MUHAMMAD AL-XORAZMIY NOMIDAGI
TOSHKENT AXBOROT TEXNOLOGIYALARI UNIVERSITETI
NUKUS FILIALI

«XALQ XO'JALIGI SOHASIDA ILG'OR TEXNOLOGIYALAR TADBIQI MUAMMOLARI»

MAVZUSIDAGI HUDUDIY ILMIY-TEXNIK KONFERENSIYASI

MA'RUZALAR TO'PLAMI

- Chorvachilikda ilg'or texnologiyalar va innovatsion yechimlar
- Dasturlash, kiber xavfsizlik va qishloq xo'jaligi fan sohalari integratsiyasi
- Ta'lim va ishlab chiqarishda innovatsiyalar, tahlil va prognozlash vositalari

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- To‘plam hujjatlarini avtomatik umumlashtirish dasturiy vositasining infratuzilmasi va unda axborot oqimimini boshqarishning IDEF modellari;
- Dasturiy vosita arxitekturasi, ishlash mexanizimi va uni ishlab chiqish.

Bu vazifalar bajarilishi bo‘yicha juda uzviylikni tashkil etishi bilan birga ayniqsa 1-4 bo‘g‘inlar o‘zaro ajralmas va bir-birini to‘ldiruvchi asosi hisoblanadi. Endi mazkur vazifalarning mohiyatiga va ularni yechish usullari yoki mexanizmlari batafsilroq to‘xtalinadi.

ARS-Uz tizimi uchun qo‘yolgan vazifalar, keltirilgan ob’ektlari va ulardagi munosabatlari bo‘yicha uning infratuzilmasini 1-rasmdagi kabi taklif etiladi.

ARS-Uz tizimi infratuzilmasini tashkil etuvchi har bir elementi alohida vazifa hisoblanib, ularni 4 qismga ajratish mumkin: maxsus ma’lumotlar va bilimlar bazasi; matematik-algoritmik ta’minot; kiruvchi-chiquvchi hujjat va foydalanuvchi interfeyslari. Endi tizim asosi bo‘lgan MB loyihalash masalasi qaraladi.

Maqolada doimiy rivojlanishda bo‘lgan matnli hujjatlarni avtomatik qayta ishlash yo‘nalishlari hisoblangan kalit so‘zlarni ajratib olish, matnni umumlashtirish va nomlangan ob'ektni tanish uslubiyatlari tadqiqlari natijasida o‘zbek tilida berilgan bir jinsli elekrton matnli hujjatlarni predmet sohalari asosida umumlashtirish masalasi va uni yechish vazifalari keltirildi.

Foydalanilgan adabiyotlar

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NUMERICAL METHOD FOR SOLVING THE PROBLEM OF INTEGRAL GEOMETRY ON A FAMILY OF SEMICIRCLES

f-m.f.d., prof. N.U.Uteuliev *(Nukus branch of TUIT),*

PhD G.M.Djaykov *(Nukus branch of TUIT),*

D.Sh.Yuldoshev *(Nukus branch of TUIT)*

Abstract. We study the problem of integral geometry on a family of semicircles. A numerical algorithm for finding an approximate solution based on Tikhonov regularization is constructed.

Keywords: Integral geometry problems, inversion formula, algorithm, regularization, Radon transform

Reconstructing a function based on its spherical Radon transform with limited integration centers forms the foundation of several modern visualization technologies. This approach is employed in various fields, ultrasound imaging, Synthetic-aperture radar, as well as photoacoustic and thermoacoustic tomography.

Motivated by applications in thermoacoustic tomography, the problem of recovering a function supported in a ball from its average values over spheres centered on the boundary of the ball has received considerable attention in the last decade, with results appearing in various papers during this decade [1, 2].

Let's denote $L_H = \{(x,y): x \in R^1, 0 \le y \le H\}$. For everyone (x,y) lying in the lane L_H. Let us denote by $C_0^2(L_H)$ the class of functions $u(x,y)$ that have all continuous partial derivatives up to $2-$order inclusive and are compactly supported with support in the strip L_H.

Statement of the problem. In a strip L_H restore a function of two variables $u(x,y)$ if the integrals of it over the curves of the family are known $\{\Upsilon(x,y)\}$

$$\int\limits_{\Upsilon(x,y)} g(x,\xi)u(\xi,\eta)d\xi = f(x,y) \qquad (1)$$

where an arbitrary family curve is represented by the expression

$$\Upsilon(x,y) = \left\{(\xi,\eta):(x-\xi)^2+\eta^2 = y^2,\ 0 \le \eta \le y \le H, -\infty < x < \infty\right\}.$$

When restoring function, $u(x,y)$ the following questions arise? 1. Uniqueness recovery function $u(x,y)$; Inversion formulas and recovery algorithms, recovery stability.

All of these questions are essentially answered for the classical Radon transform occurring in X-ray CT, positron emission tomography, and magnetic resonance imaging. However, they are much more complex and not as well understood for the circular Radon transform occurring in the thermoacoustic tomography.

1. Inversion formula

Let us rewrite equation (1) for $g(x,\xi)=1$ in the following form

$$\int\limits_{\Upsilon(x,y)} u(\xi,\eta)d\xi = f(x,y) \qquad (2)$$

The solution to equation (2) has the following form:

$$\hat{u}(\lambda,y) = \frac{1}{\pi y}\frac{\partial}{\partial y}\int_0^y \frac{\eta ch\left(\lambda\sqrt{y^2-\eta^2}\right)}{\sqrt{y^2-\eta^2}} \cdot \hat{f}(\lambda,\eta)d\eta.$$

2. Sequence of approximate solutions integral geometry problems based on the regularizing operator

Firstly, in the last formula you can notice that for a fixed $0 \le \eta \le y \le H$ $ch\left(\lambda\sqrt{y^2-\eta^2}\right)$ tend to infinity at $|\lambda| \to \infty$.

Secondly, instead of $f(\lambda,\cdot)$ measured $f^{\delta}(\lambda,\cdot) = f(\lambda,\cdot) + \delta f(\lambda,\cdot)$, where is $\delta f(\lambda,\cdot)$ the measurement error. The Fourier transform can be written as

$$f^{\delta}(\lambda,\cdot) = \int_{-\infty}^{+\infty} f(\mathrm{x},\cdot)e^{i\lambda x}dx + \int_{-\infty}^{+\infty} \delta f(\mathrm{x},\cdot)e^{i\lambda x}dx$$

where $\int_{-\infty}^{+\infty} \delta f(\mathrm{x},\cdot)e^{i\lambda x}dx$ is the Fourier transform of the noise, which usually contains a white noise component. Since when $\lambda \to \infty$ $\int_{-\infty}^{+\infty} \delta f(\mathrm{x},\cdot)e^{i\lambda x}dx \to const$ and the integral $f^{\delta}(\lambda,\cdot)$ diverges.

If we want to build approximate solutions for the last equation that are stable to small deviations of the right-hand side $f(x,y)$, using the inverse Fourier transform, then we need to suppress the influence of high frequencies λ.

Consider the operator

$$R(u,\alpha) = L^{-1}\left[\psi\left(\hat{u}(\lambda,y),\lambda\right)\cdot W(\lambda,\alpha)\right]$$

where L^{-1} is the inverse Fourier transform, and $W(\lambda,\alpha)$ −is a certain given function defined for all non-negative values of the parameter α and any λ for which the inverse Fourier transform is taken.

Let the function $W(\lambda,\alpha)$ satisfy the following conditions:

1. $W(\lambda,\alpha)$ defined in area $(\alpha \ge 0, -\infty < \lambda < +\infty)$;
2. $0 \le W(\lambda,\alpha) \le 1$ for all values $\alpha \ge 0$ and λ;
3. $W(\lambda,0) \equiv 1$;
4. for everyone $\alpha > 0$ $W(\lambda,\alpha)$ −even in λ and $W(\lambda,\alpha) \in L_2(-\infty,\infty)$;
5. for everyone $\alpha > 0$ $W(\lambda,\alpha) \to 0$ at $\lambda \to \pm\infty$;
6. for $\alpha \to 0$ $W(\lambda,\alpha) \to 1$, without decreasing, and on any segment $|\lambda| \le \lambda_1$ this convergence is uniform;
7. for everyone $\alpha > 0$ $ch(\lambda\,\cdot)W(\lambda,\alpha) \in L_2(-\infty,\infty)$;

8. for any $\lambda \neq 0\, W(\lambda,\alpha) \to 0$ and $\alpha \to 0$ this convergence is uniform on any segment $[\lambda_1,\lambda_2]$, $0<\lambda_1<\lambda_2$.

If the function $W(\lambda,\alpha)$ satisfies conditions 1-8, then the operator defined with its help $R(u,\alpha)$

$$R(u,\alpha)=\frac{1}{\pi y}\frac{\partial}{\partial y}\int_0^y\int_{-\infty}^{+\infty}\frac{\eta ch\left(\lambda\sqrt{y^2-\eta^2}\right)W(\lambda,\alpha)}{\sqrt{y^2-\eta^2}}\cdot\hat{f}(\lambda,\eta)d\eta$$

is the regularizing operator for equation (2) [3].

Let's consider a method for constructing a regularizing operator in the following form

$$u_{\alpha_1}(x,y)=\frac{1}{\pi y}\frac{\partial}{\partial y}\int_0^y\int_{-\infty}^{+\infty}\frac{ch^2\left(\lambda\sqrt{y^2-\eta^2}\right)}{ch^2\left(\lambda\sqrt{y^2-\eta^2}\right)+\alpha_1\left(1+\lambda^2\right)}\cdot\frac{\eta\hat{f}(\lambda,\eta)e^{-i\lambda x}}{\sqrt{y^2-\eta^2}}d\lambda d\eta$$

3. Numerical experiment

For the numerical experiment, we introduce uniform grids along x,y, $x\in[-a,a], y\in[c,d]$. $x_k=-a+kh_x$, $y_j=c+jh_y$, Where $h_x=\frac{2a}{n_x}, h_y=\frac{d-c}{n_y}$.

The discrete Fourier transform for a function $f(x_i,\cdot)$ is determined by the formula

$$\hat{f}(\lambda_m,\cdot)=\sum_{k=0}^{n_x-1}f(x_k,\cdot)e^{i\lambda_m x}=\sum_{k=0}^{n_x-1}f(x_k,\cdot)e^{i2\pi km/n_x},\ m=0,1,...,\mathrm{n}_x-1$$

Here $\lambda_m=m\Delta\lambda,\ \Delta\lambda=\frac{2\pi}{T}$.

Inverse discrete Fourier transform

$$f(x_k,\cdot)=\sum_{m=0}^{n_x-1}\hat{f}(\lambda_m,\cdot)e^{-i2\pi km/n_x},\ k=0,1,...,\mathrm{n}_x-1$$

Taking into account the above, we rewrite the inversion formula in the following form:

$$u_{\alpha_2}(x_k,y_j)=\frac{1}{\pi y}\frac{\partial}{\partial y}\int_0^{y_j}\frac{T(x_k,\mathrm{y}_j,\eta)d\eta}{\sqrt{y_j^2-\eta^2}} \tag{3}$$

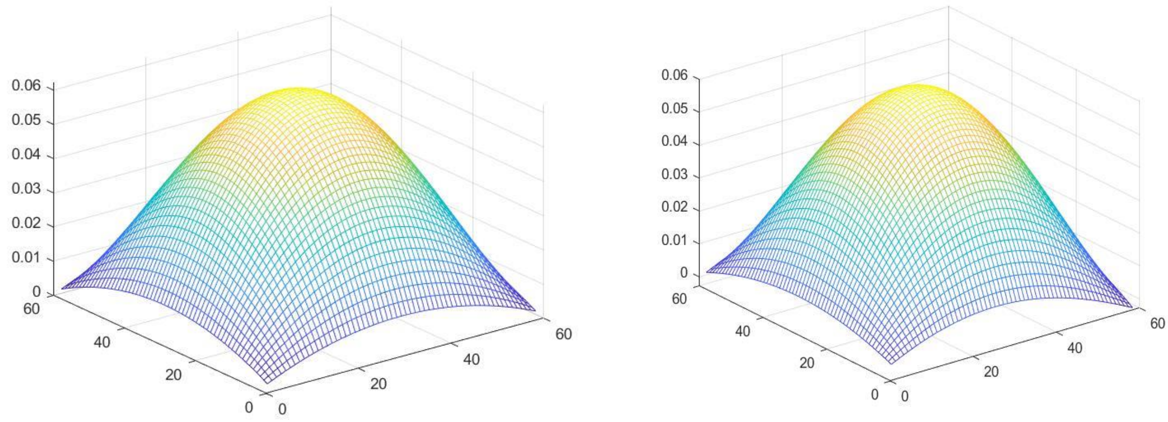
Where $T(x_k,\mathrm{y}_j,\eta)=\int_{-a}^{+a}\frac{ch^2\left(\lambda\sqrt{y_j^2-\eta^2}\right)\eta\hat{f}(\lambda,\eta)e^{-i\lambda x_k}}{ch^2\left(\lambda\sqrt{y_j^2-\eta^2}\right)+\alpha_1\left(1+\lambda^2\right)}d\lambda$

After calculating the values of the functions, $T\left(x_k, y_j, \eta\right)$integral (3) is calculated using non-standard quadrature formulas, which explicitly take into account the nature of the singularity.

We use the following function as a test example

$$u(x,y)=\left(x^2-1\right)\left(y^2-\frac{y}{2}\right)$$

We present the results for the exact right-hand side in Fig.1 and, for comparison, show the results using formula (3).



a) **b)**

Fig.1. Results of restoring the test function. a) exact solution, b) restoration according to the formula

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SUN'IY NEYRON TARMOQ YORDAMIDA QUYI AMUDARYO HUDUDIDAGI SUV SIFATINI BASHORATLASH

t.f.d., prof. X.N.Zaynidinov *(TATU)*
X.Sh.Quzibayev *(TATU tayanch doktoronti)*

Annotatsiya. Suv havzalaridagi fizik, kimyoviy va biologik jarayonlarning murakkab muhitida suv sifati o'zgaruvchilarining chiziqli bo'lmagan xatti-harakatlarini hisobga olgan holda suv sifatini modellashtirish qiyin. Quyi Amudaryo