

µāÇā Óyó ÓÑ# SéÑ# Óyú# #/ā

' » N , i 507 E/ Á Ô c +±7b g Í D²(4 -A/£

/; "8 w6 ' V wK •

%-D GT " 7W " K•"K,>->-¶ œ@! @o

...œ@Áb ÖBLDª N • N N=y• N=yDð8 Z7bg - +±J+È- w 7bg"xA ¹ w È- , L
+± J[@â x - f › *b ÖBLDª N • +±3ñ = ÷ %ø) 3 w /ø³ =ØÔ &Až±i 50 N , w' »
¶Uç çUJN , i 507 E/ Á Ô c)3 @ç@î³ È- Ô c +±N , i 507 E/ Á Ô c 2(4 wU50;~7bgD°TKc
Bð• Ö±±ò â 8 w& Í D²(4 E=y³ • , , L w È=• ; N , i 507 E/ Á Ô c æ" 3 Í D²(4 S ê ù
O! @ ýP] ! @wÈ(Ý³ *b ÖBLDª N • +± ELP 1ëÓ Ô c w¹@î³ A Ô c 0f" +±6 u T

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*b gD¶ *bKh& ÖBLDª 0vK¼ â : 959 C"2(4
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Dè] µª +±u È %

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c • "È(Ý³ *b ÖBLDª N • +± EL& 1ëÓ Ô c "
' æ" /8 ÈC"TD°P "s*^ » Ô c i • ' Ç"- -
Í D²M%SD°± + ([003 ½³ - 0v(ÝAž&BLDª
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@ÍÔ c • "&- 0vL<3i T 2M6 - Ç+±¼c u È "
sA æ" Ô c • 4 ±D°g : o "59A 9 d ...US ê
: B±+K MÀ' ([Öý ' - .ú z Nµf - æ" "£ '
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U3ì A0j "f ±2(4 +±Ö . T6* "£ ýP 2(4 +±Q@
T "s È › ' 0Ä" @@ÍÔ c • KèÓD°T " /8 Z ÈKr
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B' f 1Ts ; BLDª N • +±• " N , "3 ½³ 2(4
: 9 GÓ2(• & Í D² Ç T¹ ELT+±ž ú "£ Fò

*U7bg>yÉLO %og z Nµf' - ' ¼c G † È- + ([
"Ö /ø³ Í D²(4 +±• " N , "3 ½³ G † È-
+±Ô*L g)3 "£ Á*UN1÷ èçÖ ; .ç 3ü4-4 èçÖ Ô c
4 5+±æ" &BLDª N 2(4 E=y , , L 3 ½"4 È=•
; uE èçÖ Ô c 0f" È(Ý2(4 +±DÀ' D™
EL&→] C C WÀ' D™ "6* L 6 u ¼c G † È- "
ýP ³ Ô c T6* "sA æ" U ÈKr Í D²(4 +±Á*U
9 d4g] 6 uO¹@i%

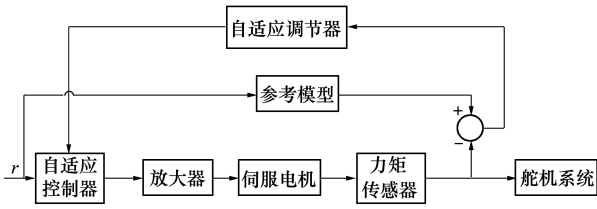
µ &*b ÖBLDª N • +±Ô c • @@K MÀ' Y '
ý ' ' » N , i 507 E/ Á Ô c +±Ô c • @@îæ" %
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- " 59& » L->@ ELú Á+±7bg Í D²(4 6 D°ª
+±E/ Á T %N , i 507 E/ Á Ô c 2(4 +±Ô c • i •
f › =ØÔ &Až±! T¹ (Ü° +± C59: ÚA0
i %û59È gBLDª N 2(4 +±E/ Á6* È %

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N , i 507 E/ Á Ô c \ - .ú =&ì+±7 E/ Á @@
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6*] C C W 50 N , +±DÀ' "£ - ÄK (Ü2(4 +±m

6 \$ - 7! 6*y %N, i 50 Ô c • EÐðã . ú
NµCDÀ' ú Nµ' 1 = " U Á *U 7 6 ,m! - +±\$%D
\$ i %

Á *U » BLDª N • +±N, i 507 E/ Á Ô c 2(4
+±4 ± - + ß m.g %° h>@^ i 50 N, & AØ(4
1 7 E/ Á A07 g ±3ñ = " £ Z AØ(4 2 =ØÔ &
AŽ¹ A0Ô c • %@@ÎÔ c • # ">@o BLDª N 2(
4 \$ BâB²/ Ç)3 @ç' 9 #2(4 K (Ü ME?* • g • Ë
ME?* • %



+ ßæBLDª N • N, i 507 E/ Á Ô c 2(4 s +

50; ~2(4 æ/8

$$\dot{x} = Ax + Bu = Ax - Bw$$

$$v = Cx + Ju = Cx - Jw$$

$$w = \phi \%_o "x "r o \%_o$$

< Z "x g n 4!'ã . >Fü"u 1 v g z > m 4!DÀ' 1
DÀ' >Fü"w g ú Nµ C +±m 4!DÀ' >Fü"φ %o =
.g ý W>Fü80 • %

- É & » \$ Bâ8 D : 0v <

$$\eta \%_q "t_\beta o = \overset{t_1}{\underset{t_1}{U}} v t - r_1^0 "t_\beta > t_1 \%_o$$

+±(, ú Nµ \$ w = φ \%_o "x "r o "...U • e • δ " - Ä
%_o < +±m 6? x \%_o \%_o "t o \$ Bâ8 D : 0v <

Äx \%_o Ä < δ \%_o Äx \%_o + r \%_o Ä o" Ft > ! \%_o
æææ & » B²/ Ç2(4 " € \$ Bâ

$$\underset{t_1}{\overset{t_1}{x}} \%_o ! " Fw = \phi \%_o "x "t o \%_o$$

" F/ ' K (Ü2(4 g # = Dß²/ Ç +± %

& » # = Dß²/ Ç2(4 " 8 A " B 1 • 6* Ô " A " C
1 • 6* > i "x " F ME?* •

$$H \%_o = C \%_o J - A \sigma^\beta + J \%_o$$

g Ri • Ë * • +±r > @Ž # \ â...U Ë - KbK "L ;
Ë • Ç &/ - KbP " - Ä

$$PA + A P = - LL$$

$$B P + K L = C$$

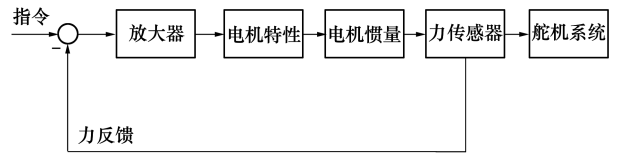
$$K K = J + J \%_o$$

= /ø # " H \%_o g Ri • Ë - Kb* •

#‡ BLDª N 2(4 i 50 N,

i 50 N, \ - W)3 +±Ô c N, " E ^ - Ä N
, i 507 E/ Á Ô c 2(4 : 9 » £ • < +±Ô c " °
: L -> @ & T6* 4 4 E = y • % AØ(4 1 i 50 N,
x K! T6* +± - 7! T ^ 7 E/ Á g ± @ i " T6* - 7! T
/ 8 Ó * ^ AØ(4 1 i 50 N, x K! +±ã . A >
FüCDÀ' A >Fü' ÓFü" 7 E/ Á g ± 6 ü < |
+±æ > • C! Ý Ô c , " - 2(4 +±T6* 4 4 Dë
] C ÒDþL H T6* 4 4 @ %

*b ÖBLDª N • +±i)34 ± - + 0 m.g %û +
Z , 8 ' " *b ÖBLDª N • h>@ñ = 2 äY0Äk
T • &g : *b g & Ë M L • & Fü N • & Ø D™ ,
• & b g ° %



+ 0æ*b ÖBLDª N • 4 ±

@ @ 7 E/ Á Ô c • # " 3 BLDª N 2(4 0 - C g
- 8 • < ä

$$y_p = k_p \frac{Z_p \%_o}{R_p \%_o} \%_o + d_u o \%_o$$

< Z "u_p "y_p 3 X g 2(4 > i "x +±DÀ' ; DÀ' "k_p g
- P M³ Ë + ÷ "Z_p \%_o "R_p \%_o \ 2(4 W- +±Ü 3 0Ä }
GMi < "d_u = .g DÀ' +±ÿ • \$ %

2(4 +±i 50 N, = .g g

$$y_m = k_m \frac{Z_m \%_o}{R_m \%_o} r \%_o$$

< Z "y_m g i 50 N, +±DÀ' "r g - 7! 6*y +±i 50DÀ'
' \$ %

Ô c , 4 \ @ @ Ë / € +±Ô c • " - Ä K (Ü2(4
%_o Z +±m 6 \$ 6*y " £ A2(4 +±DÀ' j 6*]
C CW 50 N, +±DÀ' %g Ë (Ý 7 E Ô c , 4 1 ; L •
@ i ; +±L -> @ & 2(4 1 i 50 N, %_o - 8 t @ ä

ßo Z_p \%_o \ N • g m +± @üç = vNÄ - GMi < "
R_p \%_o +±N • +±7 -> *y g n "ME?* • G_p \%_o +±% &
N • n^M = n - m %

0o G_p^-ß \%_o U • \%_o ! J"δ_1 +±80! 7? ½ "δ_1
\ e • %

o Z_m \%_o "R_m \%_o \ N • 3 X g q_m "p_m +±

@Ûç =wNÄ- GMi< "£,%&Kc n_m^M = q_m - p_m ; G_p %o
±±%&Kç%ov" n_m^M = n^M %

ï 50 N , L->®f > =ØÔ &AŽ±±• " N , ÷2(
4 >®o ±±- \ 4 4 E6 " UBLD^a N • Dý=y # " g H
B^2AFüj 6* < + Ô g DÀ' *b , g ! 2 B! Æ' g :
*b g DÀ' *b , g ! 2 ! Æ' ' Ë÷÷K %o %f > '
([BÛ' 3 ï 50 N , @ëj 6 Kç(4 " Ä] : X Ô
c • ±±*b ÖBLD^a N 2(4 ±±)3 ME?* • ±±@ÛÄ
É g

$$G_m \%o = \frac{\textcircled{R} \text{ B!}}{\%o + \text{B}J0o \%o - J0's + \text{B} \times \text{B!}^o \%o}$$

ú†=ØÔ &AŽ±±0- C N ,

úŽ† g : *b g
BLD^a N 2(4 ±±g : *b g ^1 FÜN • *U
- Kc T(Û7=•g "& » 6,%/ ' *b g "£ ME?* •
=•g g â

$$G_B \%o = \frac{\text{B}}{T_{d,s} + \text{B}} \%!$$

< Z " T_d g #K! e • %

úŽ† 3i T ì k

3i T ì k ±±*U' & Ô c @ÛÄg DÀ' ±±*b g Ô c
\$ E = y r i ^1 ì (' k T "&c; OžÕ,! "n È- È-
*b g DýÕ * * 3i T ì k ±± < 3i T 2M; " 3
3i T ì k >óg)3 ±± , (Û7 "£ Ë÷÷g â

$$K_f = \frac{U_{\cdot \ddot{u} \ddot{v} \ddot{w} \ddot{x}}}{U_{\cdot \ddot{q} \ddot{l}}}$$

úŽ† f 1Ts

f 1Ts *U » ,! "n È- *b g ^1 7bg K! ±±È- í D^a
4@ß "\$ K' È- P M^3 FÜ% * * f 1Ts YCØUFü^1
È- ME^D#ND8 ±±ž ú " Dp>ó@Ñg f 1Tm M
E?È- ^1 š D^y Ó x K! ...U3i T! , 2(â

$$T_L = K_L \%o - \theta_{B0} \%80$$

< Z " K_L g f 1TG Ó2(• "θ_0 g 7bg ±±DýÕ>ÿ Ó %

¼ Ô c • @ÛÛ

í D^2(4 *^ » ' NA &C*y ÿ • &- 0v±±
ž ú "U c ^ Dð8 Z e G' (Y Ä \ (YÄŽ^Kzç ^ 3 2(4
±±QÛ T ^1 C CWT6* %g ^3 "µK'E È : 7œYÄŽ"Y

7 @ÛÛ- WSL†. = ' - • ±±N , ï 507 E/ Á Ô c
• "£ Z @ÛÛ††. = ' - • K} c C CWM U -
WM D^> ±±80! ^2 "û59 6 u] E- z ! D^T ±±
, Û. \ 8Ž"ý P 2(4 ±±QÛ T ^1 C CWT6* %

f > 2(4 C CWM \$ " 3 Ô c • @ÛÛg -
8 • < â

$u_p = \theta_1 \%o \omega_1 + c_1^M r + u_a \%o$
< Z "u_a \ - D^2 ÖDÀ' " *U' f ±±2(4 ±±T6* £ A
: K¼# K! ±± C59 C "/ x g L†. = ' - • % .
%80 < S' %80 < Ä

$$e = \frac{\text{B}}{c_1} G_m \%o \%b_1 + u_a + d_{B0} \%80$$

ææ7 E/ Á Ô c ±±, 4 \ E6 u_a % - ÄK (Û2(4
±±m6 \$ U d_B = ! ±±ò â 8 . 6*y "£ A %b_1 +
d_B0 & e ±±ž ú j 6* < %

E6 u_a = - C %o "£ Z C %o \ > @ÛÛ††•
F ME?* • % & » Y ^ ±±2(4 " > @ÛÛ††m6 /
Ç= ' - • ±±K65 ^ - 8 â

$$C \%o = \frac{Q \%o}{\text{B} - \frac{\text{B}}{c_1^M} G_m \%o Q \%o} \%!"$$

< Z " Q %o U m6 / Ç ±±6)3 ME?* • ^2 C " F
%o < Æ=

$$e = \left[\text{B} - \frac{\text{B}}{c_1^M} G_m \%o Q \%o \right] G_m \%o \frac{\text{B}}{c_1^M} \%b_1 + d_{B0} \%o$$

*^ 7 < Ä â

$$\Delta e \Delta_{> j} \Delta h_m \Delta_B \% \Delta \theta_1 \omega_1 \Delta_{>} + \Delta d_B \Delta_{>} o \%80$$

< Z " Ä M Ä_{>} =•g | M | ±±7-) *y " Ä M Ä_B =•g
L#] • /x / 3 "h_m \ ME? * • g B -
 $\frac{\text{B}}{c_1^M} G_m \%o Q \%o \pm \pm 2(4 \pm \pm 6 \text{B} \acute{u} \acute{A} \%(\acute{Y} U \pm K M \acute{A} \text{TM}$

C g E6 - W • F ±± Ç ±±6)3 * • Q %o - Ä h_m
±±L_B 80 • - < "

$$E6 \$ " GMi< L \%o = s + " \%o$$

ææf > ¶Uç > ÛN , @ÛÛ; g G_m \%o Q \%o g
Ri • È ME?* • % Ç v È - ã . > FÜ

$$\begin{cases} \omega = r v_B y_p v_0 \\ \xi = \xi_B \xi_o \xi \xi_x \dot{O} = L^{-B} \%o \omega \end{cases} \%o$$

ææÇ v ã . > FÜθ = k_1 "c_B "d_1 "d_B ÒE6 \$\$
" • D %o = s + "8ä Ä\$ " \$ g

$$\begin{cases} v_B = \frac{u}{s + \dots} \\ v_0 = \frac{y_p}{s + \dots} \\ \xi_B = \frac{r}{s + \dots} \\ \xi_0 = \frac{v_B}{s + \dots} \\ \xi = \frac{y_p}{s + \dots} \\ \xi_x = \frac{v_0}{s + \dots} \end{cases} \quad \%0! o$$

XC CWØ X { M³%0! @ o; P M³%0! @ o• S È-
4 " £ Fõ^U: 9+±KcBðr i "E =y &! 3 ½ %α €
, ,L Ž # ; 4 È - =• ß¹ + x²+ m.g %
=• Ô† , ,L Ž #

È- 4	È- 4	È- 4	• ÔDýÕ	• ÔDýÕ
• <	r i 0]]	M¼ ð@	• <	r i 0]]
• S	ß!	0!	KcBð	0!
• S	ß!	0!	KcBð	0!
• S	ß!	!	KcBð	!

œœE6 7 E/ Á Ô c ,

$$\begin{cases} \dot{\theta} = \Gamma \xi e \\ \Gamma = \dots \\ e = y_p - y_m \end{cases} \quad \%0\beta o$$

< Z "y_m g i 50 N, DÀ' "y_p g ÈKr2(4 DÀ' "T g
i • >Fü"3 ð¹ ξ + ± = Dë<

$$u = \omega L^{-\beta} \dots \quad \%00 o$$

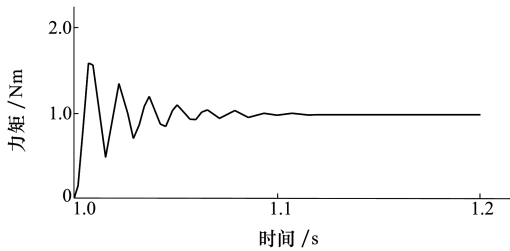
Ä Í D²(4 ± ± Ô c , g

$$u = k_1 r + c_{\beta} v_{\beta} + d_1 y_p + d_{\beta} v_0 - e_{\beta} \sum_{i=\beta}^x \gamma_i \xi_i^0 \quad \%0 o$$

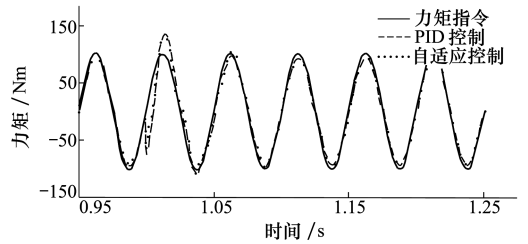
‡ , ,L 4 È

f) z ' ' /ø + ± 2(4 Ô c æ s + ÷ @ @ ð ± Ô c
0Ä" "U Xö Äö > ð ð ü ÷ (Ü ° 8 ' /ø³ ; WÍ D²
2(4 ± ± Ô c s + %

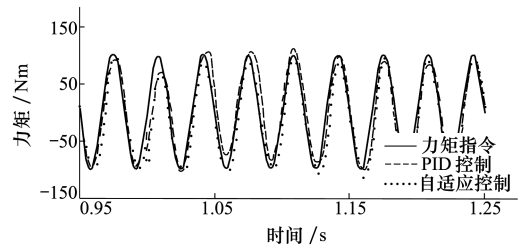
, z KcBð \$ 8 "i 50 N, DÀ' ; 7 E/ Á Ô c
• ± DÀ' &! + - + m.g % , 8 ' 2(4 KcBð ú
ÁELÓ6* L\$ Bàí D²(4 ú Á ELT + ± @ %



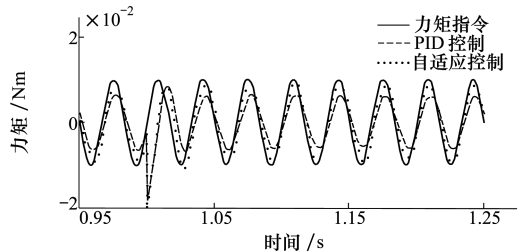
+ œ, z KcBð \$



+ œÈ- 4 ß! 0]] "0! @ • S \$ "
7bg 0! 0]] KcBðDýÕ



+ "œÈ- 4 ß! 0]] " ! @ • S \$ "
7bg 0! 0]] KcBðDýÕ



+ œÈ- 4 ß! 0]] " ! @ • S \$ "
7bg ! 0]] KcBðDýÕ

U 8 D ò â 8 & 7bg Í D²(4 E =y , ,L ãbg
U , ,L - ø ß # E =y KcBðDýÕ "BLD³ N 2(4 3

, ,L 4 È =• ; "50; ~ 7bg KcBð • Õ # " & » - +

