ELASTIKLIK NAZARIYASI SISTEMASINING FUNDAMENTAL YECHIMLARI MATRITSASINI QURISH

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ANNOTATSIYA

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.

Laplas tenglamasi uchun Koshi masalasining Karleman funksiyasi tushunchasini kiritgan M.M.Lavrentev ideyasini rivojlantirib, quyidagilarni beramiz.

Ta’rif. $y \neq x$ da aniqlangan , $\sigma > 0$ parametrdan bog‘liq (2×2)

o‘lchamli $\Pi_\sigma(y\,,x)$ matritsa $x \in D$ nuqtada va $\partial D \backslash S$ qism uchun Karleman matritsasi deyiladi, agar u quyidagi shartlarni qanoatlantirsa:

1) $\Pi_\sigma(y\,,x) = \Gamma(y-x) + G_\sigma(y\,,x)$

bunda $G_\sigma(y\,,x) - (2 \times 2)$ o‘lchamli matritsa u bo‘yicha

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

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

sistemani qanoatlantiradi, ya’ni

$$A(\partial_y)G_\sigma(y,x) = 0$$

2) Tanlangan $x \in D$ da $\Pi_\sigma(y\,,x)$ matritsa ushbu

$$\int_{\partial D \backslash S} \left[|\Pi_\sigma(y\,,x)| + \left|T(\partial_y\,,n)\Pi_\sigma(y\,,x)\right|\right] dS_y \leq \alpha\,(\sigma),$$

tengsizlikni qanoatlantiradi, bu yerda $\alpha\,(\sigma) \to 0\,,\ \sigma \to \infty$.

D soha va $\partial D \backslash S$ qismi uchun Karleman matritsasi mavjud bo‘lsin. Karleman matritsasidan foydalanib, (1) – (2) Koshi masalasi yechimining turg‘unlik bahosini osongina keltirib chiqarish, shuningdek ushbu masalaning effektiv yechilishi usulini ko‘rsatish mumkin.

1-teorema. D da regulyar bo‘lgan (1) tenglamaning yechimi quyidagi ko‘rinishga ega:

$$u(x) = \int_{\partial D} \left[\Pi_\sigma(y\,,x)\{T(\partial_y\,,n)u(y)\} - u(y)\{T(\partial_y\,,n)\Pi_\sigma(y\,,x)\}\right] \partial S_y, \quad x \in D \qquad (3)$$

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

Endi elastiklik nazariyasi sistemasining maxsus ko‘rinishdagi fundamental yechimlarini qurishga o‘tamiz. $K(w), w = u + iv$ $(u\,,v - haqiqiy)$ $-$ butun funkstiya, haqiqiy w da haqiqiy qiymat qabul qilsin va

$$K(u) \neq 0, \sup_{v\geq 1}|v^p K^p(u + iv)| \leq M(\rho\,,u) < \infty\,,$$

$$p = 0,1,2, \dots \dots; \quad u \in R^1 \quad \alpha = |y_1 - x_1|$$

bo‘lsin.

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

$$2\pi K(x_2)\Phi(y, x) = \int_0^\infty Im\frac{K(w)}{w - x_2} \cdot \frac{udu}{\sqrt{u^2 + \alpha^2}}\,, \qquad (4)$$

bu erda

$$w = i\sqrt{u^2 + \alpha^2} + y_2\ .$$

Lemma. (4) formula bilan aniqlangan $\Phi(y, x)$ funksiya quyidagi ko‘rinishga ega:

$$\Phi(y, x) = ln\frac{1}{|x - y|} + g(y\,,x)$$

bu yerda $\Phi(y, x) -$ biror funksiya, $x\,,y$ ning barcha qiymatlarida aniqlangan va butun R^2 da y o‘zgaruvchi bo‘yicha garmonik.

(4) formula bilan aniқlangan $\Phi(y, x)$ funksiya yordamida quyidagi matritsani quramiz:

$$\Pi(y\,,x) = \left\|\Pi_{kj}(y, x)\right\|_{2\times 2} = \left\|\lambda'\delta_{kj}\Phi(y, x) - \mu'(y_j - x_j)\frac{\partial\Phi(y, x)}{\partial y_k}\right\|_{2\times 2} \qquad (5)$$

2-teorema. (1.20) formula bilan aniqlangan $\Pi(y\,,x)$ matritsa quyidagi ko‘rinishga ega:

$$\Pi(y\,,x) = \Gamma(y\,,x) + G(y\,,x)$$

bu erda $\Gamma(y\,,x) -$ elastik nazariyasi sistemasining fundamental yechimi matrisasi

$G(y,x)-(2\times 2)$ matrisa x,y ning barcha qiymatlarida aniqlangan va u o‘zgaruvchi bo‘yicha butun R^2 da (1.2) sitemani qanoatlantiradi, ya’ni

$$A\left(\partial_y G(y,x)\right)=0\,.$$

3-teorema. $U(x)\in B_\rho(D)$ ushbu

$$\int\limits_{y_2=0}\frac{|U(y)|}{1+|y|^2}dS_y<\infty\;,\qquad \int\limits_{y_2=0}\frac{\left|T\left(\partial_y,n\right)U(y)\right|}{1+|y|}dS_y<\infty\;, \qquad (6)$$

chegaraviy shartlarni qanoatlantirsin. Agar $\rho<1$ bo‘lsa, u holda $x_2>0$ da

$$U(x)=\int\limits_{\partial D}\left[\Pi(x,y)\{T\left(\partial_y,n\right)U(y)\}-U(y)\{T\left(\partial_y,n\right)\Pi(x,y)\}\right]dS_y\;,x\in D$$

formula to‘g‘ridir.

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