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Литература

1. **Borubaev A.A.** *Uniform topology.// Bishkek: Ilim, 2013. (in Russian)*
2. **Engelking R.** *General Topology.//Berlin. Helderman, 1986.*
3. **Michail E.** *Topologies on spaces of subsets.//Trans. Amer. Math. Soc,Vol.71, No. 1, pp. 152-172, 1951.*
4. **Beshimov R.B., Safarova D.T.** *Some topological properties of a functor of finite degree //Lobachevskii Journal of Mathematics.Vol.42, No.12, pp.2744-2753, 2021*

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QUTB KOORDINATALAR SISTEMALARINI TADBIQLARI

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Qutb koordinatalar sistemasi ikki o‘lchamli koordinatalar sistemasi bo‘lib, unda tekislikdagi har bir nuqta qutb burchagi va qutb radiusi deb ataluvchi ikkita son orqali aniqlanadi. Ikkita nuqta orasidagi munosabatni radius va burchaklar orqali ifodalash qulay bo‘lgan hollarda qutb koordinatalar sistemasidan foydalanish maqsadga muvofiqdir.

Dekart yoki to‘g‘ri burchakli koordinatalar sistemasida bunday munosabatlar trigonometrik tenglamalarni qo‘llash orqali amalga oshiriladi. Qutb koordinatalar sistemasi nol nur yoki qutb o‘qi deb ataluvchi o‘q orqali beriladi. Bu nur chiquvchi nuqtaga koordinata boshi yoki qutb deyiladi. Tekislikdagi har qanday nuqta ikkita qutb koordinata-radius va burchak orqali aniqlanadi. Radius (radial koordinata) odatda r harfi bilan belgilanib, nuqtadan koordinata boshigacha bo‘lgan masofaga teng. Burchak koordinata ko‘p hollarda qutb burchagi yoki azimut deb ham yuritiladi. Bu miqdor φ harfi bilan belgilanib, berilgan nuqtaga tushish uchun qutb o‘qi buriladigan (soat strelkasiga qarama-qarshi yo‘nalish) burchakka teng.

Shu tarzda aniqlangan radial koordinata (radius) 0 dan ∞ gacha bo‘lgan qiymatni qabul qilishi mumkin. Burchak koordinata esa $0\circ$ dan $360\circ$ qiymatlarni qabul qilishi mumkin.

Burchak va radius tushunchalari eramizdan avvalgi birinchi ming yillik davrida ham ma’lum bo‘lgan. Grek astronomi Gipparx turli burchaklar uchun vatarlar uzunliklari jadvalini yaratgan. Samoviy jismlarning joylashuv o‘rnini aniqlashda qutb koordinatalar sistemasidan foydalanilganligi haqida ma’lumotlar mavjud. Arximed o‘zining “Spirallar” asarida Arximed spirali deb ataluvchi funksiya tavsiflangan bo‘lib, bu funksiya radiusi burchakdan bog‘liqdir. Biroq grek tadqiqotchilarning ishlarida koordinatalar sistemasini aniqlash to‘liq rivojlantirilmagan.

IX asrda fors matematigi Xabbash-al-Xasib kartografik proyeksiya va sferik trigonometriya metodlaridan foydalanib, qutb koordinatalar sistemasidan markazi sferaning biror nuqtasida bo‘lgan boshqa koordinatalar sistemasiga o‘tish masalasini o‘rgangan.

Buyuk vatandoshimiz, astronom Abu Rayhon Beruniy qutb koordinatalar sistemasi tavsifi qanday bo‘lishi haqidagi g‘oyalarni ilgari surgan. U taxminan 1025-yilda birinchilardan bo‘lib samoviy sferaning qutb ekvi-azimutal tekis taqsimlangan proyeksiyasini tavsiflagan.

Qutb koordinatalar sistemasini formal koordinatalar sistemasi sifatida kiritish bo‘yicha turlicha qarashlar mavjud. Qutb koordinatalar sisitemasining paydo bo‘lishi tarixi olib borilgan tadqiqotlarning to‘liq bayoni Garvard universiteti professori Julian Louvel Kulijning “Qutb koordinatalar sistemasining paydo bo‘lishi” nomli ishida yoritilgan.

Endi grafik tasvirlar qismiga o‘tamiz. Yuqorida aytib o‘tganimizdek, har bir nuqta qutb koordinatalar sistemasida ikkita koordinata -r yoki ρ (radial koordinata) va φ yoki θ (burchak koordinata, qutb burchagi, faza burchagi, azimut, pozitsion burchak) orqali aniqlanadi. r koordinata nuqtadan markazgacha yoki koordinata sistema qutbigacha bo‘lgan masofaga mos keladi. φ burchak esa $0\circ$ li nurdan soat strelkasi yo‘nalishiga qarama-qarshi yo‘nalishda hisoblangan burchakka teng.

φ burchak koordinatani topishda quyidagi ikkita holatni inobatga olish kerak:

1) $r = 0$ bo‘lsa, φ burchak istalgan haqiqiy son bo‘lishi mumkin;
2) $r \neq 0$ bo‘lsa, φ ning asosiy qiymatini odatda $[0; 2\pi)$
yoki $(-\pi; \pi]$ intervaldan tanlanadi.
φ burchakning $[0; 2\pi)$ intervaldagi qiymatini hisoblashda ushbu formuladan foydalanish mumkin:

$$\varphi = \begin{cases} \arctan \frac{y}{x}, & \text{agar } x > 0, \quad y \geq 0; \\ \arctan \frac{y}{x} + 2\pi, & \text{agar } x > 0, \quad y < 0; \\ \arctan \frac{y}{x} + \pi, & \text{agar } x < 0; \\ \frac{\pi}{2}, & \text{agar } x = 0, \quad y > 0; \\ \frac{3\pi}{2}, & \text{agar } x = 0, \quad y < 0; \\ -, & \text{agar } x = 0, \quad y = 0. \end{cases}$$

φ burchakning $(-\pi, \pi]$ intervaldagi qiymatini hisoblash uchun quyidagi formuladan foydalanish mumkin:

$$\varphi = \begin{cases} \arctan \frac{y}{x}, & \text{agar } x > 0; \\ \arctan \frac{y}{x} + \pi, & \text{agar } x < 0, \quad y \geq 0; \\ \arctan \frac{y}{x} - \pi, & \text{agar } x < 0, \quad y < 0; \\ \frac{\pi}{2}, & \text{agar } x = 0, \quad y > 0; \\ -\frac{\pi}{2}, & \text{agar } x = 0, \quad y < 0; \\ -, & \text{agar } x = 0, \quad y = 0. \end{cases}$$

Ikki karrali integralda qutb koordinatalar sistemasiga o‘tishda Yakobi determinant hisoblanadi.

Foydalanilgan adabiyotlar

1. **Заитов А. А.** *Элементы линейной алгебры и аналитической геометрии. Учебное пособие.* -Т.: “Тафаккур авлоди”, 2020 йил.
2. **Alixonov S.** *Matematika o‘qitish metodikasi.* – Toshkent, 2011.
3. **Pogorelov A. V.** *Geometriya* – Toshkent, 2011.
4. **Azamov A., Haydarov B. va boshqalar.** *Geometriya* –T.: Yangiyo‘l poligraf servis, 2013.

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Karno-Karateodori fazosida bir o‘lchamli sath sirtlari

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Ushbu ishda Karno-Karateodori fazosidan Yevklid fazosiga hc-differensiallanuvchi akslantirishlar sath sirtlarining metrik xossalari o‘rganiladi.

Karno-Karateodori fazosida uzluksiz hc-differensiallanuvchi akslantirishlarni qaraymiz. Bu akslantirishlar uchun har bir $g \in M$ nuqtada $dimH_gM = dimT_gM - 1 = n$ bo‘lib, M fazoni hc-differensiali syurektiv bo‘lgan n-o‘lchamli evklid fazosiga o‘tkazsin. Bunday akslantirishlarning sath sirtlari egri chiziq bo‘lib, subriman metrikada Xausdorf o‘lchovi ikkiga teng bo‘ladi [1].

Aytaylik, $(n + 1)$-o‘lchamli M Karno-Karateodori fazosining gorizontal rassloyeniyasi H_gM bo‘lib, har bir $g \in M$ nuqtada $dimH_gM = n$ bo‘lsin. Gorizontal qism rassloyeniyalarning bazis vektor maydonlarini $X_1, X_2, ..., X_N$ kabi belgilaymiz. Urinma rassloyeniyalarning vertikal tashkil etuvchilarining bazisi yagona maydondan iborat bo‘lib, uni Z bilan belgilaymiz. Karno lokal gruppasi

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Topological transformation group on hyperspace and Dugundji compacta

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Recall the following definition from [1]. Let Y be a compact Hausdorff space, X closed in Y, $C(X)$ and $C(Y)$ Banach spaces of continuous real functions on X and Y. The linear operator $\Lambda\colon\ C(X)\to C(Y)$ is called a regular extension operator if the following conditions are met:
($\Lambda1$) for any $f\in C(X)$, the narrowing of the function Λf on X coincides with f;
($\Lambda2$) $f\geq 0$ follows $\Lambda f\geq 0$;
($\Lambda3$) if f is a constant then Λf is also a constant.

A compact Hausdorff space X is called a Dugundji compacta if for any compact Y containing X, there is a regular expention operator $\Lambda\colon\ C(X)\to C(Y)$.

For a Hausdorff space X, a topological group G let $(G,\,X,\,\alpha)$ be a topological transformations group [2], where $\alpha\colon G\times X\to X$ is the action of G on X, i. e.
($\alpha1$) $\alpha(h,\,\alpha(g,\,x))=h(g(x))$ for all $g,\,h\in G$ and $x\in X$;
($\alpha2$) $\alpha(\mathrm{e},\,x)=x$ for all $x\in X$, here e is the unit of G.

Let X be a T_1-space. By $\exp X$ we denote a set of all nonempty closed subsets of X [3]. A family of sets $O\langle U_1,\,\ldots,\,U_n\rangle=\{F\in\exp X:\ F\subset\bigcup\limits_{i=1}^{n}U_i, F\cap U_1\neq\varnothing,\,\ldots,\,F\cap U_n\neq\varnothing\}$ forms a base of a topology on $\exp X$, where $U_1,\,\ldots,\,U_n$ are open nonempty sets in X. This topology is called *the Vietoris topology.* A space $\exp X$ equipped with the Vietoris topology is called a *hyperspace* of X. For a compact X Hausdorff space its hyperspace $\exp X$ is also a compact Hausdorff space. In this paper for a compact Hausdorff space X we establish that under some conditions the space $\exp_n X$ is a Dugundji compacta.

For a natural number n by $\exp_n X$ we denote the set of all n-point subsets of a compact Hausdorff space X [3]. For each n the set $\exp_n X$ is closed in $\exp X$. We put

$$\exp_\omega X=\bigcup\limits_{n=1}^{\infty}\exp_n X,$$

$$\exp_{nn} X=\exp_n X\setminus\exp_{n-1} X=\{F\in\exp X:\,|F|=n\}.$$

Lemma 1. For any positive integer n and an arbitrary infinite compact Hausdorff space X we have $[\exp_{nn} X]_{\exp X}=\exp_n X$.

Let $(G,\,X,\,\alpha)$ be a topological transformations group. For a space X and a group G we put

$$\exp(G,\,X)=\{\Phi\in\mathrm{Homeo}\,(\exp X):\ \text{there exists } g\in G \text{ such that } \Phi|_X=g\}$$

and define a map $\exp\alpha\colon\ \exp(G,\,X)\times\exp X\to\exp X$ putting

$$(\exp\alpha)(\Phi,\,F)=\Phi(F).$$

Lemma 2. For each $F\in\exp X$, $g\in G$ and $\Phi\in\exp(G,\,X)$ such that $g=\Phi|_X$ we have

$$F\in\langle U_1,\,\ldots,\,U_n\rangle\quad\Longleftrightarrow\quad\Phi\in\langle g(U_1),\,\ldots,\,g(U_n)\rangle.$$

For a family $\{\gamma\}$ of open coverings of the hyperspace $\exp X$ we define a set

$$O_\gamma=\left\{\Phi\in\exp(G,\,X):\,\forall F\in\exp X,\,\exists W\in\gamma,\,\Phi(F)\in W\Leftrightarrow F\in W\right\}.$$

We put

$$\mathcal{N}(\mathrm{E}) = \mathcal{N}_{\exp(G,\,X)}(\mathrm{id}_{\exp\, X}) = \{O_\gamma :\ \gamma - \text{open cover of hyperspace } \exp X\}\,.$$

Lemma 3. The family $\mathcal{N}(\mathrm{E})$ forms a neighborhoods system of the neutral element $\mathrm{E} = \mathrm{id}_{\exp\, X}$ in $\exp(G,\, X)$.

Proposition 1. For an open action $\alpha\colon\ G \times X \to X$ the map

$$\exp\, \alpha\colon\ \exp(G,\, X) \times \exp X \to \exp X$$

is open.

Proposition 2. For an open action $\alpha\colon\ G \times X \to X$ and every positive n the action

$$\exp\, \alpha\colon\ \exp(G,\, X) \times \exp_{nn} X \to \exp_{nn} X$$

is open.

The condition of openness of the action $\alpha\colon\ G \times X \to X$ in Proposition 2 is essential.

Exercise 1. Consider a space $(D,\, \tau_D)$, in which all single-point sets are closed, and there are at least n points, say $d_1,\, \ldots,\, d_n \in D$, for which the sets $\{d_i\}$ are not open, $i = 1,\, \ldots,\, n$. A set

$$G_{\{d_1,\ldots,d_n\}} = \{g \in \mathrm{Homeo}\,(D) :\ g(d_i) = d_j, \quad i,\, j = 1,\, \ldots,\, n\}$$

forms a group with respect to the operation of composition maps. Let $\mathfrak{A} = \{\gamma\}$ be a family open coverings of space D. Using a neighborhood system

$$\mathcal{N}(g) = \{O_\gamma(g) :\ \gamma \in \mathfrak{A}\},$$

where

$$O_\gamma(g) = \{h \in G_{\{d_1,\ldots,d_n\}} : \forall x \in D,\, \exists U \in \gamma,\, g(x) \in U \wedge h(x) \in U\}, \qquad g \in G_{\{d_1,\ldots,d_n\}},$$

we equip the set $G_{\{d_1,\ldots,d_n\}}$ with a topology, making it a Hausdorff topological space. Thus, $G_{\{d_1,\ldots,d_n\}}$ is a topological group. Note that an action $\alpha\colon\ G_{\{d_1,\ldots,d_n\}} \times D \to D$ is not open. Indeed, for an open neighborhood O of neutral element $\mathrm{e} = \mathrm{id}_D$ and points $d_i \in D$ a set

$$Od_i = \{g(d_i) :\ g \in O\} = \{d_j\}$$

is closed, but not open. Then $\mathrm{int}(Od_i) = \varnothing$ and $d_i \notin \mathrm{int}(Od_i)$, $i,\, j = 1,\, \ldots,\, n$.

Now let us show the action $\exp\, \alpha\colon\ \exp\,(G_{\{d_1,\ldots,d_n\}},\, D) \times \exp_{nn} D \to \exp_{nn} D$ also is not open. Actually, for every neighborhood O of neutral element $\mathrm{id}_{\exp\, D}$ a set

$$O\{d_1, \ldots, d_n\} = \{\Phi(\{d_1, \ldots, d_n\}) :\ \Phi \in O\} = \{\{d_1, \ldots, d_n\}\}$$

is closed in $\exp D$, but not open in it. Then $\{d_1, \ldots, d_n\} \notin \mathrm{int}(O\{d_1, \ldots, d_n\}) = \varnothing$.

For the case (weakly) d-open actions the following stricter variants of Proposition **??** hold.

Proposition 3. For each d-open action $\alpha\colon\ G \times X \to X$ and every positive n the action

$$\exp\, \alpha\colon\ \exp(G,\, X) \times \exp_n X \to \exp_n X$$

is d-open.

Proposition 4. For any weakly d-open action $\alpha\colon\ G \times X \to X$ and each positive n the action

$$\exp\, \alpha\colon\ \exp(G,\, X) \times \exp_n X \to \exp_n X$$

is weakly d-open.

Let an action on X be weakly d-open, the family $\mathscr{O} \subset \mathcal{N}_G(e)$ such that:

(i) for any $O,\, U \in \mathscr{O}$ there exists $V \in \mathscr{O}$ such that $V \subset O \cap U$;

(ii) for each $O \in \mathscr{O}$ there is $U \in \mathscr{O}$ such that $U^2 \subset O$ and $U^{-1} \subset O$.

If, in additional the conditions (i) and (ii), the family $\mathscr{O}$ satisfies following condition:

(iii) for every $O \in \mathscr{O}$ and $g \in G$ there exists $V \in \mathscr{O}$ such that $gVg^{-1} \subset O$, then X in the topology $\tau_{\mathscr{O}}$ is a G-space (not necessarily Tychonoff) [2].

Let X be a G-space with a weakly d-open action, satisfying the following property:

(s) for every points x and their neighborhoods W there exists such (countable) family $\mathscr{O}_{xW} \subset \mathcal{N}_G(\mathrm{e})$, satisfying the conditions (i)–(iii), for which there is $O \in \mathscr{O}_{xW}$ and $\mathrm{St}(x, \gamma_O) \cap (X \setminus W) = \varnothing$.

Then for a family $\mathscr{F}$ of equivariant factor maps on X the family $L = \{f \in \mathscr{F};\, p_{fh},\, f,\, h \in \mathscr{F},\, f \geq h;\, \mathscr{F}\}$ is a consisted weakly multiplicative equivariant system (corresponding μ-system) of maps on X [2].

Here are the main results of the notice.

Theorem 1. If $L = \{f_\alpha,\, f_{\beta\alpha};\, A\}$ is a consisted system of continuous maps on X, then the family $\exp(L) = \{\exp\, f_\alpha,\, \exp\, f_{\beta\alpha};\, A\}$ of continuous maps on $\exp X$ also is a consisted system.

Corollary 1. If a consisted system $L = \{f_\alpha,\, f_{\beta\alpha};\, A\}$ of continuous maps on X is weakly multiplicative, then the consisted system $\exp(L) = \{\exp\, f_\alpha,\, \exp\, f_{\beta\alpha};\, A\}$ of continuous maps on $\exp X$ is also weakly multiplicative.

Corollary 2. If a consisted system $L = \{f_\alpha,\, f_{\beta\alpha};\, A\}$ of continuous maps on X is open (d-open), then the consisted system $\exp(L)$ of continuous maps on $\exp X$ also is open (d-open).

Lemma 4. If a consisted system $L = \{f_\alpha,\, f_{\beta\alpha};\, A\}$ of continuous maps on X is equivariant, then the consisted system $\exp(L)$ continuous maps on $\exp(X)$ is also equivariant.

Lemma 5. If a consisted system $L = \{f_\alpha,\, f_{\beta\alpha};\, A\}$ of continuous maps on X is μ-system, then the consisted system $\exp(L)$ of continuous maps on $\exp X$ is also μ-system.

Theorem 2. If a space X is an *od*-space (d-space), then the hyperspace $\exp X$ is also an *od*-space (d-space).

Theorem 3. Let a space X be a G-space with open action, satisfying property (s). Then the hyperspace $\exp X$ is an *od*-space with consisted weakly multiplicative equivariant open μ-system of maps. If X is compact, then $\exp_n X$ is a Dugundji compacta.

References

1. **Pełczyński A.** *Linear extensions, linear averagings, and their applications to linear topological classification of spaces of continuous functions.* Państwowe Wydawnictwo Naukowe, Warszawa, 1970.
2. **Chatyrko V.A., Kozlov K. L.** *The maximal G-compactifications of G-spaces with special actions.* Proc. 9-th Prague Topological Symposium, Topol. Atlas, North Bay, ON, Praga, 2002, p. 15-21.
3. **Zaitov A. A., Jumaev D. I.** *Hyperspace of the* Π*-complete spaces and maps.* Eurasian Math. J., Vol. 12, no. 2, 2021, p. 104-110.

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Метод фармализма в полуевклидових пространствах

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Полуевклидова пространства R_n^m-характерна тем, что метрика пространства распадает на две части [1].