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MATRITSA ARGUMENTLI FUNKSIYALARNI TRIGONOMETRIK FURE QATORIGA YOYISH

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ANNOTATSIYA

Ma'lumki, haqiqiy o'zgaruvchili funksiyalarni trigonometrik Fure qatoriga yoyish yaxshi o'rganilgan. Biz bu yerda matritsa o'zgaruvchili funksiyalarni va ular uchun Fure qatorining matritsa argumentli funksiyalar uchun analogini qaraymiz.

Kalit so'zlar: kompleks son, matritsa, unitar matritsa, Shur teoremasi, diagonal, xos son, Fu're qatori, yuqori uchburchak matritsa

DISPERSE THE ARGUED FUNCTION OF THE MATRIX INTO TRIGONOMETRIC SERIES FURE

ABSTRACT

It is well known that the distribution of real variable functions in a trigonometric series Fure is well studied. Here we look at functions with matrix variables and the analog of the series Fure for functions with matrix arguments.

Keywords: complex number, matrix, unitary matrix, theorem Shur, diagonal, eigenvalue, series Fure, upper triangle matrix

Bizga **C** kompleks fazosi berilgan bo'lsin. $M_n(\mathbf{C})$ bilan barcha n tartibli matritsalar to'plamini belgilaymiz. Bu fazoda Shur teoremasiga ko'ra A, B matritsalar uchun shunday $T \in M_n(\mathbf{C})$ unitar matritsa mavjudki $B = T^{-1}AT$ tenglik bajariladi, bu yerda B yuqori uchburchak matritsa. Endi $q_i(x)$, $i = 1, \ldots, n$ har biri $q_i(0) = 0$ shartni qanoatlantiradigan haqiqiy ko'phadlar bo'lsin. $\mathbf{C}(x)$ bilan ratsional kasrlarni belgilaymiz. $B \in M_n(\mathbf{C}(x))$ holni ko'rib chiqamiz.

Quyidagi diagonal matritsani qaraymiz:

$$d(q_i(x)) = \begin{pmatrix} q_1(x) & . & 0 \\ . & . & . \\ 0 & . & q_n(x) \end{pmatrix}$$

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$B(q_i(x)) = B + d(q_i(x))$ ni qarasak bu matritsa ham $B(q_i(x)) \in M_n(\mathbf{C}(x))$ ga tegishli bo'ladi. $q_i(x)$ larni shunday tanlaymizki, $B_{ii} + d(q_i(x))$ elementlar turli bo'lsin. U holda $B(q_i(x))$ ning xos sonlari turli bo'ladi va $\exists S \in M_n(\mathbf{C}(x))$ teskarilanuvchi matritsa topilib u orqali $B(q_i(x))$ matritsani diagonal ko'rinishga keltirish mumkin.

$$S^{-1}B(q_i(x))S = \begin{pmatrix} B_{11}+q_1(x) & . & 0 \\ . & . & . \\ 0 & . & B_{nn}+q_n(x) \end{pmatrix} \quad (1)$$

Agar $x = 0$ desak bundan kelib chiqadiki (1) ni o'ng tomoni quyidagiga teng bo'ladi.

$$\begin{pmatrix} B_{11} & . & 0 \\ . & . & . \\ 0 & . & B_{nn} \end{pmatrix}$$

Bundan kelib chiqadiki, (1) ning chap tomoni ham $x = 0$ da yuqoridagiga teng bo'ladi.

U holda

$$B = B(q_i(x))|_{x=0} = S\begin{pmatrix} B_{11}+q_1(x) & . & 0 \\ . & . & . \\ 0 & . & B_{nn}+q_n(x) \end{pmatrix}S^{-1}|_{x=0} \quad (2)$$

Bu yerda $|_{x=0}$ bilan $x = 0$ ni qo'yishni belgilaymiz.

$A = TBT^{-1}$ va $T_1 = TS$ desak u holda quyidagi bo'ladi.

$$A = T_1\begin{pmatrix} B_{11}+q_1(x) & . & 0 \\ . & . & . \\ 0 & . & B_{nn}+q_n(x) \end{pmatrix}T_1^{-1}|_{x=0} \quad (3)$$

Yoki uni x o'zgaruvchi bo'yicha quyidagi limit ko'rinishida yozish mumkin.

$$A = \lim_{x\to 0} T_1\begin{pmatrix} B_{11}+q_1(x) & . & 0 \\ . & . & . \\ 0 & . & B_{nn}+q_n(x) \end{pmatrix}T_1^{-1} \quad (4)$$

$\lambda_1, \lambda_2, ...\lambda_s$ xos sonlarga ega A matritsa berilgan bo'lsin.

λ_k, $k = 1,...s$ larning biror atrofida $m_k - 1$ tartibli hosilasi mavjud bo'lgan f skalyar funksiya qaraymiz. U holda $f(A)$ matritsa argumentli funksiya va

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fiksirlangan x uchun uning atrofida $B_{ii}+q_i(x),\ i=1,\dots n$ aniqlangan hamda f matritsaviy funksiya uchun quyidagi tenglik o'rinli bo'ladi:

$$f(T_1\begin{pmatrix} B_{11}+q_1(x) & . & 0 \\ . & . & . \\ 0 & . & B_{nn}+q_n(x)\end{pmatrix}T_1^{-1})=(T_1\begin{pmatrix} f(B_{11}+q_1(x)) & . & 0 \\ . & . & . \\ 0 & . & f(B_{nn}+q_n(x))\end{pmatrix}T_1^{-1})$$

(4) tenglikdan kelib chiqadi

$$f(A)=\lim_{x\to 0}T_1\begin{pmatrix} f(B_{11}+q_1(x)) & . & 0 \\ . & . & . \\ 0 & . & f(B_{nn}+q_n(x))\end{pmatrix}T_1^{-1} \qquad (5)$$

Teorema: Agar f haqiqiy o'zgaruvchili skalyar funksiya A matritsa xos sonlarining biror atrofida trigonometrik qatorga yoyilsa, bu atrofdagi hamma x lar uchun quyidagi tenglik o'rinli bo'lsa:

$$f(x)=\frac{a_0}{2}+\sum_{k=1}^{\infty}a_k\cos kx+b_k\sin kx$$

U holda quydagi tenglikni o'rinli bo'ladi:

$$f(A)=\frac{a_0}{2}I+\sum_{k=1}^{\infty}a_k\cos kA+b_k\sin kA$$

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