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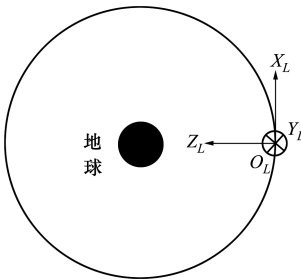
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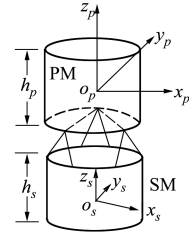
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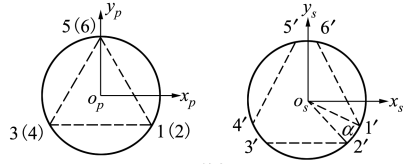
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a) 立体图



b) 俯视图

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$$\Gamma_i = \frac{h_p}{0} + \frac{h_s}{0} + \sqrt{\left(\frac{L_i}{\sqrt{0}}\right)^0 - \left(r_s \dot{u} \frac{\alpha}{0} - r_p\right)^0} \quad \%00$$

$$\alpha = U \dot{u} \left[ \beta - \left(\frac{L_i}{r_s}\right)^0 \right] \quad \%00$$

\*U r<sub>i</sub><sup>P</sup> %o = ß"0" "x"" o = •g U êX Y €2( 8 ü  
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$$\begin{cases} r_{\beta=0}^P = \left( r_p \dot{u} \left( !^\circ \alpha - r_p \right) \dot{u} \left( !^\circ \alpha - \frac{h_p}{0} \right) \right) \\ r_{\beta=x}^P = \left( -r_p \dot{u} \left( !^\circ \alpha - r_p \right) \dot{u} \left( !^\circ \alpha - \frac{h_p}{0} \right) \right) \\ r_{\beta=y}^P = \left( !^\circ \alpha - r_p \right) \dot{u} \left( !^\circ \alpha - \frac{h_p}{0} \right) \end{cases} \quad \%00$$

$$\begin{cases} r_{\beta=0}^S = \left( r_s \dot{u} \left( !^\circ - \frac{\alpha}{0} \right) \alpha - r_s \right) \dot{u} \left( !^\circ - \frac{\alpha}{0} \right) \alpha - \frac{h_s}{0} \\ r_{\beta=0}^S = \left( r_s \dot{u} \left( !^\circ + \frac{\alpha}{0} \right) \alpha - r_s \right) \dot{u} \left( !^\circ + \frac{\alpha}{0} \right) \alpha - \frac{h_s}{0} \\ r_{\beta=x}^S = \left( -r_s \dot{u} \left( !^\circ + \frac{\alpha}{0} \right) \alpha - r_s \right) \dot{u} \left( !^\circ + \frac{\alpha}{0} \right) \alpha - \frac{h_s}{0} \\ r_{\beta=x}^S = \left( -r_s \dot{u} \left( !^\circ - \frac{\alpha}{0} \right) \alpha - r_s \right) \dot{u} \left( !^\circ - \frac{\alpha}{0} \right) \alpha - \frac{h_s}{0} \\ r_{\beta=y}^S = \left( -r_s \right) \dot{u} \left( \frac{\alpha}{0} \right) \alpha - \dot{u} \left( \frac{\alpha}{0} \right) \alpha - \frac{h_s}{0} \\ r_{\beta=y}^S = \left( r_s \right) \dot{u} \left( \frac{\alpha}{0} \right) \alpha - \dot{u} \left( \frac{\alpha}{0} \right) \alpha - \frac{h_s}{0} \end{cases}$$

Öü† È 3 ½

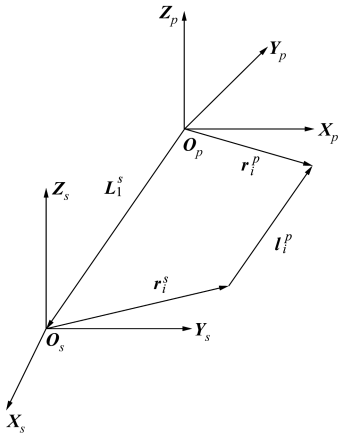
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$$l_i^p = r_i^p - A_p^S \omega_{\beta}^S + r_i^S \quad \%o$$

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$$F_Y^S \propto T_Y^S \dot{\Theta} = \Phi^S f \quad \%o$$

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$$\Phi^P = \begin{bmatrix} k_{\beta}^P & k_0^P & k^P & k_x^P \\ \%_{q_3}^P \times k_{\beta}^P & \%_{q_0}^P \times k_0^P & \%_{\beta}^P \times k^P & \%_{q_x}^P \times k_x^P \\ k_n^P & k^P \\ \%_{q_0}^P \times k_n^P & \%_{\beta}^P \times k^P \end{bmatrix}$$

$$\Phi^S = \begin{bmatrix} A_p^S k_{\beta}^P & A_p^S k_0^P & A_p^S k^P \\ \%_{q_3}^S \times A_p^S k_{\beta}^P & \%_{q_0}^S \times A_p^S k_0^P & \%_{\beta}^S \times A_p^S k^P \end{bmatrix}$$

$$\begin{bmatrix} A_p^S k_x^P & A_p^S k_n^P & A_p^S k^P \\ \%_{q_x}^S \times A_p^S k_x^P & \%_{q_n}^S \times A_p^S k_n^P & \%_{\beta}^S \times A_p^S k^P \end{bmatrix}$$

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$$\omega_p^S \times = \begin{bmatrix} ! & -r_{iz} & r_{iy} \\ r_{iz} & ! & -r_{ix} \\ -r_{iy} & r_{ix} & ! \end{bmatrix}$$

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$$F_g^P = - \frac{\mu m_p}{\%_{q_g}^P} r_g^P$$

$$F_g^S = - \frac{\mu m_s}{\%_{q_g}^S} r_g^S \quad \%o$$

$$T_g^P = \frac{\mu}{\%_{q_g}^P} r_g^P \times \%_{J_p} r_g^P \quad \%o$$

$$T_g^S = \frac{\mu}{\%_{q_g}^S} r_g^S \times \%_{J_s} r_g^S \quad \%o$$

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\omega\_{S/I}^S /N D) T MFü- Kbg J\_F ",%& » L € ±±D^TM

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$$\omega_{S/I}^S = J_S^{-B} [T_W^S - J_F \omega_F^S -$$

$$\omega \omega_{S/I}^S \times \%_{J_S} \omega_{S/I}^S + J_F \omega_F^S] \quad \%o$$

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$$T_{dx} = \sum_{k=\beta}^K C_k \omega_z^0 \dot{\omega}_z \times \%_{q_k} \omega_z t o + \omega_y^0 \dot{\omega}_y \times \%_{q_k} \omega_y t o \dot{\omega}_o$$

$$T_{dy} = \sum_{k=\beta}^K C_k \omega_x^0 \dot{\omega}_x \times \%_{q_k} \omega_x t o + \omega_z^0 \dot{\omega}_z \times \%_{q_k} \omega_z t o \dot{\omega}_o$$

$T_{dz} = \sum_{k=1}^K C_k \omega_y^0 \dot{\omega}_k \omega_y t + \omega_x^0 \dot{\omega}_k \omega_x t$

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$\bullet \cdot \omega_y^1 \omega_z 3 X g Wæ > 7 ND \rangle \pm DTEL C_k$

$g \ddot{O}l \ddagger : = \ddot{Z} \cdot \mathcal{F}_{dx} T_{dy}^1 T_{dz} 3 X g Wæ > 7$

$\pm \ddot{Y} \cdot \ddot{E} - \%$

$$\widehat{M}_S^{-\beta} = \begin{pmatrix} \times & J_S^{-\beta} \\ \beta & \times \\ \frac{1}{m_S} I & \times \\ \times & \times \end{pmatrix}$$

$$\widehat{\omega}_{S/I}^S = \omega_{S/I}^S + \varepsilon v_{S/I}^S g \text{ iX4 } \& \& \text{ \& ELÓ } \widehat{\omega}_{S/P}^S = \omega_{S/P}^S + \varepsilon v_{S/P}^S g \text{ iX, } \& \& \text{ » } \hat{e}X \pm \& \& \text{ \& ELÓ } \widehat{q}_{e\beta} g \text{ iX Y } \in \}$$

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$$\omega_{S/P}^S = -J_S^{-\beta} \omega_{S/I}^S \times \mathcal{M}_S \omega_{S/I}^S + J_S^{-\beta} T_S^S - \omega_{P/I}^S + \omega_{S/P}^S \ddot{O} \omega_{P/I}^S$$

$$v_{S/P}^S = -\omega_{S/I}^S \times v_{S/I}^S + \frac{F_S^S}{m_S} - v_{P/I}^S + \omega v_{S/P}^S \ddot{O} \omega_{P/I}^S + \omega_{S/P}^S \ddot{O} v_{P/I}^S$$

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$$\widehat{\omega}_{P/L}^P = -\widehat{M}_P^{-\beta} \widehat{\omega}_{P/I}^P \times \mathcal{M}_P \widehat{\omega}_{P/I}^P + \widehat{M}_P^{-\beta} \widehat{F}_P^P - \omega_{e\beta}^M \widehat{\omega}_{L/I}^L \widehat{q}_e + \widehat{\omega}_{P/L}^P \ddot{O} \widehat{q}_e^M \widehat{\omega}_{L/I}^L \widehat{q}_e \% \beta \beta o$$

$$\widehat{M}_P = m_p \frac{1}{\mathcal{E}} I_{\times} + \varepsilon J_P$$

$$\widehat{M}_P^{-\beta} = \begin{pmatrix} \times & J_P^{-\beta} \\ \beta & \times \\ \frac{1}{m_P} I & \times \\ \times & \times \end{pmatrix}$$

$\widehat{\omega}_{P/I}^P = \omega_{P/I}^P + \varepsilon v_{P/I}^P g \text{ êX } \pm \pm 4 \& \& \text{ \& ELÓ } \widehat{\omega}_{P/L}^P =$

$\omega_{P/L}^P + \varepsilon v_{P/L}^P g \text{ êX, } \% \& \text{ » } 7W \cdot D \cdot E \in \} 42(\pm \pm \& \text{ \& ELÓ } \widehat{\omega}_{L/I}^L = \omega_{L/I}^L + \varepsilon v_{L/I}^L g 7W \cdot D \cdot E \in \} 42(, \% \& ]$

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& » 7W • D • E €} 42(±± & \& £ p •  $\widehat{F}_P^P$  g % \*UU

êX 7 ± ± & \& È " 2 & \& \hat{O}c È & \& \& £ Fú È¹ & \& \ddot{Y} \cdot \ddot{E} \% \widehat{\omega}\_{P/L}^P \ddot{O} g \ddot{o} \dots K\beta\%

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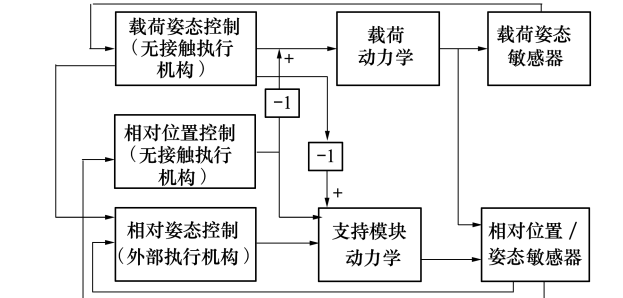
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$$\widehat{\omega}_{S/P}^S = -\widehat{M}_S^{-\beta} \widehat{\omega}_{S/I}^S \times \mathcal{M}_S \widehat{\omega}_{S/I}^S + \widehat{M}_S^{-\beta} \widehat{F}_S^S - \omega_{e\beta}^M \widehat{\omega}_{P/I}^P \widehat{q}_{e\beta} + \widehat{\omega}_{S/P}^S \ddot{O} \widehat{q}_{e\beta}^M \widehat{\omega}_{P/I}^P \widehat{q}_{e\beta} \% \beta \beta o$$

$$\widehat{M}_S = m_s \frac{1}{\mathcal{E}} I_{\times} + \varepsilon J_S$$

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Ö Ôc "UCF " = y g ± E = y, % & , . Ôc % UE

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 E P » Õ Ô c>@o±±ò â Z %' » 7 3 ½ "û  
 Ô c±±È\*UT &-. T ÷ L•T>ÿÓ' p "@@Î³  
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 ,%& » êX±± êÕ Ô c , %

úy† x9 ,%& » i 50D•E€} 4 2( ±±,%&DýÕ Ô  
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: 50;~,%& Õ Ô c ±±ò â 8 "4 ' êX,%&  
 » i 50D•E€} 4 2( ±±,%&DýÕ Ô c ,

$$\hat{u}_c^p = k_{p,\beta} \% q_e^M - q_c^o + k_{D,\beta} \% \omega_{P/L}^{PM} - \hat{w}_{P/L}^p o + \times_{\beta} \hat{O}$$

$k_{p,\beta}^{-1} k_{D,\beta} g \hat{O} c i \cdot \hat{q}_e^M \omega_{P/L}^{PM} g \hat{e}X,%& » i 50$   
 $D \cdot E \in \} 4 2( \pm \pm L H p \cdot 1 > \hat{y} E L \hat{O} \hat{q}_c^1 \hat{w}_{P/L}^p g \hat{E}$   
 $K r " x F \hat{u} \hat{A} ] \pm p \cdot 1 > \hat{y} E L \hat{O} \%$

úy#† R9 ,%& » x9 ±±,%&DýÕ Ô c ,  
 g . >@o±±,%& z , "@@Î i X,%& » êX  
 ±±, D•- € C,%&DýÕ Ô c ,

$$\hat{u}_c^s = k_{p,0} \% q_e^M - q_c^o + k_{D,0} \% \omega_{S/P}^{SM} - \hat{w}_{S/P}^s o -$$

$$\hat{e} J_s^{-B} T_Y^s + \times_{\beta} \hat{O} \quad \% \beta " o$$

$k_{p,0}^{-1} k_{D,0} g \hat{O} c i \cdot \hat{q}_e^M \omega_{S/P}^{SM} g i X,%& » \hat{e}X \pm$   
 $L H \& £ p \cdot 1 \& £ > \hat{y} E L \hat{O} \hat{q}_c^1 \hat{w}_{S/P}^s g " x F \hat{u} ]$   
 $@ \hat{t} \pm \& £ p \cdot 1 \& £ > \hat{y} E L \hat{O} \hat{q}_Y^s g \hat{O} ? " = y g$   
 $\pm \& i X \pm \hat{y} \cdot \hat{E} - \%$

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 h±±%& , . >ÿ3 X g φ<sub>β</sub> % D<sup>T</sup>Y o& %<sub>β</sub> >ÿ o&  
 ψ<sub>β</sub> % p 7Vÿ o" 4/ 'ã . 8±±,%& , . >ÿ3 X g φ<sub>1</sub> &  
 θ<sub>1</sub> & ψ<sub>1</sub> %\*^ » i X ±± ELg Ô T μ<sup>a</sup> "m μφ = φ<sub>β</sub> -  
 φ<sub>1</sub> " μθ = θ<sub>β</sub> - θ<sub>1</sub> " μψ = ψ<sub>β</sub> - ψ<sub>1</sub> F\* ,8 %o < Fù"

$$\beta o \hat{u} \mu \phi ) \hat{u} \mu \theta ) \hat{u} \mu \psi ) \beta$$

$$\hat{e} \mu \phi ) \mu \phi$$

$$\hat{e} \mu \theta ) \mu \theta$$

$$\hat{e} \mu \psi ) \mu \psi$$

$$\alpha e \alpha 0 o^{-1} K c \div^{-1} K c \quad 7 < F \hat{u} 8 \% o ! \%$$

$$m \hat{e} X Y \in 2( ] i X Y \in 2( \pm \pm , . D^{TM} - K b$$

0- C g

$$A_p^s = \begin{pmatrix} \beta & \psi_{\beta} & ! \\ -\psi_{\beta} & \beta & ! \\ ! & ! & \beta \end{pmatrix} \begin{pmatrix} \beta & ! & -\theta_{\beta} \\ ! & \beta & ! \\ \theta_{\beta} & ! & \beta \end{pmatrix} \frac{1}{4}$$

$$\alpha \begin{pmatrix} \beta & ! & ! \\ ! & \beta & \varphi_{\beta} \\ ! & -\varphi_{\beta} & \beta \end{pmatrix} = \begin{pmatrix} \beta & \psi_{\beta} & -\theta_{\beta} \\ -\psi_{\beta} & \beta & \varphi_{\beta} \\ ! & -\varphi_{\beta} & \beta \end{pmatrix}$$

%β o

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 (L<sub>β</sub><sup>S</sup> L<sub>β</sub><sup>S</sup> L<sub>β</sub><sup>S</sup>) "F Ò? " =y g ± & Á # h ±±  
 J-Ó

$$l_i = | A_p^s r_i^p - L_{\beta}^s - r_i^s | =$$

$$\alpha \sqrt{\begin{matrix} \% \beta_{ix}^p + \psi_{\beta_{iy}}^p - \theta_{\beta_{iz}}^p - L_{\beta}^s - r_{ix}^s o^0 + \\ \alpha \% \beta_{ix}^p + r_{iy}^p + \varphi_{\beta_{iz}}^p - L_{\beta}^s - r_{iy}^s o^0 + \\ \alpha \% \beta_{ix}^p - \varphi_{\beta_{iy}}^p + r_{iz}^p - L_{\beta}^s - r_{iz}^s o^0 \end{matrix}}$$

%βo

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 4) ÷ êX&i X g % - ò â 8 "l<sub>i</sub> %o = β"0" "x"" o  
 \ » φ<sub>β</sub> "θ<sub>β</sub> "ψ<sub>β</sub> "L<sub>β</sub><sup>S</sup> "L<sub>β</sub><sup>S</sup> ¹ L<sub>β</sub><sup>S</sup> ±±\* • %3 £ U 4/  
 'ã . φ<sub>1</sub> = ! "θ<sub>1</sub> = ! "ψ<sub>1</sub> = ! "L<sub>β</sub><sup>S</sup> = %βe! e- Γ<sub>1</sub> oKqðp  
 , - "Ä ]

$$l_i - L_i = \frac{N_i}{N_{\beta}} \Bigg|_{\substack{\varphi_1 = ! \\ \theta_1 = ! \\ \psi_1 = !}}^{\varphi_1 = !} \mu \phi +$$

$$L_i^s = ( ! ! - \Gamma_1 )$$

$$\alpha \frac{N_i}{N_{\beta}} \Bigg|_{\substack{\varphi_1 = ! \\ \theta_1 = ! \\ \psi_1 = !}}^{\varphi_1 = !} \mu \theta + \frac{N_i}{N_{\beta}} \Bigg|_{\substack{\varphi_1 = ! \\ \theta_1 = ! \\ \psi_1 = !}}^{\varphi_1 = !} \mu \psi +$$

$$L_i^s = ( ! ! - \Gamma_1 ) \quad L_i^s = ( ! ! - \Gamma_1 )$$

$$\alpha \frac{N_i}{N_{\beta}^s} \Bigg|_{\substack{\varphi_1 = ! \\ \theta_1 = ! \\ \psi_1 = !}}^{\varphi_1 = !} \mu_{\beta}^s + \frac{N_i}{N_{\beta}^s} \Bigg|_{\substack{\varphi_1 = ! \\ \theta_1 = ! \\ \psi_1 = !}}^{\varphi_1 = !} \mu_{\beta}^s +$$

$$L_i^s = ( ! ! - \Gamma_1 ) \quad L_i^s = ( ! ! - \Gamma_1 )$$

$$\alpha \frac{N_i}{N_{\beta}^s} \Bigg|_{\substack{\varphi_1 = ! \\ \theta_1 = ! \\ \psi_1 = !}}^{\varphi_1 = !} \mu_{\beta}^s \quad \% \beta o$$

$$L_i^s = ( ! ! - \Gamma_1 )$$

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@î±%& z 4) ¹,%& , .

$$\begin{cases} \varphi_B = \mu\theta \\ \theta_B = \mu\theta \\ \psi_B = \mu\psi \\ \mathcal{L}_B = (\mu L_B^S \quad \mu L_B^S \quad - \Gamma_1 + \mu L_B^S) \end{cases} \quad \%B o$$

& %B< QDæ )

$$i_i = \frac{N_i}{M_B} \varphi_B + \frac{N_i}{M_B} \theta_B + \frac{N_i}{M_B} \psi_B + \frac{N_i}{M_B} L_B^S +$$

$$\infty \frac{N_i}{M_B} L_B^S + \frac{N_i}{M_B} L_B^S \quad \%! o$$

\*^ »,%& , . ¹,%& z 4) 3ü] @î' ' " < ,mæ  
/8 3ñ%! ±2( • - KbCE - € % Wæ/8 WW

Fü" lo Ä ¼ φ<sub>B</sub> ¼ θ<sub>B</sub> ¼ ψ<sub>B</sub> ¼ L<sub>B</sub><sup>S</sup> ¼ L<sub>B</sub><sup>S</sup> 1 L<sub>B</sub><sup>S</sup> %E - ' Ä ] ,%  
>ÿELÓ ¹ ,%&ELÓ±±] @Fü

$$\omega_{S/P}^S = \begin{pmatrix} \beta & \psi_B & ! \\ -\psi_B & \beta & ! \\ ! & ! & \beta \end{pmatrix} \begin{pmatrix} \beta & ! & -\theta_B \\ ! & \beta & ! \\ \theta_B & ! & \beta \end{pmatrix} \begin{pmatrix} \varphi_B \\ ! \\ ! \end{pmatrix} +$$

$$\begin{pmatrix} \beta & \psi_B & ! \\ -\psi_B & \beta & ! \\ ! & ! & \beta \end{pmatrix} \begin{pmatrix} ! \\ ! \\ ! \end{pmatrix} + \begin{pmatrix} ! \\ ! \\ \psi_B \end{pmatrix} = \begin{pmatrix} \varphi_B + \psi_B \theta_B \\ \theta_B - \psi_B \varphi_B \\ \psi_B \end{pmatrix} \quad \%B o$$

$$v_{S/P}^S = \begin{pmatrix} L_B^S \\ L_B^S \\ L_B^S \end{pmatrix} + \omega_{S/P}^S \times \mathcal{L}_B \quad \%0 o$$

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ê X ,%& » i 50D•E€	$k_{p,B} = \rightarrow \pm K \infty \beta - \beta - \beta o$
} 4 2( ±±,%& DýÖ	$k_{D,B} = \rightarrow \pm K \infty \theta - \theta - \theta o$
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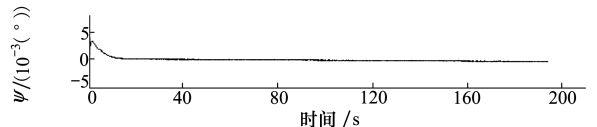
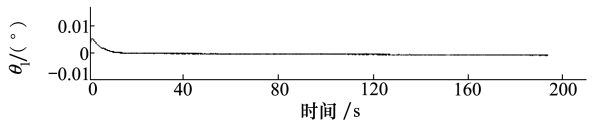
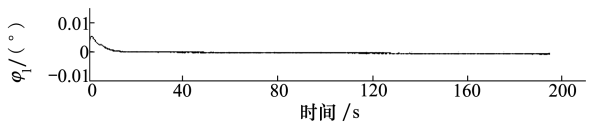
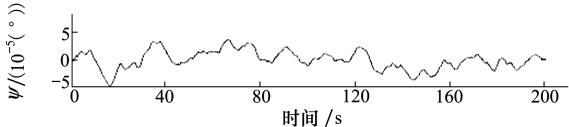
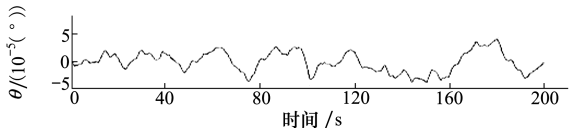
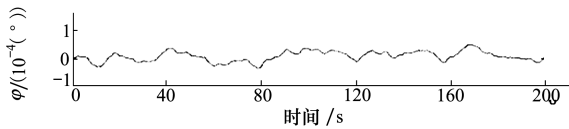
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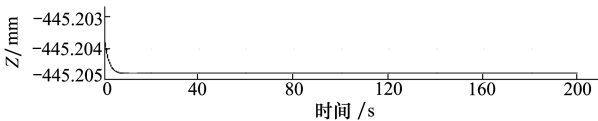
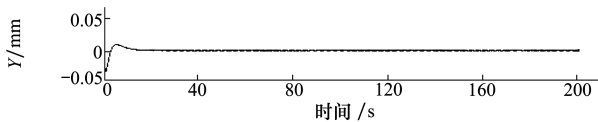
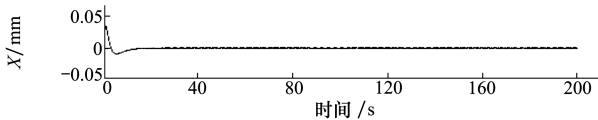
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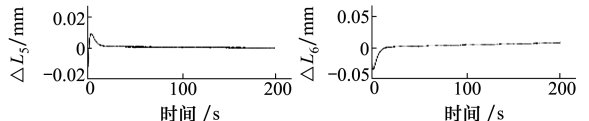
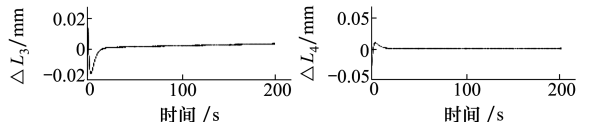
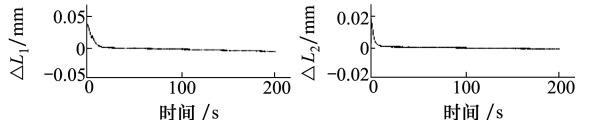
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 ý ¶H î ð ž k ž ” ü d ž ” Āç \_üLž ” wUŽ Ö f ž l ž ù X › ž k • ! • Uñd X • w ž ! • ç Ö = wñd ž l ž k ç k ç U f • U i q l ù ù d l w  
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( B Ž ù d • • ! ö w ž l ù w ù ” ¶ • w ù w ç è • f w ù d ž ù U ž ù ç ç ç ” i ð ž B ! ! @ ” d=ž U )  
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Ū ç Y 9 P Y á ç ž • ç w & w ç ] w ù l ü w ù ç d k d q ç ù = ç ž w l ’ ç @ i ç ] ž w ’ w Öèè%Ö = wñd ž l ž k ç è U f • U o  
 q l ù ù d l w ù ] q • › • ! ç • ž k ç ž w ù w è X % è U f • U X › ü o L ž ; i X % è ü ç ç ç w X › ü o = w l ž U w l • & ¼ ù w w wñw f  
 w l ç Uñd ] • w ž ; f ž l ž ù ] › ž k L ž ; ù ç w ç & w ž w l w • ] › ü L ž ; ù ç f w l f w ] ù ç d L ž ž = • U ð ž ;  
 q ç • ç L ž ; ž è ç w f ” w l • ç ù L ž ; w ç @ 4 q ç ç ž • ! w l w • ] › ü L ž ; ç è ; & f ç q ç f = k w l ù ç ; k ù d K  
 w ž L ž ; L ž U f = k w l w ç Ž ç ž ù = • ! w l w ù ç ü ç || ù w w l ç Uñd ] • w ž ; f ž l ž ù @ U ð ž ; & w ž w • ] › K  
 ü • ! Öèè q l ù ù d l w ù ù d k d ] › U ù d L ž f ” L ž ; ç q L ž ; ü ç ç • ç ! ç U w L ž w & = d › ù d w l › ü U @ L K  
 w ç ç ž Ž > U › • ž w l = ” w l è Ö ù ç w ç U = › ç ž ; ” L ž ; w l ç Uñd ] • w ž ; ! è X L ž ; i X ù ü › ] w Öèè  
 q l ù ù d l w • ç = k ç @ i ç ] ž w d ž w l ] U ù d B = ç f • ! ù ç w ç @ L ž w ç f L ž ; w l ] U ù ç ] ž w ç ç ç • ! ç • ç  
 ç w l ç ç w l ù ç ü ç ž Ž i ç ü U ð ž ; ç ü w ù ç f w l U ù L ž w k • ! ù ç d L ž ž = • U ð ž ; L ž ; U wñw ] L ž ; ü ù d B = ç f • !  
 Öèè q l ù ù d l w Ž

B äe s - ç á Öèè q l ù ù d l w › ü U @ U w ç ç ž ç + ç Uñd ] • w ž ; f ž l ž ù ] › ž k + è Ö ù ç w ç + ù ç d L ž ž = • U ð ž ; ç  
 ç ü U ð ž ; ç ] U ù ç ] ž w ç ç ç • ! ç • ç