KOSHI MASALASINI STATIKA TENGLAMALARI SISTEMASI UCHUN YECHISH

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Annotasiya: *Bu ishda momentli elastikliklik nazariyasi tenglamalari sistemasi yechimini fazoda yechim va uning kuchlanishi soha chegarasining musbat o‘lchovli qismida berilganda sohaning ichiga topish masalasi qaraladi. Bunday masalaga Koshi masalasi deyiladi. Qaralayotgan masalaning yechimi mavjudligi kriteriyasi keltiriladi.*

Kalit so‘zlar: *Momentli elastikliklik nazariyasi, Karleman funksiyasi, Karleman matritsasi, Somilion-betti, Koshi masalasi.*

Kirish. Elastiklik elastiklik nazariyasi tenglamalari sistemasi tadqiqotning ob’ekti hisoblanib Koshi masalasi o‘rganiladi.

D elastic muhit R^2 da chegaralanmagan bir bog‘lamli, chegarasi $y_2 = 0$ haqiqiy o‘qning l bo‘lagi va $y_2 > 0$ yarim tekilikda yotuvchi silliq S egri chiziqdan ibotat bo‘lsin , ya’ni D qalpoq shaklidagi soha .

$$A(\partial_y)u(y) = 0 \qquad (1)$$

$$\left.\begin{aligned} &u(y) = f(y), \qquad y \in S \\ &T(\partial_y, n)u(y) = g(y), y \in S \end{aligned}\right\} \qquad (2)$$

Bunda $S - \partial D$ ning qismi, $f(y) = \left(f_1(y); f_2(y)\right)$ va $g(y) = \left(g_1(y); g_2(y)\right)$ lar esa S da berilgan uzluksiz vektor – funksiyalar. $n = (n_1; n_2)$ - y nuqtada S ga berilgan uzluksiz vektor – funksiyalar.

(1)-(2) masalani D sohada qaraymiz. Bunday soha uchun Karleman matrisasi $\Pi_\sigma(y, x)$ qurulgan

$$Im\frac{exp\,\sigma\left(\sqrt{u^2+\alpha^2}+y_2\right)}{\left(\sqrt{u^2+\alpha^2}+y_2-x_2\right)}=$$

$$=exp\,\sigma y_2\left[\frac{(y_2-x_2)\,sin\,\sigma\sqrt{u^2+\alpha^2}}{u^2+r^2}-\frac{\sqrt{u^2+\alpha^2}\,cos\,\sigma\sqrt{u^2+\alpha^2}}{u^2+r^2}\right],$$

bu yerda $r=|x-y|$.

$$\Phi_\sigma(y,x)=-\frac{\exp\sigma(y_2-x_2)}{2\pi}\,\varphi_\sigma(y,x),$$

$$\varphi_\sigma(y,x)=\int_0^\infty\frac{u}{u^2+r^2}\left[\frac{(y_2-x_2)\ \sin\sigma\ \sqrt{u^2+\alpha^2}}{\sqrt{u^2+\alpha^2}}-\ \cos\sigma\sqrt{u^2+\alpha^2}\right]du\,.$$

$\Phi(y,x)$ funksiyani $\alpha>0$ va $y\neq x$ larda quyidagi tenglik bilan aniqlaymiz:

$$2\pi K(x_2)\Phi(y,x)=\int_0^\infty \mathrm{Im}\frac{K(w)}{w-x_2}\cdot\frac{udu}{\sqrt{u^2+\alpha^2}}, \qquad (3)$$

Bu yerda $w=i\sqrt{u^2+\alpha^2}+y_2$. (3) formulaga $\Phi(y,x)=\Phi_\sigma(y,x)$, $\sigma>0$ deb

$\Pi_\sigma(y,x)=\left\|\Pi_{kj}(y,x,\sigma)\right\|_{2\times2}=$

$$=\|\lambda'\delta_{kj}\Phi_\sigma(y,x)-\mu'\left(y_j-x_i\right)\partial\Phi_\sigma(y,x)/\partial y_k\|_{\,2\times2} \qquad (4)$$

ni quramiz.

Quyidagi funksiyani qaraymiz

$$u_\sigma(x)=\int_S[\Pi_\sigma(y,x)\{T\left(\partial_y,n\right)u(y)\}-u(y)\{T\left(\partial_y,n\right)[\Pi_\sigma(y,x)\}]ds_y\,. \qquad (5)$$

2.1-теорема. $u(x)-A(\partial_y)u(y)=0$ sistemaning D, sohadagi regulyar echimi l da quyidagi shartlarni qanoatlantirsin

$$|u(y)|+\left|T\left(\partial_y,n\right)u(y)\right|\leq M,\quad y\epsilon l \qquad (6)$$

Bu holda $\sigma>0$ uchun ,

$$|\,u(x)-u_\sigma(x)|\leq M\,C(\lambda,\mu,x)\,\sigma\,exp(-\sigma x_2),\quad x\epsilon D \qquad (7)$$

bunda

$$C(\lambda,\mu,x)=C(\lambda,\mu)\int_a^b\left[\ln(\alpha^2+x_2^2)+\frac{1}{\sqrt{\alpha^2+x_2^2}}\right]dy_1$$

$\alpha = |y_1 - x_1|$, a ва $b -\ l$ kesmaning oxirgi nuqtalari.

$$u(x) = \int_{\partial D} [\Pi_\sigma(y, x)\{T(\partial_y, n)u(y)\} - u(y)\{T(\partial_y, n)\Pi_\sigma(y, x)\}]\, \partial S_y,$$

$$x \in D \qquad (3)$$

bu yerda $\Pi_\sigma(y, x) -$ D *soha uchun Karleman matritsasi.*

$x = (x_1, x_2)$ va $y = (y_1, y_2)$ nuqtalar E^2 - ikki o‘lchovli evklid fazosidan olingan bo‘lsin va D elastik muhit E^2 da bo‘lakli - silliq ∂D chiziq bilan chegaralangan sohadan iborat bo‘lsin, $S - \partial D$ ning silliq qismi.

D sohada bir jinsli momentli elastiklik nazariyasi tenglamalari sistemasi [5]

$$\begin{cases} (\mu+\alpha)\Delta u + (\lambda+\mu-\alpha) grad div u + 2\alpha\, rot w + \rho\theta^2 u = 0, \\ (\nu+\beta)\Delta w + (\varepsilon+\nu-\beta) grad div w + 2\alpha\, rot u - 4\alpha w + j\theta^2 w = 0, \end{cases} \qquad (1.14)$$

berilgan bo‘lsin. Bu yerda $U(x) = (u_1(x), u_2(x),\ \ w_1(x), w_2(x)) = (u(x), w(x))$ sistemaning yechimi, Δ - Laplas operatori, $\lambda, \mu, \nu, \beta, \varepsilon, \alpha$ elastik muhitni xarakterlaydigan sonlar bo‘lib, quyidagi shartlarni qanoatlantiradi $\mu > 0,\ 3\lambda + 2\mu > 0,$ $\alpha > 0,\ \varepsilon > 0,\ 3\varepsilon + 2\nu > 0,\ \beta > 0,\ \ j > 0,\ \rho > 0,\ \ \theta \in R^1.$

$U(x) - D$ sohada (0.1) sistemaning regulyar yechimi bo‘lsin va S da quyidagi Koshi shartlarini qanoatlantirsin:

$$\left.\begin{array}{ll} U(y) = f(y), & y \in S \\ T(\partial_y, n)U(y) = g(y), & y \in S \end{array}\right\} \qquad (1.15)$$

Bunda $T(\partial_y, n(y))$ -kuchlanish operatori deb atalib u quyidagi ko‘rinishda ifodalanadi

$$T(\partial_y, n(y)) = \begin{Vmatrix} T^{(1)}(\partial_y, n) & T^{(2)}(\partial_y, n) \\ T^{(3)}(\partial_y, n) & T^{(4)}(\partial_y, n) \end{Vmatrix},$$

$$T^{(i)}(\partial_y, n) = \left\| T^{(i)}_{kj}(\partial_y, n) \right\|_{2x2}, \quad i = 1,2,3,4,$$

$$T^{(1)}_{kj}(\partial_y, n) = \lambda n_k \frac{\partial}{\partial y_j} + (\mu-\alpha) n_j(y) \frac{\partial}{\partial y_k} + (\mu+\alpha)\delta_{kj} \frac{\partial}{\partial n(y)}, \quad k, j = 1,\ 2,$$

$$T^{(2)}_{kj}(\partial_y, n) = T^{(3)}_{kj}(\partial_y, n) = 0,\ \ k, j = 1,\ 2,$$

$$T_{kj}^{(4)}(\partial_y, n) = \varepsilon\, n_k(y)\frac{\partial}{\partial y_j} + (\nu-\beta) n_j(y)\frac{\partial}{\partial y_k} + (\nu+\beta)\,\delta_{kj}\frac{\partial}{\partial n(y)},\ \ k, j = 1, 2.$$

$n(y) = (n_1(y), n_2(y)) -$ ∂D -chegaraning y nuqtasidagi tashqi birklik normal vektori, $f(y) = (f_1(y), f_2(y))$ и $g(y) = (g_1(y), g_2(y)) - S$ da berilgan uzluksiz vektor – funksiyalar, δ_{kj} - Kroneker simvoli.

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