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ПАРАБОЛИЧЕСКИЙ ТИП ДВИЖЕНИЯ ИСЗ В НЕСТАЦИОНАРНОМ ПОЛЕ ТЯГОТЕНИЯ ЗЕМЛИ (интервал $\alpha_2 < w < \alpha_1$, случай $v = v_0 \sin \alpha \psi$)

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Найдены полярные координаты близкого ИСЗ в случае нестационарного поля тяготения, принимая решения, найденные в стационарном поле тяготения, за первое приближение, ограничиваясь членами рядов $O(k^2)$ включительно, где k – модуль эллиптического интеграла 1-го рода.

Пусть близкий ИСЗ совершает движение в нестационарном поле тяготения Земли на основной плоскости. Рассмотрим случай параболического типа движения при периодическом изменении главных моментов инерции Земли, т.е.

$$v = v_0 \sin \alpha \psi. \quad (1)$$

В этом случае дифференциальные уравнения движения ИСЗ будут иметь вид*

$$\ddot{\rho} = \frac{C^2}{\rho^3} - \frac{\mu}{\rho^2} + v_0 \rho \sin \alpha \psi, \quad \alpha - \text{const}, \quad (2)$$

$$\frac{d\vartheta}{dt} = \frac{C}{\rho^2}. \quad (3)$$

Для получения второго приближения в решениях (2) и (3) используем решение стационарной задачи на интервале $\alpha_2 < w < \alpha_1$ [1]:

$$\rho = \left(\rho_{00} + \frac{1}{2} \rho_{12} k^2 \right) + (\rho_{01} k + \rho_{02} k^2) \cos \psi + \frac{1}{2} \rho_{12} k^2 \cos 2\psi, \quad (4)$$

$$\rho^{-2} = \left[1 + \left(\frac{1}{2} R_{11}^2 + R_{12} \right) k^2 + 2(R_{11} k + R_{12} k^2) \cos \psi + \left(\frac{1}{2} R_{11}^2 + 2R_{22} \right) k^2 \cos 2\psi \right] \rho_{00}^{-2}, \quad (5)$$

$$\rho^{-3} = \rho_{00}^{-3} \left[1 + \left(\frac{15}{2} R_{11}^2 + 6R_{02} \right) k^2 + (6R_{11} k + 6R_{12} k^2) \cos \psi + \left(\frac{15}{2} R_{11}^2 + 6R_{22} \right) k^2 \cos 2\psi \right], \quad (6)$$

$$dt = [l_{00} + k^2 l_{02} + k l_{11} \cos \psi + k^2 l_{22} \cos 2\psi] d\psi. \quad (7)$$

Используя (1) и (4), вычислим $\rho \sin \alpha \psi$:

$$\begin{aligned} \rho \sin \alpha \psi = & \left(\rho_{00} + \frac{1}{2} \rho_{12} k^2 \right) \sin \alpha \psi + (\rho_{01} k + \rho_{02} k^2) \cdot \frac{1}{2} \sin[(\alpha - 1)\psi] + \\ & + (\rho_{01} k + \rho_{02} k^2) \cdot \frac{1}{2} \sin[(\alpha + 1)\psi] + \frac{1}{4} \rho_{12} k^2 \sin[(\alpha - 2)\psi] + \frac{1}{4} \rho_{12} k^2 \sin[(\alpha + 2)\psi]. \end{aligned} \quad (8)$$

*Шинибаев М.Д., Есенов Е.К. Орбитальные движения близкого ИСЗ в нестационарном поле тяготения Земли. – Алматы: Фылым, 2009. – 89 с.

Подставим (5), (6), (7) и (8) в (2):

$$d\rho = \left\{ \begin{array}{l} (H_{00} + k^2 H_{02}) + (kH_{11} + k^2 H_{12}) \cos \psi + k^2 H_{22} \cos 2\psi + (H_{30} + k^2 H_{32}) \sin \alpha \psi + \\ + (kH_{41} + k^2 H_{42}) \sin(\alpha - 1)\psi + (kH_{41} + k^2 H_{42}) \sin(\alpha + 1)\psi + (k^2 H_{52}) \sin(\alpha + 2)\psi + \\ + k^2 H_{52} \sin(\alpha - 2)\psi \end{array} \right\} d\psi. \quad (9)$$

Здесь введены обозначения

$$\begin{aligned} H_{00} &= h_{00}l_{00}, \quad H_{02} = h_{02}l_{00} + \frac{1}{2}l_{11}h_{11} + l_{02}h_{00}, \quad H_{11} = h_{11}l_{00} + h_{00}l_{11}, \quad H_{12} = h_{12}l_{00}, \\ H_{22} &= h_{22}l_{00} + \frac{1}{2}l_{11}h_{11} + 2h_{00}l_{22}, \quad H_{30} = h_{30}l_{00}, \quad H_{32} = l_{00}h_{32} + \frac{1}{2}l_{11}h_{11} + \frac{1}{2}h_{41}l_{11} + l_{02}h_{30}, \\ H_{41} &= l_{00}h_{41} + \frac{1}{2}l_{11}h_{30}, \quad H_{42} = l_{00}h_{42}, \quad H_{52} = l_{00}h_{52} + \frac{1}{2}l_{11}h_{41} + l_{22}h_{30}, \quad h_{00} = (C\rho_{00}^{-3} - \mu\rho_{00}^{-2}), \\ h_{02} &= \left[C\rho_{00}^{-3} \left(\frac{15}{2}R_{11}^2 + 6R_{02} \right) - \mu\rho_{00}^{-2} \left(\frac{1}{2}R_{11}^2 + 2R_{02} \right) \right], \quad h_{11} = [C\rho_{00}^{-3} 6R_{11} - 2\mu\rho_{00}^{-2} R_{11}], \\ h_{12} &= [C\rho_{00}^{-3} 6R_{12} - 2\mu\rho_{00}^{-2} R_{12}], \quad h_{22} = \left[C\rho_{00}^{-3} \left(\frac{15}{2}R_{11}^2 + 6R_{22} \right) - \mu\rho_{00}^{-2} \left(\frac{1}{2}R_{11}^2 + 2R_{22} \right) \right], \\ h_{30} &= \rho_{00}, \quad h_{32} = \frac{v_0}{2}\rho_{12} = h_{52}, \quad h_{41} = \frac{v_0}{2}\rho_{01}, \quad h_{42} = \frac{1}{2}\rho_{02}, \quad h_{30} = v_0\rho_{00}. \end{aligned}$$

Проинтегрируем (9) от нуля до верхних переменных пределов:

$$d\rho = \left\{ \begin{array}{l} (\eta_{00} + k\eta_{01} + k^2\eta_{02}) + (\eta_{10} + k^2\eta_{12})\psi + (k\eta_{21} + k^2\eta_{22}) \sin \psi + k^2\eta_{32} \sin 2\psi + \\ + (k\eta_{41} + k^2\eta_{42}) \cos \psi + k^2\eta_{52} \cos 2\psi + (\eta_{60} + k^2\eta_{62}) \cos \alpha \psi + \\ + (k\eta_{71} + k^2\eta_{72}) \cos(\alpha - 1)\psi + (k\eta_{71} + k^2\eta_{72}) \cos(\alpha + 1)\psi + \\ + k^2\eta_{82} \cos(\alpha - 2)\psi + k^2\eta_{82} \cos(\alpha + 2)\psi + k\eta_{91} \psi \cos \psi + k^2\eta_{102} \psi \cos 2\psi \end{array} \right\} d\psi. \quad (10)$$

Здесь введены обозначения:

$$\begin{aligned} \eta_{00} &= \frac{l_{00}H_{30}}{\alpha}, \quad \eta_{01} = \frac{2l_{00}H_{41}\alpha}{\alpha^2 - 1}, \quad \eta_{02} = \frac{l_{00}H_{32}}{\alpha} + \frac{2l_{00}H_{42}\alpha}{\alpha^2 - 1} + \frac{2l_{00}H_{52}\alpha}{\alpha^2 - 4} + \frac{l_{02}H_{30}}{\alpha}, \quad \eta_{10} = l_{00}H_{00}, \\ \eta_{12} &= l_{00}H_{02} + l_{02}H_{00}, \quad \eta_{21} = l_{00}H_{11}, \quad \eta_{22} = l_{00}H_{12}, \quad \eta_{32} = \frac{1}{2}l_{00}H_{22} + \frac{1}{2}l_{11}H_{11}, \quad \eta_{41} = \frac{l_{11}H_{30}}{\alpha}, \\ \eta_{42} &= \frac{2\alpha l_{11}H_{41}}{\alpha^2 - 1}, \quad \eta_{52} = \frac{2l_{22}H_{30}}{\alpha}, \quad \eta_{60} = -\frac{l_{00}H_{30}}{\alpha}, \quad \eta_{62} = -\frac{l_{00}H_{32}}{\alpha} - \frac{l_{11}H_{41}}{2(\alpha - 1)} - \frac{l_{11}H_{41}}{2(\alpha + 1)}, \\ \eta_{71} &= -\frac{l_{00}H_{41}}{\alpha - 1} - \frac{l_{11}H_{30}}{2\alpha}, \quad \eta_{72} = -\frac{l_{00}H_{42}}{\alpha - 1}, \quad \eta_{82} = -\frac{l_{00}H_{52}}{\alpha - 2} - \frac{l_{11}H_{41}}{2(\alpha - 1)} - \frac{l_{22}H_{30}}{\alpha}, \quad \eta_{91} = l_{11}H_{00}, \\ \eta_{102} &= 2l_{22}H_{00}. \end{aligned}$$

Проинтегрируем (10) от нуля до верхних переменных пределов:

$$\begin{aligned} \rho &= (k\tau_{01} + k^2\tau_{02}) + (\tau_{10} + k\tau_{11} + k^2\tau_{12})\psi + (\tau_{20} + k^2\tau_{22})\psi^2 + (k\tau_{31} + k^2\tau_{32}) \cos \psi + \\ &+ k^2\tau_{42} \cos 2\psi + (k\tau_{51} + k^2\tau_{52}) \sin \psi + k^2\tau_{62} \sin 2\psi + (\tau_{70} + k^2\tau_{72}) \sin \alpha \psi + \\ &+ (k\tau_{81} + k^2\tau_{82}) \sin(\alpha - 1)\psi + (k\tau_{91} + k^2\tau_{92}) \sin(\alpha + 1)\psi + k^2\tau_{102} \sin(\alpha - 2)\psi + \\ &+ k^2\tau_{112} \sin(\alpha + 2)\psi + k\tau_{121} \psi \sin \psi + k^2\tau_{132} \psi \sin 2\psi. \end{aligned} \quad (11)$$

Здесь введены обозначения

$$\begin{aligned}
 \tau_{01} &= \eta_{21} - \eta_{91}, \quad \tau_{02} = \eta_{22} + \frac{1}{2}\eta_{32} - \frac{1}{4}\eta_{102}, \quad \tau_{10} = \eta_{00}, \quad \tau_{11} = \eta_{01}, \quad \tau_{12} = \eta_{02}, \quad \tau_{20} = \frac{1}{2}\eta_{10}, \quad \tau_{31} = \eta_{91} - \eta_{21}, \\
 \tau_{22} &= \frac{1}{2}\eta_{12}, \quad \tau_{32} = -\eta_{22}, \quad \tau_{42} = \frac{1}{4}\eta_{102} - \eta_{32}\frac{1}{2}, \quad \tau_{51} = \eta_{41}, \quad \tau_{52} = \eta_{42}, \quad \tau_{62} = \frac{1}{2}\eta_{52}, \quad \eta_{70} = \eta_{60}\frac{1}{\alpha}, \\
 \eta_{72} &= \eta_{62}\frac{1}{\alpha}, \quad \tau_{81} = \frac{\eta_{71}}{\alpha-1}, \quad \tau_{82} = \frac{\eta_{72}}{\alpha-1}, \quad \tau_{91} = \frac{\eta_{71}}{\alpha+1}, \quad \tau_{92} = \frac{\eta_{72}}{\alpha+1}, \quad \tau_{102} = \frac{\eta_{81}}{\alpha-2}, \quad \tau_{112} = \frac{\eta_{82}}{\alpha+2}, \\
 \tau_{121} &= \eta_{91}, \quad \tau_{132} = \frac{1}{2}\eta_{102}.
 \end{aligned}$$

Используя (11), вычислим $C\rho^{-2}$:

$$\begin{aligned}
 C\rho^{-2} = & (B_{00} + kB_{01} + k^2B_{02}) + (B_{10} + kB_{11} + k^2B_{12})\psi + (B_{20} + k^2B_{22})\psi^2 + \\
 & +(kB_{31} + k^2B_{32})\cos\psi + k^2B_{42}\cos 2\psi + (kB_{51} + k^2B_{52})\sin\psi + k^2B_{62}\sin 2\psi + \\
 & +(B_{70} + k^2B_{72})\sin\alpha\psi + k^2B_{82}\sin 2\psi + k^2B_{92}\cos 2\alpha\psi + (kB_{101} + k^2B_{102})\sin(\alpha-1)\psi + \\
 & +(kB_{111} + k^2B_{112})\sin(\alpha+1)\psi + k^2B_{122}\sin(\alpha-2)\psi + k^2B_{132}\sin(\alpha+2)\psi + \\
 & +(kB_{141} + k^2B_{142})\psi\sin\psi + k^2B_{152}\psi\sin 2\psi + k^2B_{162}\cos 2(\alpha-1)\psi + k^2B_{172}\psi\cos 2\psi + \\
 & +k^2B_{182}\cos 2(\alpha+1)\psi + k^2B_{192}\psi\cos\psi + k^2B_{202}\psi\sin(\alpha-1)\psi + k^2B_{212}\psi\sin(\alpha+1)\psi + \\
 & +k^2B_{222}\cos(\alpha-2)\psi + k^2B_{232}\cos(\alpha+2)\psi + k^2B_{242}\psi^2\sin\psi + k^2B_{252}\psi\cos(\alpha-2)\psi + \\
 & +k^2B_{262}\psi\cos(\alpha+2)\psi + k^2B_{272}\psi\cos\alpha\psi,
 \end{aligned} \tag{12}$$

где

$$\begin{aligned}
 B_{00} &= 2C, \quad B_{01} = -C\tau_{01}, \quad B_{02} = C\left(-\tau_{02} + 3\tau_{01}^2 + \frac{3}{2}\tau_{31}^2 + \frac{3}{2}\tau_{51}^2 + \frac{3}{2}\tau_{81}^2 + \frac{3}{2}\tau_{91}^2\right), \quad B_{10} = -\tau_{10}C, \quad B_{11} = -\tau_{11}C, \\
 B_{12} &= C\left[3\tau_{121}\left(\tau_{51} + \frac{1}{2}\tau_{121}\right) + 6\tau_{01}\tau_{11} - \tau_{12}\right], \quad B_{20} = -\tau_{20}C, \quad B_{22} = C(\tau_{22} + 3\tau_{11}^2), \quad B_{31} = -C\tau_{31}, \\
 B_{32} &= C(-\tau_{32} + 6\tau_{01}\tau_{31}), \quad B_{42} = C\left(-\tau_{42} + 3\tau_{31}^2 - \frac{3}{2}\tau_{51}^2 + 3\tau_{81}\tau_{91}\right), \quad B_{51} = -C\tau_{51}, \quad B_{52} = C(6\tau_{01}\tau_{51} - \tau_{52}), \\
 B_{62} &= C(\tau_{31}\tau_{51} - \tau_{62}), \quad B_{70} = -C\tau_{70}, \quad B_{72} = C[3\tau_{31}(\tau_{81} + \tau_{91}) - \tau_{72}], \quad B_{82} = C\tau_{51}(\tau_{91} - \tau_{81}), \\
 B_{92} &= C(-3\tau_{81}\tau_{91}), \quad B_{101} = -C\tau_{81}, \quad B_{102} = C(-\tau_{82} + 6\tau_{01}\tau_{81}), \quad B_{111} = -C\tau_{91}, \quad B_{112} = C(6\tau_{01}\tau_{91} - \tau_{92}), \\
 B_{122} &= C(3\tau_{31}\tau_{81} - \tau_{102}), \quad B_{132} = C(3\tau_{31}\tau_{91} - \tau_{112}), \quad B_{141} = -C\tau_{121}, \quad B_{142} = C(\tau_{01}\tau_{121} + \tau_{11}\tau_{51})6, \\
 B_{152} &= C(3\tau_{31}\tau_{121} - \tau_{132}), \quad B_{162} = -C\frac{3}{2}\tau_{81}^2, \quad B_{172} = -3C\tau_{121}\left(\frac{1}{2}\tau_{121} + \tau_{51}\right), \quad B_{182} = -C\tau_{91}^23, \quad B_{192} = 6C\tau_{11}\tau_{31}, \\
 B_{202} &= 6C\tau_{11}\tau_{81}, \quad B_{212} = 6C\tau_{11}\tau_{91}, \quad B_{222} = 3C\tau_{51}\tau_{81}, \quad B_{232} = -3C\tau_{51}\tau_{91}, \quad B_{242} = 6C\tau_{11}\tau_{121}, \quad B_{252} = 3C\tau_{81}\tau_{121}, \\
 B_{262} &= -3C\tau_{91}\tau_{121}, \quad B_{272} = 3C\tau_{121}(\tau_{91} - \tau_{81}).
 \end{aligned}$$

Используя (12), перепишем (3) в следующем виде:

$$\begin{aligned}
 d\vartheta = & \left\{ (E_{00} + kB_{01} + k^2B_{02}) + (E_{10} + E_{11}k + k^2E_{12})\psi + (E_{20} + k^2E_{22})\psi^2 + (kE_{31} + k^2E_{32})\cos\psi + \right. \\
 & + k^2E_{42}\cos 2\psi + (kE_{51} + k^2E_{52})\sin\psi + k^2E_{62}\sin 2\psi + (E_{70} + k^2E_{72})\sin\alpha\psi + k^2E_{82}\cos 2\alpha\psi + \\
 & +(kE_{101} + k^2E_{102})\sin(\alpha+1)\psi + k^2E_{112}\sin(\alpha-2)\psi + (kE_{91} + k^2E_{92})\sin(\alpha-1)\psi + \\
 & + k^2E_{122}\sin(\alpha+2)\psi + (kE_{131} + k^2E_{132})\psi\sin\psi + k^2E_{142}\psi\sin 2\psi + k^2E_{152}\cos 2(\alpha-1)\psi + \\
 & + k^2E_{162}\cos 2(\alpha+1)\psi + k^2E_{172}\psi\cos 2\psi + (kE_{181} + k^2E_{182})\psi\cos\psi + k^2E_{192}\psi\sin(\alpha-1)\psi + \\
 & + k^2E_{202}\psi\sin(\alpha+1)\psi + k^2E_{212}\cos(\alpha-2)\psi + k^2E_{222}\cos(\alpha+2)\psi + k^2E_{232}\psi^2\sin\psi + \\
 & + k^2E_{242}\psi\cos(\alpha-2)\psi + k^2E_{252}\psi\cos(\alpha+2)\psi + k^2E_{262}\psi\cos\alpha\psi + kE_{271}\psi^2\cos\psi + \\
 & \left. + k^2E_{282}\psi^2\cos 2\right\}\psi. \tag{13}
 \end{aligned}$$

Здесь введем обозначения

$$\begin{aligned}
E_{00} &= l_{00}B_{00}, \quad E_{01} = B_{01}l_{00}, \quad E_{02} = l_{00}B_{02} + l_{02}B_{00} + \frac{1}{2}l_{11}B_{31}, \quad E_{10} = l_{00}B_{10}, \quad E_{11} = l_{00}B_{11}, \\
E_{12} &= l_{00}B_{12} + l_{02}B_{10}, \quad E_{20} = l_{00}B_{20}, \quad E_{22} = l_{00}B_{22} + l_{02}B_{20}, \quad E_{31} = l_{00}B_{31} + l_{11}B_{00}, \quad E_{32} = l_{00}B_{32} + l_{11}B_{01}, \\
E_{42} &= l_{00}B_{42} + \frac{1}{2}l_{11}B_{31} + 2l_{22}B_{00}, \quad E_{51} = l_{00}B_{51}, \quad E_{52} = l_{00}B_{52}, \quad E_{62} = l_{00}B_{62} + l_{00}B_{82} + \frac{1}{2}l_{11}B_{51}, \\
E_{70} &= l_{00}B_{70}, \quad E_{72} = l_{00}B_{72} + l_{02}B_{70} + l_{11}B_{101} + l_{11}B_{111}, \quad E_{82} = l_{00}B_{92}, \quad E_{91} = l_{00}B_{101} + \frac{1}{2}l_{11}B_{70}, \\
E_{92} &= l_{00}B_{102} + l_{22}B_{70}, \quad E_{101} = l_{00}B_{111} + l_{11}B_{70}, \quad E_{102} = l_{00}B_{112} + l_{22}B_{70}, \quad E_{112} = l_{00}B_{122} + \frac{1}{2}l_{11}B_{101}, \\
E_{122} &= l_{00}B_{132} + \frac{1}{2}l_{11}B_{11}, \quad E_{131} = l_{00}B_{141}, \quad E_{132} = l_{00}B_{142}, \quad E_{142} = l_{00}B_{152} + \frac{1}{2}l_{11}B_{141}, \quad E_{152} = l_{00}B_{162}, \\
E_{162} &= l_{00}B_{182}, \quad E_{172} = l_{00}B_{172} + 2l_{22}B_{10}, \quad E_{181} = l_{11}B_{10}, \quad E_{182} = l_{00}B_{192} + l_{11}B_{111}, \quad E_{192} = l_{00}B_{202}, \\
E_{202} &= l_{00}B_{212}, \quad E_{212} = l_{00}B_{222}, \quad E_{222} = l_{00}B_{232}, \quad E_{232} = l_{00}B_{242}, \quad E_{242} = l_{00}B_{252}, \quad E_{252} = l_{00}B_{262}, \\
E_{262} &= l_{00}B_{272}, \quad E_{272} = l_{11}B_{20}, \quad E_{282} = 2l_{22}B_{20}.
\end{aligned}$$

Проинтегрируем (13) от нуля до верхних переменных пределов:

$$\begin{aligned}
\Theta &= (b_{00} + kb_{01} + k^2b_{02}) + (b_{10} + kb_{11} + k^2b_{12})\psi + (b_{20} + kb_{21} + k^2b_{22})\psi^2 + (b_{30} + k^2b_{32})\psi^3 + \\
&\quad + (kb_{41} + k^2b_{42})\sin\psi + k^2b_{52}\sin 2\psi + (kb_{61} + k^2b_{62})\cos\psi + k^2b_{72}\cos 2\psi + \\
&\quad + (b_{80} + k^2b_{82})\cos\alpha\psi + k^2b_{92}\sin 2\alpha\psi + (kb_{101} + k^2b_{102})\cos(\alpha-1)\psi + \\
&\quad + (kb_{111} + k^2b_{112})\cos(\alpha+1)\psi + k^2b_{121}\cos(\alpha-2)\psi + k^2b_{132}\cos(\alpha+2)\psi + \\
&\quad k^2b_{142}\sin 2(\alpha-1)\psi + k^2b_{152}\sin 2(\alpha+1)\psi + (kb_{161} + k^2b_{162})\psi\cos\psi + k^2b_{172}\psi\cos 2\psi + \\
&\quad + k^2b_{182}\psi\sin 2\psi + (kb_{191} + k^2b_{192})\psi\sin\psi + k^2b_{202}\sin(\alpha-1)\psi + k^2b_{212}\psi\cos(\alpha-1)\psi + \\
&\quad + kb_{221}\sin(\alpha+1)\psi + k^2b_{232}\psi\cos(\alpha+1)\psi + k^2b_{242}\sin(\alpha-2)\psi + k^2b_{252}\sin(\alpha+2)\psi + \\
&\quad + kb_{261}\psi^2\sin\psi + k^2b_{272}\psi^2\cos\psi + k^2b_{282}\psi\sin(\alpha-2)\psi + k^2b_{292}\psi^2\sin 2\psi + \\
&\quad + k^2b_{302}\psi\sin(\alpha+2)\psi + k^2b_{312}\psi\sin\alpha\psi. \tag{14}
\end{aligned}$$

Здесь введены обозначения:

$$\begin{aligned}
b_{00} &= \frac{1}{\alpha}E_{70}, \quad b_{01} = E_{51} + \frac{E_{91}}{\alpha-1} + \frac{E_{101}}{\alpha+1} - E_{181}, \quad b_{02} = E_{52} + \frac{1}{2}E_{62} + \frac{1}{2}E_{72} + \frac{E_{92}}{\alpha-1} + \frac{E_{102}}{\alpha+1} + \frac{E_{112}}{\alpha-2} + \\
&\quad + \frac{E_{122}}{\alpha+2} - \frac{1}{4}E_{172} - E_{182} - 2E_{232} - \frac{E_{242}}{(\alpha-2)^2} - \frac{E_{252}}{(\alpha+2)^2} - \frac{E_{262}}{\alpha^2}, \quad b_{10} = E_{00}, \quad b_{11} = E_{01}, \quad b_{12} = E_{02}, \\
b_{20} &= \frac{1}{2}E_{00}, \quad b_{21} = E_{11}, \quad b_{22} = \frac{1}{2}E_{12}, \quad b_{30} = \frac{1}{3}E_{20}, \quad b_{32} = \frac{1}{3}E_{22}, \quad b_{41} = E_{31} + E_{131}, \quad b_{42} = E_{32} + E_{132} - 2E_{271}, \\
b_{52} &= \frac{1}{2}\left(E_{41} + \frac{1}{2}E_{142} - \frac{1}{2}E_{282}\right), \quad b_{61} = -E_{51} + E_{181}, \quad b_{62} = -E_{52} + E_{182} + 2E_{232}, \quad b_{72} = -\frac{1}{2}E_{62} + \frac{1}{4}E_{172}, \\
b_{80} &= -\frac{1}{\alpha}E_{70}, \quad b_{82} = -\frac{1}{\alpha}E_{72} + \frac{1}{\alpha^2}E_{262}, \quad b_{92} = \frac{1}{22}E_{82}, \quad b_{101} = -\frac{E_{91}}{\alpha-1}, \quad b_{102} = -\frac{E_{92}}{\alpha-1}, \quad b_{111} = -\frac{E_{101}}{\alpha+1}, \\
b_{112} &= -\frac{E_{102}}{\alpha+1}, \quad b_{122} = \frac{1}{\alpha-2}\left(\frac{E_{242}}{\alpha-2} - E_{112}\right), \quad b_{132} = \frac{1}{\alpha+2}\left(\frac{E_{252}}{\alpha+2} - E_{122}\right), \quad b_{142} = \frac{E_{152}}{2(\alpha-1)}, \quad b_{152} = \frac{E_{162}}{2(\alpha+1)}, \\
b_{161} &= -E_{131} + 2E_{271}, \quad b_{162} = -E_{132}, \quad b_{172} = \frac{1}{2}(E_{282} - E_{142}), \quad b_{182} = \frac{1}{2}E_{192}, \quad b_{191} = E_{181}, \quad b_{192} = E_{182} + 2E_{232}, \\
b_{202} &= \frac{E_{192}}{(\alpha-1)^2}, \quad b_{212} = -\frac{E_{192}}{\alpha-1}, \quad b_{221} = \frac{E_{202}}{(\alpha+1)^2}, \quad b_{232} = -\frac{E_{202}}{\alpha+1}, \quad b_{242} = \frac{E_{212}}{\alpha-2}, \quad b_{252} = \frac{E_{222}}{\alpha+2}, \quad b_{261} = E_{271}, \\
b_{272} &= -E_{232}, \quad b_{282} = \frac{E_{242}}{\alpha-2}, \quad b_{292} = \frac{1}{2}E_{282}, \quad b_{302} = \frac{E_{252}}{\alpha+2}, \quad b_{312} = \frac{E_{262}}{\alpha}.
\end{aligned}$$

Полученные выражения полярных координат (11) и (14) содержат как вековые, так и периодические члены, следовательно, можно утверждать, что периодические изменения главных моментов инерции Земли в случае параболического типа движения ИСЗ приводит к появлению вековых членов в решениях соответствующих дифференциальных уравнений.

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СТАЦИОНАРЛЫ ЕМЕС ЖЕРДІҢ ТАРТЫЛЫС ӨРІСІНДЕГІ ЖАСАНДЫ ЖЕР СЕРІГІ (ЖЖС)
ҚОЗҒАЛЫСЫНЫҢ ПАРАБОЛАЛЫҚ ТҮРІ
($\alpha_2 < w < \alpha_1$ интервалы, $v = v_0 \sin \alpha \psi$ жағдайы)

$O(k^2)$ мүшелері қатарымен шектеліп, бірінші жұмықтаудағы стационарлық тартылыш құшін есепке ала отырып жақын ЖЖС стационарлық емес тартылыш өрісіндегі полярлық координаттары табылған, мұнда k – 1-ші түрдегі эллиптик интегралдың модулі.

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PARABOLIC TYPE MOTION OF ARTIFICIAL EARTH SATELLITE
IN NON-STATIONARY EARTH GRAVITATIONAL FIELD
(interval $\alpha_2 < w < \alpha_1$, case $v = v_0 \sin \alpha \psi$)

The polar coordinates for case of close AES in non-stationary Earth gravitational field are received, take the found solutions in stationary field as the 1-approach, with limit of members of rows $O(k^2)$ inclusive, where k – modul of elliptic integral 1-st kind.