 dB
-60 dB
-80 dB
-100 dB
-120 dB

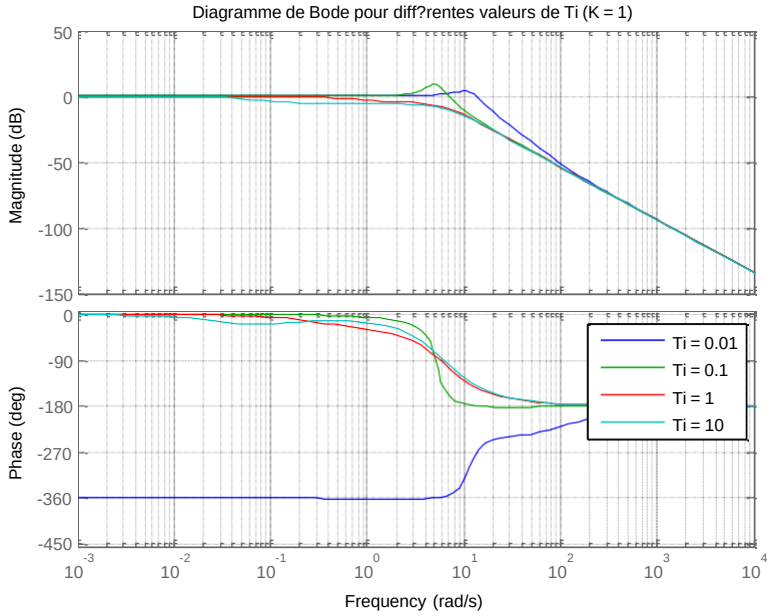
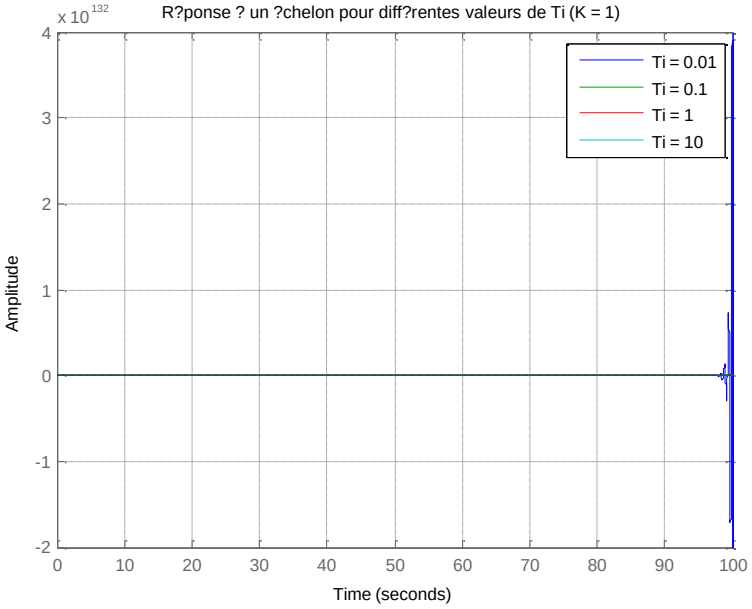


Diagramme de Bode pour diff?rentes valeurs de Ti (K = 1)
Magnitude (dB)
Phase (deg)
Frequency (rad/s)
Ti = 0.01
Ti = 0.1
Ti = 1
Ti = 10


x 10^132
R?ponse ? un ?chelon pour diff?rentes valeurs de Ti (K = 1)
Ti = 0.01
Ti = 0.1
Ti = 1
Ti = 10
Amplitude
Time (seconds)
4
3
2
1
0
-1
-2
0
10
20
30
40
50
60
70
80
90
100

```
% III) Analuse du regulateur PID

% Initialisation
G = tf([20], [1 9 20]); % Fonction de transfert du systeme
K = 1; % Gain fixe
Ti = 1; % Valeur fixe de Ti
Td_values = [0.01, 0.1, 1, 10]; % Valeurs de Td

% Regulateurs PID pour chaque Td
PID1 = K * (1 + tf([1], [Ti 0]) + Td_values(1) * tf([1 0], [1]));
PID2 = K * (1 + tf([1], [Ti 0]) + Td_values(2) * tf([1 0], [1]));
PID3 = K * (1 + tf([1], [Ti 0]) + Td_values(3) * tf([1 0], [1]));
PID4 = K * (1 + tf([1], [Ti 0]) + Td_values(4) * tf([1 0], [1]));

%  Boucles  ouvertes
G_open1 = series(PID1, G);
G_open2 = series(PID2, G);
G_open3 = series(PID3, G);
G_open4 = series(PID4, G);

% Boucles ferm?es
G_closed1 = feedback(G_open1, 1);
G_closed2 = feedback(G_open2, 1);
G_closed3 = feedback(G_open3, 1);
G_closed4 = feedback(G_open4, 1);


% 1) Diagramme de Bode
figure;
bode(G_open1, G_open2, G_open3, G_open4);
title('Diagramme de Bode - R?gulateur PID');
legend('Td=0.01', 'Td=0.1', 'Td=1', 'Td=10');

% 2) Lieu de Black-Nichols
figure;
nichols(G_open1, G_open2, G_open3, G_open4);
title('Lieu de Black - R?gulateur PID');
legend('Td=0.01', 'Td=0.1', 'Td=1', 'Td=10');
```

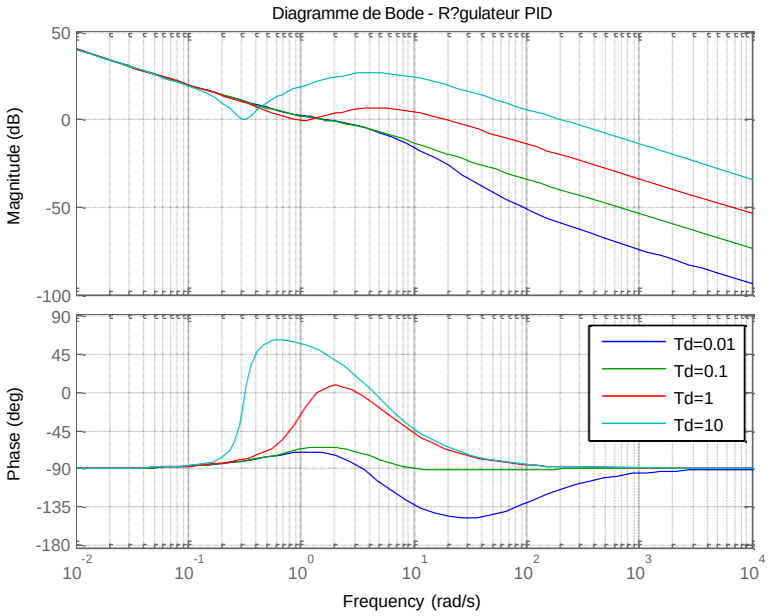
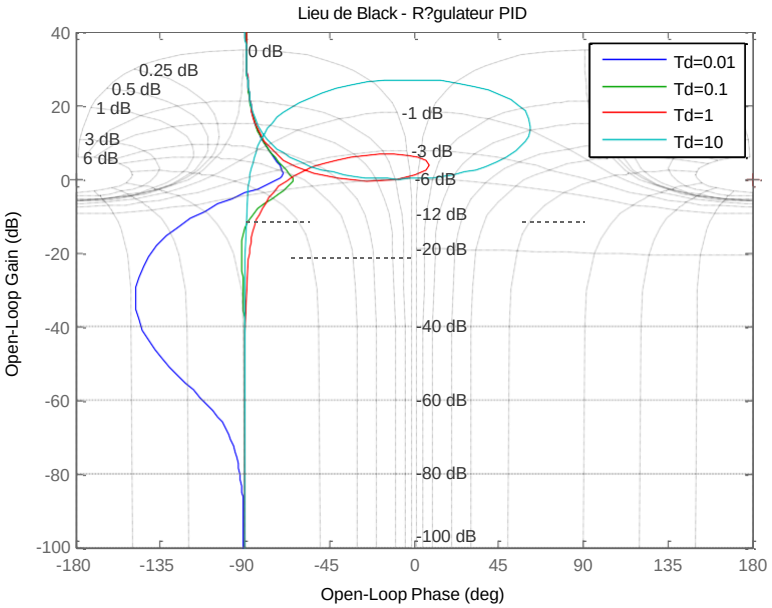


Diagramme de Bode - R?gulateur PID
Magnitude (dB)
Phase (deg)
Frequency (rad/s)
Td=0.01
Td=0.1
Td=1
Td=10


Lieu de Black - R?gulateur PID
Open-Loop Gain (dB)
Open-Loop Phase (deg)
0 dB
0.25 dB
0.5 dB
1 dB
3 dB
6 dB
-1 dB
-3 dB
-6 dB
-12 dB
-20 dB
-40 dB
-60 dB
-80 dB
-100 dB
Td=0.01
Td=0.1
Td=1
Td=10