JYYSçåÑÑ s ys–VÑÓ yÓ ÓÑ¥ SéÑ# Ó ú’ # #ää

' » C .è "x Fü+± G ç g | 9, 4 Ç z æ"

u 5-3Ï w M wAd(6* w=®Ù8¶

‰¬D G T “ 7 Õ C “ K• ” K,>¬ >¬¶ œ®ß! ! ®0o

…œ>®Åý ' ³ - .ú V*U G ç g ; , 4 x K!+±C .è ÷ ç g 0 m} 4] 0Ä, 4 z 4›+±| 9 Ç z 0Ä" EŒÐô- Kc Uƒ•¢, - w L‹3ì TC .è "x Füæ/8 D™C g Fü'x C .è œÍ 7 ç g +±0 mA ÷"x C M L • +±"x C A œæ/8 wÆ 59 & Ç z æ/8 !o ? wÄ] , 4 +± z 4› - ; V*U U3ì Ç k " (!o - < HÕ ê i m M 1 +±- E4CKLKL• ýP Ç z 1ëÓ @ÎÄg , ,L 4 ÉO¹@î³ A 0Ä" +±6 u T ¹ E/ Á T

œJ[œ@úÅ ç g | 9 Ç z HÕ ê 4CKLKL•
Z + 3 1¨ $ ÅÆÐ× Žœœœ´ ([4 -. Åöœœœ´ 0 4C$ Åß! ! ! KO®' ‰0! ß o! 0K!0 K!®

œœE g, 4 +±1ë-› Ç z \ (Ý C E ¶ Z+± J[- \ x - ®Ò%K½,m ç g - \ +± ELþ , ”V*U G ã ç g | 9 &, 4 Ç z ” = g € z È ¸ .þ - M³ +±-A/£ & %æ0Ò%

, z ”*^ » 3ì *b"x C - \ þ , =&Ì ”£ 1ëÓP A = Y { ” ‘ ' » C .è "x Fü+±, 4 Ç z æ" +±-A /£] ³ › Ez ” %´ ([Òý ' ³ - .ú ' » 3ÓŒ h € - < ¹ …%ù•¿ wUJ=¿ › wwU U vK @ÙU¢ ” Âi o +±' Ç >ï "x 0 # Ç z 0Ä" ‰w¶ K‹=¦ ¢¿ù K‹¦K Uù¢=ùU” Õ öo”U * *’ >ï "x 0 } 4 A # ”£ Ç z 1ëÓD°P ”s 8 >ï "x %æ} 4 "x Fü …UK½g A # £ Ç z T6* R ” 8 Kz%´ ([×Òý ' ³ - .ú 3ì T N •] Dë# K! +±Ç z 0Ä" ”U t @ëM L • z 4› œ1ë -› - +±Ž # 8 ”A æ" 8ä Ä µ 1ë-› +± Ç z 4 É ”s ¯ É M L • z 4› œ…UK½g A ”A æ" ^ G RFúKz{ , 4 +± Ç z 1ëÓ %´ (["Òý ' V*U É C .è ? ½, 4 z 4›+± Ç z æ" ”9 d ”A æ" £ W50 ;~>ï "x g +±} 4 "x FüA ”€ A A D° T # ”£ Ç z T6* R ” 8 Kz%

C ” , Ç z 1ëÓ } %k •] wù¢ù ›=üw¢¿ q¢ù=¢¿”HÕ êo\ =ŽFü - W Ç z 2(4 1ëÓ+±Fú>® 4 4 x - ”£ i ; 1 >ï "x %æx K! : 9 +± , 3 0 ,% Ò%

4) 7 3 ½”Y ´ ý ' ³ - .ú V*U G ç g ; , 4 x K!+±C .è ÷ ç g 0 m} 4] 0Ä, 4 z 4›+± | 9 Ç z 0Ä" ”A æ" x : ³ 0 mA : * *’ # Ç z u É R ” 8 Kz+± : Bà” 9 # ”V*U HÕ ê E C ³ 4CKLKL• ”E - ' ý P ³ Ç z u É %] ³ ï 50 ´ ([®Ò+± \ þ ”Y ´ ý ' +± æ" 9 # @î³ D°P +± Ç z 1ëÓ ¹ D° g +±E/ Á T %

ÓŒ Ç z N ¸ ÷ Ç z æ"

ÓŽÓŒ Ç z Ž #

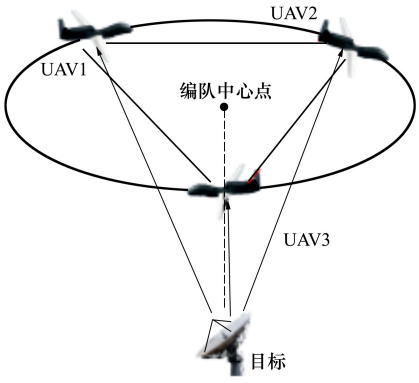
¯ + ß m.g ”7 > L- >® ã ç g ’ &, 4 E =y | 9 Ç z %t Ç ü W ç g t =ò 4 6 Hêi ¹ "x C M L • ”£ ! 4 9 - W, 4 N =y ”, 4 T7! z » 4C KLZ ð %æ8 æ% ç g V*U Hêi 8ä Ä 7 CØ+± z 4› } 4 ”V*U"x C M L • "x Fü7 CØ] , 4 +±C .è % 50;~] $ # K!+± 9 ’ T ”‡ ' ¯ 8 t @ëå

8 , 4 g /(Õ, 4 ”U G ã ç g E =y Ç z ‰ G x z ” g Dª Hêi # Ì $ g ' ó ”¹ = ã ç g # Ì J ø N ó +£ N ”3 ã ç g 8ä +± z 4› œ÷C .è œ4 # K! ` ”E6 # K! ` i D° < +± 3ñ• › ”A t Ç, 4 /(ÕD°• ” , 4 U $ | # K! ² +± z /(Fü * *’ +- ; ”V*UE6 # K! ` ,% Dþ+± 3ñ• › ¹ =, 4 } 4 ? 0Ä%

---

c /l L Å0! ß K!×K3!
‰520- ø Åu 5-3Ï %8 ®ßõ o”>¬ D G T “ œ† µ ”h >®û ¸ ' FþM¦, Å* ã 7 &c.þ “ ' Fþ ‰ß×® 00 cBqÖ
ç g 3ñ 5) 7W, Mûg] @îA/£ %

8 , 4 L†• : Õ ”F : L->®50;~ $ # K!+±9 ' T ”V*U ã ç g z 4› œ÷C .è œ”± = Ç z æ/8 Ë(Ý, 4 Ç z ? 0Ä%



+ ßœG ç g | 9 Ç z Ë ,

ÓŽ#‡ Ç z æ"

Y ´ ý ' +±0Ä" h>®^ 6 TF 3 3ñ = åÑÃu ”V *U M4 C .è Ç z 0Ä" !o ' , 4 +± T 7! z 4› $x_!$ +&c; ” 3 C .è "x Fü+±L‹ 3ì T æ/8 U $x_!$ 1 - Kc Uƒ•¢, - D™C g Fü"x C .è œÍ 7 ç g +±0 mA ÷"x C M L • +±"x C A œæ/8 ”!o ' Ç z ? +±=•Dë < +- ; ”!o ' Ç z ? Z ï Fü+±i ”¹ =, 4 z 4› +±] 0Ä%Ò 8 ' \ & ü WF 3 +±A 3ó ø 3ú % ßŽ0ŽŽœ, 4 T 7! z 4› +±!o ?

t Ç G g | 9 Ç z N , 1 »] ð/§ K!,! >ÿ} 4 2(Z ”, 4 +±,L Ë } 4 g x_t = x_t ”y_t ”z_t Ò ” ç g >ï "x 0 +±} 4 g x_i = x_i ”y_i ”z_i Ò ”i = ß”0” %1 ç g] , 4 x K!+±C .è g

$$\rho_i = \grave{A}x_i - x_t \grave{A} =$$

$$œ\sqrt{‰(x_i - x_t)^2 + ‰(y_i - y_t)^2 + ‰(z_i - z_t)^2}$$

%ßo

$$\begin{cases} r^0 = ‰(x_t^0 + y_t^0 + z_t^0) \\ r_i^0 = ‰(x_i^0 + y_i^0 + z_i^0) \end{cases} \qquad ‰o$$

< Z ”r g, 4 m‹ g ;])0 BUð x K!+±C .è ”& %ßo < æ £ 5•/ø %0o< Ä]

$$\rho_i^0 - r_i^0 - r^0 = -2‰(x_i x_t + y_i y_t + z_i z_t) \qquad ‰o$$

$$\begin{cases} \rho_ß^0 - r_ß^0 - r^0 = -2‰(x_ß x_t + y_ß y_t + z_ß z_t) \\ \rho_0^0 - r_0^0 - r^0 = -2‰(x_0 x_t + y_0 y_t + z_0 z_t) \\ \rho^0 - r^0 - r^0 = -2‰(x x_t + y y_t + z z_t) \end{cases}$$

œœ7 ' ”M4 C .è Ç z æ/8 ¯ ‰o< m.g ”3 £ Æ g - Kb• < 6

$$\boldsymbol{A}_ß \boldsymbol{x}_t = \boldsymbol{B}_ß \qquad ‰o$$

< Z

$$\boldsymbol{B}_ß = \begin{bmatrix} \rho_ß^0 - r_ß^0 - r^0 \\ \rho_0^0 - r_0^0 - r^0 \\ \rho^0 - r^0 - r^0 \end{bmatrix} œ\boldsymbol{A}_ß = \begin{bmatrix} -2(x_ß & -2(y_ß & -2(z_ß \\ -2(x_0 & -2(y_0 & -2(z_0 \\ -2(x & -2(y & -2(z \end{bmatrix}$$

œœ@ÎÄ7 < ”, 4 +± T 7! z 4› $x_!$ g

$$\boldsymbol{x}_! = \boldsymbol{A}_ß^{-ß} ¼ \boldsymbol{B}_ß \qquad ‰o$$

3 £ ‰g Uƒ•¢, - %æ¹ = ; 4 +±0Ä" %

ßŽ0ŽŽœ, 4 } 4 +±!o ?

B ' "x C A œ ‰ρ_i o ± ' Ç z æ/8 g

$$\rho_i = \grave{A}x_i - x_t \grave{A} + \varepsilon_{\rho i} \ ”i = ß\sim \qquad ‰o$$

œœ $\varepsilon_{\rho i} \sim N$ %b”σ_ρ^0 o%3 0v < +± Dæ› $\boldsymbol{x}_!$ 1 E =y Uƒ•¢, - £ * *' P NM¦ Ä]

$$\rho_i = \grave{A}x_i - x_! \grave{A} - \frac{‰(x_i - x_!)‰(x_i - x_!)}{\grave{A}x_i - x_! \grave{A}} -$$

$$œ\frac{‰(y_i - y_!)‰(y_i - y_!)}{\grave{A}x_i - x_! \grave{A}} - \frac{‰(z_i - z_!)‰(z_i - z_!)}{\grave{A}x_i - x_! \grave{A}} + \varepsilon_{\rho i}$$

%®o

7 ' Ä] J ' Ç z æ/8 ”Æ=- Kb+±• < ¯ 8

$$\boldsymbol{A}\boldsymbol{y} = \boldsymbol{B} \qquad ‰o$$

< Z å

$$\boldsymbol{A} = \begin{bmatrix} \frac{x_ß - x_!}{\rho_ß^M} & \frac{y_ß - y_!}{\rho_ß^M} & \frac{z_ß - z_!}{\rho_ß^M} \\ \frac{x_0 - x_!}{\rho_0^M} & \frac{y_0 - y_!}{\rho_0^M} & \frac{z_0 - z_!}{\rho_0^M} \\ \frac{x - x_!}{\rho^M} & \frac{y - y_!}{\rho^M} & \frac{z - z_!}{\rho^M} \end{bmatrix} œ\boldsymbol{y} = \begin{bmatrix} x_t - x_! \\ y_t - y_! \\ z_t - z_! \end{bmatrix}$$

$$\boldsymbol{B} = \begin{bmatrix} \rho_ß^M - \rho_ß + \varepsilon_{\rho ß} \\ \rho_0^M - \rho_0 + \varepsilon_{\rho 0} \\ \rho^M - \rho + \varepsilon_\rho \end{bmatrix} œ\grave{A}x_i - x_! \grave{A} = \rho_i^M$$

1¨ i » ‰o< ” !o ' J ' Ç z æ/8 +±?

$$\boldsymbol{y}\hat{A} = \boldsymbol{A}^{-ß}\boldsymbol{B} \qquad ‰o$$

J ' ? $\boldsymbol{y}$Â‰g 8 ´ ± EMæ/8 +±• › ó 4 %

ç g >ï "x 0 0 mA g µx_i ”A$ Bà µx_i ~ N %b”σ_i^0 o”B ' æ/8 ‰oE 59 Ä] - 3õ+± Ç z æ/8

$$\left[\frac{x_i - x_!}{\rho_i^M} - \boldsymbol{a}_i \mu x_i \quad \frac{y_i - y_!}{\rho_i^M} - \boldsymbol{b}_i \mu x_i \quad \frac{z_i - z_!}{\rho_i^M} - \boldsymbol{c}_i \mu x_i\right] ¼$$

$$\begin{bmatrix} x_t - x_! \\ y_t - y_! \\ z_t - z_! \end{bmatrix} = \rho_i^M - d_i \mu x_i - \rho_i + \varepsilon_{\rho i} \qquad ‰!o$$

< Z å

$$\boldsymbol{a}_i = \frac{N\left(\frac{x_i - x_!}{\rho_i^M}\right)}{N\mu x_i} = \left[\frac{ß}{\rho_i^M} - \frac{x_i - x_!}{\%\rho_i^M o} \quad -\frac{x_i - x_!\%y_i - y_! o}{\%\rho_i^M o} \quad -\frac{\%x_i - x_! o\%z_i - z_! o}{\%\rho_i^M o}\right] \qquad \%ßßo$$

$$\boldsymbol{b}_i = \frac{N\left(\frac{y_i - y_!}{\rho_i^M}\right)}{N\mu x_i} = \left[-\frac{\%x_i - x_! o\%y_i - y_! o}{\%\rho_i^M o} \quad \frac{ß}{\rho_i^M} - \frac{\%y_i - y_! o^0}{\%\rho_i^M o} \quad -\frac{\%y_i - y_! o\%z_i - z_! o}{\%\rho_i^M o}\right] \qquad \%ßßo$$

$$\boldsymbol{c}_i = \frac{N\left(\frac{z_i - z_!}{\rho_i^M}\right)}{N\mu x_i} = \left[-\frac{\%x_i - x_! o\%z_i - z_! o}{\%\rho_i^M o} \quad -\frac{\%y_i - y_! o\%z_i - z_! o}{\%\rho_i^M o} \quad \frac{ß}{\rho_i^M} - \frac{\%z_i - z_! o^0}{\%\rho_i^M o}\right] \qquad \%ßß o$$

$$\boldsymbol{d}_i = \frac{N_i^M}{N\mu x_i} = \left[-\frac{x_i - x_!}{\rho_i^M} \quad \frac{y_i - y_!}{\rho_i^M} \quad \frac{z_i - z_!}{\rho_i^M}\right] \qquad \%ßßxo$$

4 5 %ß! o 2 %ßßxo" Ä] A æ/8 g

$$\%\boldsymbol{A} - \mu\boldsymbol{A}\ o\boldsymbol{y} = \%\boldsymbol{B} - \mu\boldsymbol{B}\ o \qquad \%ßß"o$$

$$\begin{cases} \mu x = [\ \mu x_ß \quad \mu x_0 \quad \mu x\ ] \\ \boldsymbol{G}_ß = \rangle\pm Uk\ \boldsymbol{a}_ß \quad \boldsymbol{a}_0 \quad \boldsymbol{a}\ Ò \\ \boldsymbol{G}_0 = \rangle\pm Uk\ \boldsymbol{b}_ß \quad \boldsymbol{b}_0 \quad \boldsymbol{b}\ Ò \\ \boldsymbol{G} = \rangle\pm Uk[\boldsymbol{c}_ß \quad \boldsymbol{c}_0 \quad \boldsymbol{c}\ ] \\ \boldsymbol{G}_x = \rangle\pm Uk[\boldsymbol{d}_ß \quad \boldsymbol{d}_0 \quad \boldsymbol{d}\ ] \end{cases} \qquad \%ßß o$$

$$\begin{cases} \boldsymbol{A}^M = \boldsymbol{A} - \mu\boldsymbol{A} \\ \boldsymbol{B}^M = \boldsymbol{B} - \mu\boldsymbol{B} \end{cases} \qquad \%ßß®o$$

F 6

$$\boldsymbol{A}^M\boldsymbol{y} = \boldsymbol{B}^M \qquad \%ßß o$$

$\mu\boldsymbol{A}$ "$\mu\boldsymbol{B}$ =•.g g

$$\begin{cases} \mu\boldsymbol{A} = [\boldsymbol{a}_i\ \mu x_i \quad \boldsymbol{b}_i\ \mu x_i \quad \boldsymbol{c}_i\ \mu x_i] \\ \text{œ} = [\boldsymbol{G}_ß\mu x \quad \boldsymbol{G}_0\mu x \quad \boldsymbol{G}\ \mu x] \\ \mu\boldsymbol{B} = \boldsymbol{d}_i\ \mu x_i\ Ò = \boldsymbol{G}_x\mu x\ Ò \end{cases} \qquad \%ßß o$$

$\boldsymbol{H}_y = x\boldsymbol{G}_ß + y\boldsymbol{G}_0 + z\boldsymbol{G} - \boldsymbol{G}_x$ "£ Z ‰"y "z o+±i g

J ' Ç z æ/8 +±? $\boldsymbol{y}$ ", 4 +± Ç z ? g å

$$\begin{cases}] = \%À\ \mu x\ À_0^0 + \lambda\ À\boldsymbol{y}\ À_0^0 o \\ ü¼Ùwwv\boldsymbol{Ay} - \boldsymbol{B} + \boldsymbol{H}_y\ \mu x = \end{cases} \qquad \%ß! o$$

5•/ø %ß o&%ß! o< Ä

$$y_{Âi}\ \%U‡k] = \%À\ \mu x\ À_0^0 + \lambda\ À\boldsymbol{y}\ À_0^0 o =$$

$$\text{œ}U‡k] = \%\boldsymbol{Ay} - \boldsymbol{B}\ o\boldsymbol{H}_y^{-0}\%\boldsymbol{Ay} - \boldsymbol{B}\ o + \lambda\boldsymbol{y}\ \boldsymbol{y}\ Ò \qquad \%ßßo$$

g ³ !o? $y_{Âi}$ "& %ß o <!o - Kc) £ Dý0Ä Ä

$$y_{Âi} = \%\boldsymbol{A}\ \boldsymbol{H}_y^{-0}\boldsymbol{A} + \lambda\boldsymbol{I}\ o^{-ß}\boldsymbol{A}\ \boldsymbol{H}_y^{-0}\boldsymbol{B} \qquad \%ßßo$$

< Z "$\boldsymbol{A}$ "$\boldsymbol{B}$ "$\boldsymbol{H}_y$ t *^0 m} 4 &C .è i ÷ $\boldsymbol{y}$Âo

? -59 < Z λ +±i úL->®E - ' +±@ÎÄ%

ßŽÒŽ œï • λ +±o?

$$y_{Âi} = \boldsymbol{y}^M + \delta\boldsymbol{y} \qquad \%ßßo$$

$\delta\boldsymbol{y}$ g ,L Ë i ; Ç z ? +± i " 3 %ßßo < ' %ß o < Ä] δy +±=•Dë<

$$\delta\boldsymbol{y} = \%\boldsymbol{A}^M\boldsymbol{H}_y^{-0}\boldsymbol{A}^M + \lambda\boldsymbol{I}\ o^{-ß}\%\boldsymbol{A}^M\boldsymbol{H}_y^{-ß}\mu x - \lambda\boldsymbol{y}^M o \qquad \%ßßxo$$

£ t æA g

$y_{Xi6}\%\delta y\ o = 6\%\delta y\ \delta y\ o =$

$$\text{œ}6\ \%\boldsymbol{A}^M\boldsymbol{H}_y^{-ß}\mu x - \lambda\boldsymbol{y}^M o\ \%\%\boldsymbol{A}^M\boldsymbol{H}_y^{-0}\boldsymbol{A}^M + \lambda\boldsymbol{I}\ o^{-ß} o$$

$$\text{œ}\%\boldsymbol{A}^M\boldsymbol{H}_y^{-0}\boldsymbol{A}^M + \lambda\boldsymbol{I}\ o^{-ß}\%\boldsymbol{A}^M\boldsymbol{H}_y^{-ß}\mu x - \lambda\boldsymbol{y}^M o Ò\ \%ßß"o$$

œœï • λ +±] @Îi g

$$\hat{\lambda} = U‡k]_\lambda = ¿\ y_{Xi6}\%\delta y\ o Ò =$$

$$\text{œ}\ U‡k]_\lambda = ¿x\ \lambda^0\boldsymbol{y}\ \%\boldsymbol{A}^M\boldsymbol{H}_y^{-0}\boldsymbol{A} + \lambda\boldsymbol{I}\ o^{-0}\boldsymbol{y}\ Ò + \qquad \%ßßo$$

$$\text{œ}6\ \mu x\ \boldsymbol{H}_y^{-ß}\boldsymbol{A}\ \%\boldsymbol{A}^M\boldsymbol{H}_y^{-0}\boldsymbol{A} + \lambda\boldsymbol{I}\ o^{-0}\boldsymbol{A}\ \boldsymbol{H}_y^{-ß}\mu x\ ÒW$$

Ç v

$$\begin{cases} \boldsymbol{p} = \lambda^0\boldsymbol{y}\ \%\boldsymbol{A}^M\boldsymbol{H}_y^{-0}\boldsymbol{A} + \lambda\boldsymbol{I}\ o^{-0}\boldsymbol{y} \\ \boldsymbol{q} = 6\ \mu x\ \boldsymbol{H}_y^{-ß}\boldsymbol{A}\ \%\boldsymbol{A}^M\boldsymbol{H}_y^{-0}\boldsymbol{A} + \lambda\boldsymbol{I}\ o^{-0}\boldsymbol{A}\ \boldsymbol{H}_y^{-ß}\mu x\ Ò \end{cases} \qquad \%ßß®o$$

& $\boldsymbol{A}\ \boldsymbol{H}_y^{-0}\boldsymbol{A}$ E =y &>ÿ C Ä

$$\boldsymbol{A}\ \boldsymbol{H}_y^{-0}\boldsymbol{A} = \boldsymbol{Q}\ \boldsymbol{\Lambda}\boldsymbol{Q} = \boldsymbol{Q}\ \rangle\pm Uk\%\mu_ß"\mu_0"\mu\ o\boldsymbol{Q} \qquad \%ßßo$$

$$\boldsymbol{D} = \rangle\pm Uk\ \%\mu_ß + \lambda\ o^{-0}"\%\mu_0 + \lambda\ o^{-0}"\%\mu_N + \lambda\ o^{-0}Ò \qquad \%ßßo$$

3 %ßßo¹ %ßß®o< ' %ßß"o< Ä

$$\begin{cases} \boldsymbol{p} = \lambda^0\boldsymbol{y}\ \boldsymbol{Q}\ \boldsymbol{DQy} = \lambda^0\%\boldsymbol{Qy}\ o\boldsymbol{DQy} \\ \boldsymbol{q} = 6\ \mu x\ \boldsymbol{H}_y^{-ß}\boldsymbol{AQ}\ \boldsymbol{DQA}\ \boldsymbol{H}_y^{-ß}\mu x\ Ò = \\ \text{œ}6\ \%\boldsymbol{QA}\ \boldsymbol{H}_y^{-ß}\mu x\ o\boldsymbol{DQA}\ \boldsymbol{H}_y^{-ß}\mu x\ Ò \end{cases} \qquad \%ßßo$$

$$\boldsymbol{C}_{ß} = \boldsymbol{Qy}\ ”\boldsymbol{C}_0 = \boldsymbol{QA}\ \boldsymbol{H}_y^{-ß}\ µx\ \%£\ Z$$

$$\begin{cases} \boldsymbol{C}_{ß} = \left(c_{ßß}\quad c_{ßo}\quad c_{ß}\right) \\ \boldsymbol{C}_0 = \left(c_{0ß}\quad c_{00}\quad c_0\right) \end{cases} \qquad ‰ßo$$

3 %0 o&‰! o¹ ‰ßo<5•/ø Ä] ï • λ g

$$\hat{\lambda} = U‡k] = ¿\left[® \frac{6x c_0^0 W}{‰_i + \lambda\ o^0} + \lambda^0 ® \frac{c_ß^0}{‰_i + \lambda\ o^0} \right] \qquad ‰0o$$

f › ï 50´ ([Ò”E6 λ +±i g

$$\hat{\lambda} = \frac{ß}{0}] = ¿\frac{6x c_0^0 W}{c_ß^0 \mu_i} + \frac{ß}{0}] U4\frac{6x c_0^0 W}{c_ß^0 \mu_i} \qquad ‰\ o$$

3 ï • λ +±i ’ Ç z ? +±=•Dë< Ä] Ç z ? g

$$y_{\hat{A}i} = \left(\boldsymbol{A}\ \boldsymbol{H}_y^{-0}\boldsymbol{A} + \left(\frac{ß}{0}] = ¿\frac{6x c_0^0 W}{c_ß^0 \mu_i} + \frac{ß}{0}] U4\frac{6x c_0^0 W}{c_ß^0 \mu_i} \right) \boldsymbol{I} \right)^{-ß}$$

$$\boldsymbol{A}\ \boldsymbol{H}_y^{-0}\boldsymbol{B} \qquad ‰×o$$

Óyú‡ , 1ë Ó } o) µã×d+±o?

û æ/8 %ß! o Ä]

$$\delta\boldsymbol{\rho} = \boldsymbol{\rho}\ ‰_q\ ”y_t\ ”z_t\ o - \boldsymbol{\rho}\ ‰_!\ ”y_!\ ”z_!\ o=$$

$$œ\frac{\delta\boldsymbol{\rho}}{\delta\boldsymbol{x}_!}\delta\boldsymbol{x} + \varepsilon \qquad ‰"o$$

< Z ”ε g 0v u C .è A ”$\delta\boldsymbol{x}$ = ‰x_t ”δy_t ”δz_t o g ç g 0 mA ”3 ‰"o< , -

$$\delta\boldsymbol{\rho} = \boldsymbol{H}\delta\boldsymbol{x} + \varepsilon \qquad ‰\ o$$

< Z

$$H = \left[\frac{x_i - x_!}{\rho_i^M} - \boldsymbol{a}_i\ ¼µx_i\ œ\frac{y_i - y_!}{\rho_i^M} - \boldsymbol{b}_i\ ¼µx_i\ œ\frac{z_i - z_!}{\rho_i^M} - \boldsymbol{c}_i\ ¼µx_i \right] \qquad ‰®o$$

$$\varepsilon = \boldsymbol{d}_i\ µx_i - \varepsilon_{\rho i} \qquad ‰\ o$$

Dþi] ” Ä]

$$\delta\boldsymbol{\rho} = \boldsymbol{H}\delta\boldsymbol{x} \qquad ‰\ o$$

& ‰ o <0v $ QDæ‡ … $\boldsymbol{H}^{-ß}$ 6

$$\delta\boldsymbol{x} = \boldsymbol{H}^{-ß}\delta\boldsymbol{\rho} \qquad ‰×!\ o$$

A | æ g

$$6\%\delta x\delta x\ \ o= \boldsymbol{H}^{-ß}\ 6\%\delta\boldsymbol{\rho}\delta\boldsymbol{\rho}\ \ o\%\boldsymbol{H}\ \ o^{-ß} \qquad ‰×ßo$$

œ œ g HÕ ê ò C & >ÿ p 2M6 ” t @ë 6%$\delta\boldsymbol{\rho}\delta\boldsymbol{\rho}$ o ¿ : ,% A æ ,%9 t g ß”F 6

$$6\%\delta x\delta x\ \ o= \%\boldsymbol{H}\ \boldsymbol{H}\ o^{-ß} \qquad ‰×0o$$

$$\boldsymbol{x}_{HÕ\ ê} = \sqrt{v‡Ù\ 6\%\delta x\delta x\ \ o} \qquad ‰×\ o$$

#‡ , ,L ËO¹

#ŽÓ‡ , ,L Ž #

g O¹@îm ý Ç z æ" +±6 u T ÷E/ Á T ”Y ´ ý ' 8 t @ëŽ # å

ßo ã ç g ÇP £ ! 4 , 4N =y ”ü ã ç g +±C .è"x FüA æ ÷0 m"x FüA æ $ Bà¯ 8 2(å

$$\begin{cases} \sigma_i^0 = \sigma_ß^0 \\ \sigma_\rho^0 = \sigma_0^0 \end{cases} œ‰= ß”0” o$$

œœ0o ´ Z+±} 4 2(4 g ü Hi K×] ð /§ K!,! >ÿ } 4 2(”} 4 Ì %æg])0 BUð %

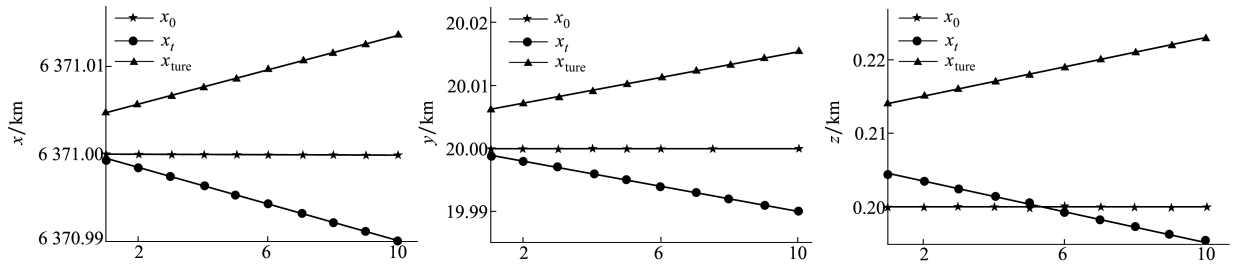
#Ž#‡ , ,L 4 É

0ŽŽŽœÇ z 0Ä" +±6 u T ÷E/ Á T 3 ½

, 4+±,L Ë z 4› g $\boldsymbol{x}_{wü}$ = ‰ ®ß”0! ”!. 0o” ã ç g+±J ø z 4› ¯=• ß m.g ”, z g ´] %' » Y ´ ý ' +±Ç z 0Ä" ” ü NA O¹ Z 0 mFü"x A i » g K! ! ”!. ! ß ´] Ò', 4 +± T 7! z 4› $\boldsymbol{x}_!$ = $x_!$ ” $y_!$ ”$z_!$ Ò ÷, 4 +±!o ? } 4 $\boldsymbol{x}_t$ = x_t ”y_t ”z_t Ò ¯ + 0 m.g %

=• Ó‡ ç g+±J ø z 4›

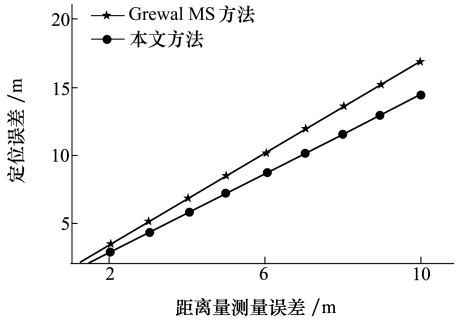
ç g 4C$	0 m} 4 ð]
ß	‰ ®! ŽŽ”ß Ž”ßo
0	‰ ®ßŽ”ß Ž”ßo
	‰ ®ßŽŽ”0! Ž”ßo



a) 目标的横坐标 x　　b) 目标的纵坐标 y　　c) 目标的竖坐标 z

+ 0œ, 4 +± T 7! z 4› ÷ Ç z ?

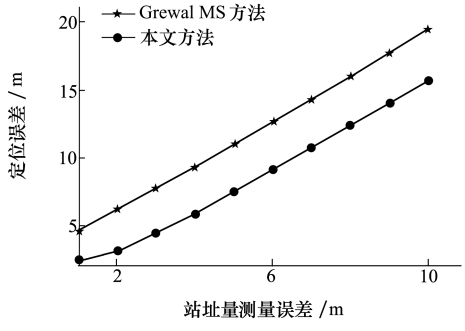
œœK¼m0 mA +±Ë T ”, 4 +±T 7! z 4› ¹ !o ? } 4 t : 9 /8 Ó+±| .è ,L Ë } 4 ”k &c”x_t ! ÒDþ ,L Ë z 4› +‘ C ” ¬, 4 +±T 7! z 4› ; ,L Ë z 4› | D° T # ”Y0Ä" Ê&œ6*? 0Ä] D° g)3 +±} 4 % g 3 ½Ç z 0Ä" +±6 u T ÷E/ Á T ”3 Y æ" ; M4 C .è Ç z æ" E =y ³ Q æL•! D° å€ ç g >ï "x 0 +±0 mA * *’ # ”f C .è "x FüA +± i ”! D° ¹ 52+±Ç z 1ë Ó ”, ,L ¯ + m.g +‘ C ”UC .è "x FüA : +±z ý 8 ”! D° ¹ 52 & » ç g 0 m"x FüA C+±E/ Á T ”, ,L ¯ + ×m.g %



+ œÇ z A K¼C .è Fü'x A C+±! D° +

¯ + m.g ”K¼mC .è "x FüA +±Ë T ”Y0Ä" . ,mD° ª +±Ç z 1ë Ó %k &c”€ ç g 0 mFü'x A g L## ”Y0Ä" ¤ 6 D° ª +±Ç z u É %û M4 +±C .è 0Ä" #2 ‡] ,8 ' ”£ Ç z 1ë Ó]])0 w ±1ë Ó+±ž ú ”U0Ä" Dð8 Z B ’ ³ ! G+±A % 4) 7 ”Y æ" ! ¤ 6 u T %

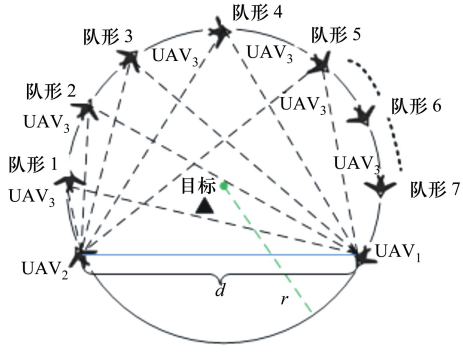
3 C .è Fü'x A +±i @ëg σ_0 %d Ž! 0 ´] ”£ B ’ ç g >ï "x 0 +±0 mFü'x A ”0 W0Ä" +±Ç z A K¼0 mFü'x A C+±! D° ¯ + ×m.g å



+ ×œÇ z A K¼0 mFü'x A C+±! D° +

*^ + × - ”8 0 mFü'x A : * *’ ”k &c Y 0Ä" E/ Á T ! g ”1ë Ó ! P ¬4 5 + ; + × ,8 ' ”Y æ" +±Ç z 1ë Ó ; k E » M4 Ç z æ" % 0ŽDŽDœ ç g 4CKLKL• 3 ½

E6 - < HÕ ê & Á+±4CKLKL• ‰g)3 4C KLKL• ” ý P Ç z 1ë Ó %' » + ßm ý ' +±G g | 9 Ç z N¸ ”Y ´ V*U ã ç g +±J ø z 4› =• .g £3ñ = +±4CKLKL• ”4CKLKL• +±SL,Ý + ¯ + " m .g ”G ç g ÇP £ ! 4 , 4 N =y ”£ 7WE&ž 3 A, 4 z 4› +± Â ž 2 X » 3 Z %' » ßŽ 7¯ m ý ' +± HÕ ê+±!o ? æ" ”V*U U3ì Ç k " 3 ç g 4CKL +± m 6 KL• m M 1 +± HÕ ê i !o ? £ « ' - < HÕ ê i m M 1 +±4CKLKL• % ç g +±4CKLKL• +± =•.g ¯ 8 å



+ "œ ç g 4CKLKL• SL,Ý +

ßo öÆ ¹ öÆ x K! +±C .è d . : ” öÆ+±z 4› !ì ,m7WE&3 DýÕ ”Ä] d Ž # 8 +±m 6 KL• ”¯ =• 0 m.g %

=• #‡ d k Óý # ç g 4CKLKL•

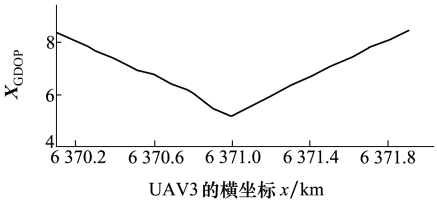
ç g 4C$	0 m} 4 ð]
ß	‰ ®! ŽÃ”ß Ž”ßo
0	‰ ®ßŽ”ß Ž”ßo
	‰”$\sqrt{ßq‰q}$ ®ßo^0 w0! ”ßo” ®! j x j ®0

0o d U g K! %b”0 o Z 7 <] T Ê N i ”9 # ” öÆ+±z 4› !ì ,m7WE&3 DýÕ ”Ä] ç g 4CKL +±m 6 KL• ”¯ =• m.g %

=• ú‡ ç g 4CKL+± m 6 KL•

ç g 4C$	z 4› ð]
öÆß	‰ ®ßq! Žd ”0! q√ ßq! ŽÐ"d 0 ”ßo ! d 0
öÆÐ	‰ ®ßW! Žd ”0! q√ ßq! ŽÐ"d 0 ”ßo ! d 0
öÆ	‰” √ ßq‰q ®ßo0 w0! ”ßo ®! j x j ®0

&=• 0 mE +± ç g KL• E =y HÕ ê!o ? ”£ , ,L 4 É ¯ + m.g %

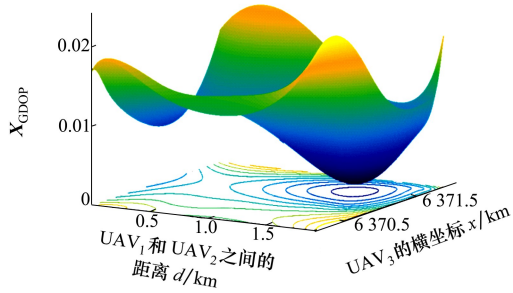


+ œHÕ êK¼ ç g 4CKLF 3 KL• C +

¯ + m.g ”HÕ ê+± i K½m öÆ W} 4 x Ë T59 u ü < ; Ë T ”6 - W; k +± ® < i ”‘ # ® < i m M 1 +± ç g 4CKLKL• ^ \ U d ‰ßŽ Ž # 8 +± - E4CKLKL• ”A KL• \ *^ ‰ ®! ŽÐ”ß Ž”ßo”‰ ®ßŽ”ß Ž”ßo”‰ ®ß”0ß”ßœE W%æm-› Ç+± - WJ=>ÿ 6 >ÿ• %

& » ¯=• mE +± m 6 +± ç g 4CKLKL• ”Ê N!o ? KL• m M 1 +± HÕ ê”4 É ¯ + ®m.g %

+ ®Z HÕ ê 6 - Wn 3 ; k +± ® < i ”z » d = ß®ß”x = ®ß 0 1 ” ç g 4CKL+± z 4› g å ‰ ®! ŽÐ×"ß Ž× ß” ßo” ‰ ®ßŽ ""ß Ž× ß” ßo” ‰ ®ßŽÐ”0! Ž !”ßo” ç g +± - 4CKLKL• g • 6 >ÿ• ”£, 4 z » • 6 >ÿ• Z ð • 8 æKœÐþ# HÕ ê - < %



+ ®œHÕ êK¼ ç g 4CKL+± m 6 KL• C +

#ŽÚ‡ , ,L 4 É 3 ½

û + 0 - ”U : 50;~ ç g >ï "x 0 +±0 mA # ”Y ´ ý ' +± Ç z æ" u É E » M4 C .è Ç z 0Ä" %/£ £ Ì ”M4 C .è Ç z æ" 1ë Ó]])0 w ± 1ë Ó+±K} c ”B ' ³ Ý+±A M¦ %&! + 0 ¹ + - ”B ' ç g 0 mA ; ”M4 æ" +± Ç z u É G - È %4) 7 ”Y æ" ¤ 6 7œª +± 6 u T ¹ E/ Á T %

' » Y ´ m ' /ø +± G g | 9 Ç z N ¸ ”=• E ' ã ç g 7WÆ&ž 3 +± m 6 KL• ”V*U U3ì Ç k " (!o - < HÕ ê i & Á +± 4CKLKL• ”¯ + " 2 m .g ” . ç g 4CKLKL• g • 6 >ÿ• ”j Fü¬ ç g 4CKL+± Z ð U] L• +± Â ž L• Dþ 4 +± z 4› ” ý P , 4 Ç z 1ë Ó %

ú‡ 4 ‡ @ç

Y ´ ý ' ³ - .ú G g | 9] L•, 4 Ç z æ" ” 4) 5 50;~ ³ ç g >ï "x 0 +± Fü'x A ¹ C .è "x FüA ”Ç z u ÉD° M4 +± C .è Ç z æ" ' A! ! ª ”EGÐô , ,L O¹@î³ £ 6 u T ¹ E/*U T %

& » Y ´ m ' /ø +± G ç g | 9 Ç z N ¸ ”, 4 +± z 4› 1 » • 6 >ÿ• +± Z ð • 8 æKœÐþ”Á @î 4CKLKL• g • 6 >ÿ• ” ý P ç g Ç z 1ë Ó %

ï 50´ ([Å

ßÒœe M5- Z ”6 " ”{ ñ (Û ”0v Ž: -› Ç(Ü ° 8 ç g G (Î g Ó à 0ƒ-A/£ .ÒŽ>¬ D G T “ “ Ò ” 0! ß ” ×‰ oå ß! 0 KS! ×

; @ö ¶ H _U• d•¿k” @ >•” Âç .= =” wUŽ öÆ X ü wHX = ¬¿ • ù•¿¿U= U¿ù Õ ù=¬¿KX Ú =¿k ü¿› ¢ ¿ù ¢WU=¿wƒ 6¿ù=Φ¿K

] ¿w .ÒŽ. •ü¢¿U •¦ ¶ • ¢wd w¢¿ ê• ƒwùd¿=ùU ¿=ù ¢ =wƒ” 0! ß ” ×‰ oå ß! 0 KS! × ‰=¿ d=¿ o

0Òœe { B² g ”{ € " ”ML ƒ ”0v Ž' » G g | 9 +± g Dª #½Ç z 3 ½ .ÒŽ(Ý L$Dë” 0! ß®' ‰ßßßo åßßßKßß×”

Âç dU• @t¿k” Âç î =U• &•” ; @ö ¶ H .=¿k” wUŽö¿U ƒ = •¦ ö=¢&• ¢¿ êU =ù Â• ùUU• ¿ ê¢ ù=¬¿ >U › • ¿ X ü wHX wUU• ù •• q ¢UK

v•¿ .ÒŽX•› ¢¿ • U Ut" 0! ß®" %ßßßoå ßßßKß×" %æ¿ d=¿ o
Òœ_ö¶H ý" ö¶ ." > î " wUŽ •¿ wUŽ¿ › •wJ Â UwK @JUt Â•ùUv•¿ ö k•¢=wd] =¿k ⇶ KÕ=¦¦ ¢ ¿ù K¿¦Kö¢¢=ùU X Uü¢ K
] ¿w .ÒŽçó66 ¢U¿ •¿ Æd=ùü Ut ùd¿• •kf" 0! ß!" " ‰oå ß"" Kß" 0

×Òœ^ * D¶"Ü T I "• # "0v Ž- .ú3ì T N • ö Ç z 0Ä" .ÒŽ>¬¶*b } .þ - T " " Ò " 0! ß"" ×0‰oå00KO"" 0
; @ Hü•dü=" è6¶H ÕUd ¿k" ; @ _U¿" wUŽ ö Â•ùU=Uv•¿ö k•¢=wd] =¿k wd Â=¿ UtK •¢¢ùv•¿ ùd¿=@u .ÒŽ.•ü¢K
¿U •¦ î ⇒ =U¿ ¿=ù ¢ =w/" 0! ß"" ×0‰oå 00KO"" 0 ‰¿ d=¿ o

"ÒœH• 6ü öÂ X i " ü 6çÂÂ Â • " ö¶Õ• 6ü i ö êŽH•&U ê• =v•¿=¿k i f w] " ç¿ ¢vU ¶UU=kUv•¿" U¿> ç¿wk¢Uv•¿ .ÒŽü = f ç¿K
w¢ = ù=q =¿Ut f • ù= •] qüwUv•¿U i wUv=vù " 0! ! ®" %×oå K ×
Òœ_ ; =@U¿" ; @ö¶H _•ü] =¿" P _U•d•¿k" wUŽÕ=w¢&ùw› ö›Ubqvù èUüi wK • ¢U¿w ••q ¢Uvù •¿w¢ ¦•¢ Xü v•K öÆ
UkU¿ wö ùwüUv¢ U¿> i ¿ •¢ èUüi w Òœöi X6 0! ß® ç¿w¢¿Uv•¿U Õ =k¿ 6¿k=¿ ¢=¿k ùd¿=ùU •¿¦ ¢ ¿ù U¿> •] qüw¢
U¿> ç¿¦•¢] Uv•¿ =¿ 6¿k=¿ ¢=¿k •¿¦ ¢ ¿ù " 0! ß®

®Òœ{ 4 R "P| "5ÃuB} Ž- .ú/` ' +± Õ ö #½Ç z æ" ÷ £ T6* 3 ½ .ÒŽZ * .þ " " 0! ! " %×oå×® K× 0
Âç ü U¿ùdü¿" ü 6çê=¿k" î çö î =U¿ù=Žö • •&ü w Õ ö êU =ù Â•ùUv•¿ X wd•› U¿> çw ê ¢¦•¢] U¿ù ö¿Uf = .ÒŽi ù=¿ù
d=¿U' 0! ! " %×oå ×® K× 0 %æ¿ d=¿ o

Òœèö¶ î " _ ¶ö¶ ¶ @" ö_Â • ÕŽö ê ¢wü¢&Uv•¿ö¿Uf = •¦ wd • kü Ut= › •¿ wUŽ¿ › •wJ Â Uwi @Ut .ÒŽçó66
¢U¿ •¿ =¢ùü=w ² i f w] çç ö¿U•k ² Õ=k=wU i =k¿U êÞù =¿k" ß " × ‰oå ß×! KßX0

ô9—VãY÷ssSã—9Yæã¦ sÞ9Ys¥ 9 ãYJs• s• 9 é Y, Û¬ ' 9çã• s¥ ×çãé• s t 9¥Vã 9 ã9çé—ãB ã¥Y

P _U•d•¿k" ; @ö¶H è ¿k" H • ¿¿ ¿k" _ ö¶ Õ•¿k =

‰ùd•• •¦ öüw] Uv•¿" ¶•¢wd w¢¿ ê• fwùd¿=ùU ¿=ù ¢ =w/" î =Õ¿ ®ß! ! ®0" d=¿Ub

Û çY—9ÞYå >U › •¿ wd •ùUv•¿ •¦ ù ¢U ü¿] U¿¿ › U ¢=U ù d=ù ‰ öÆo U¿> wd q ü›• ¢U¿k w UwUtk wÿ U
wUtk wù••q ¢Uvù •ùUv•¿] wd•› = q¢•q• › =¿ wd= qUbq ¢Ž d ¿•¿ =¿ Ut @JUv•¿ U&•üw¢ U q ü›• › =wU¿ù =¿K
¦•¢] Uv•¿ = wUU¿ ¦•¢] › w U¿•wd ¢ @JUv•¿ &f ü =¿k Uf • f ¦•¢] ü UŽ>f • ù=¿k wd U&•ù @JUv•¿" q• =v•¿ =¿¦•¢K
] Uv•¿ •¦ wd wUtk wùU¿ & •&Wù=¿ › ŽX U¿ d= " wd ù ¢WU=¿ @JUv•¿Õ ùUt=U& Ut wd] Uü¢ › ¢ ü w •¦ q ü›•
› =wU¿ù " •ùUv•¿ ¢¢ ¢ •¦ öÆ U¿> › =wU¿ù K] Uü¢=¿k ¢¢ ¢ •¦ ¢U¿k ¿ •¢ Ž> ⇒ " U¿ •¿ =¿ ¿ü] ¢Uv•¿
] wd•› = Ubqq =› w Utùd ¦•¢ wd & w¦•¢] Uv•¿" d• •&½ùvù = w ¿dU¿ù wd •ùUv•¿ Uùüü¢Uùf" U¿> wd
] ¿v•¿ › ¦•¢] Uv•¿ =] Ubqq › w wd] =¿⇶ U HÕ êŽ d ⇶ ü Uv•¿ ù ¢=¦f wd ùU⇒ =v/ U¿> U•UbqWU&=v/ •¦ wd q¢•K
q• ›] wd•› Ž

Þãe s—•çå öÆ+ ù••q ¢Uvù •ùUv•¿+ HÕ ê+ ¦•¢] Uv•¿

© 2019 Journal of Northwestern Polytechnical University.

This is an Open Access article distributed under the terms of the Creative Commons Attribution License ‰ttp å//creativecommons.org/licenses/by/4.0 o" which permits unrestricted use " distribution " and reproduction in any medium " provided the original work is properly cited.