QUTB KOORDINATALAR SISTEMASIDA UCHBURCHAK YUZINI HISOBLASHNI MATEMATIK MODELI

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ANNOTATSIYA

Ushbu maqolada dekartd koordinatalar sistemasida ishlanish yo‘llazi mavjun va murakkab bo‘lmagan ayrim masalalrni Qutib koordinatalar sistemasida berilishi va ishlanish yo‘llari hamda uning matematik modelini ishlab chiqish bo‘yicha na’munalar va tavsiyalar keltirilgan.

Kalit so‘zlar: Dekart koordinatalar sistemasi, Qutb koordinatalar sistemasi, masala, vektor, uchburchak, kenglama.

Tekislikda Dekart koordinatalar sistemasi - Tekislikda biror O nuqtada kesishuvchi o‘zaro perpendikulyar 2 ta o‘qni olamiz. Bu o‘qlarning har birida O nuqtadan boshlab birlik vektorlarni ajratamiz. Musbat yo‘nalishlari mos ravishda $\vec{i},\vec{j}$ vektorlar bilan aniqlanuvchi 2 ta o‘qdan tashkil topgan sistema tekislikda **To‘g‘ri burchakli koordinatalar sistemasi** deyiladi. O nuqta koordinatalar boshi $\vec{i},\vec{j}$ vektorlar esa ortogonal va birlik vektorlardir.

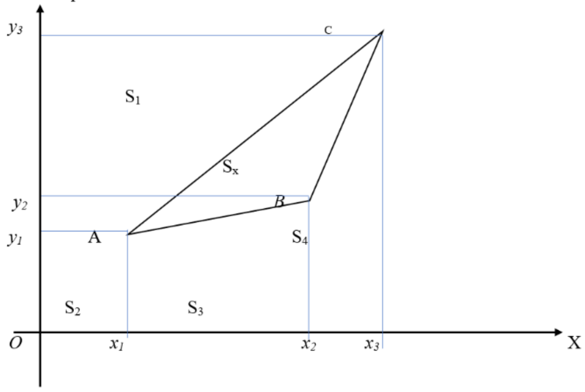
Ox, *Oy* o‘qlar mos ravishda abssissalar va ordinatalar o‘qi deyiladi. To‘g‘ri burchakli koordinatalar sistemasida har doim avvalo nuqtaning abssissasi, keyin esa ordinatasi belgilanadi.

Endi quyidagi masalani hal qilaylik:

Masala 1. Dekart koordinatalar sistemasida uchlari A$(x_1; y_1)$, $B(x_2: y_2)$, $C(x_3; y_3)$ nuqtalarda bo‘lgan uchburchak yuzini toping?

Yechish: Buning uchun koordinata tekisligida uchlari A$(x_1 y_1)$, $B(x_2 : y_2)$, $C(x_3; y_3)$ nuqtalarda boʻlgan istalgan uchburchakni qaraymiz. Keyin esa bizga ma'lum boʻlgan turli xil shakl yuzalari ustida almashtirishlar bajarib quyidagi ifodalarni hosil qilamiz:

$S_1=(x_1 + x_3)(y_3 - y_1)/2$ (chizmadagi trapetsiya yuzi)



$S_2=x_1 \ y_1$ (chizmadagi toʻgʻri toʻrtburchak yuzi)

$S_3=(x_2 - x_1)(y_1 + y_2)/2$ (chizmadagi trapetsiya yuzi)

$S_4=(y_2 + y_3)(x_3 - x_2)/2$ (chizmadagi trapetsiya yuzi)

$S_5 = x_3 \ y_3$;

(S_5 yuza chizmada hosil boʻlgan eng katta toʻgʻri toʻrtburchak yuzi)

$S_x = S_5 - (S_1 + S_2 + S_3 + S_4)$

(S_x yuza biz qidirayotgan Δ ABC yuzi)

Bu ifodalarni soddalashtirib quyidagi formulaga ega boʻlamiz:

$$S_x = \frac{1}{2} \cdot |[x_1 \cdot (y_3 - y_2) + x_2 \cdot (y_1 - y_3) + x_3 \cdot (y_2 - y_1)]| \qquad (1)$$

Qutb koordinatalar sistemasi - Tekislikda biror *O* nuqtani *OL* nur va bu nurda yotuvchi $OA=\vec{\imath}$ birlik vektorni olamiz. Agar tekislikda olingan *OL* nurni *Ox* oʻq deb olinsa va $\vec{\imath}$ vektorni *O* nuqta atrofida *Oy* oʻqidagi $\vec{\jmath}$ birlik vektor ustiga tushirish uchun qisqa yoʻl boʻyicha burish soat strelkasi xarakatiga teskari boʻlsa, u holda koordinatalar sistemasi musbat orientatsiyali, tekislikni esa orientatsiyalangan deyiladi. Hosil qilingan geometrik obraz *qutb koordinatalar sistemasi* deyiladi. U odatda $R=\{O; \vec{\imath}\}$ koʻrinishida belgilanadi. *O* nuqta qutb boshi, *OL* nur qutb oʻqi deyiladi. *M* nuqtaning tekislikdagi holati ikkita son : biri $|\vec{\imath}|=1$ birlik kesma yordamida oʻlchangan $\rho = |OM|$ masofa, ikkinchisi *OL* va *OM* nurlar orasidagi $\varphi = (\vec{\imath}; \overrightarrow{OM})$ burchak bilan toʻla aniqlanadi. ρ masofa *M* nuqtaning *qutb radiusi* deyiladi.

Nuqtaning Dekart va Qutb koordinatalar sistemalari orasidagi bogʻlanishi Tekislikda (O, $\vec{\imath}$) qutb koordinatalar sistemasi berilgan boʻlsin. Koordinatalar boshi qutb boshi bilan,abssissalar oʻqining musbat qismi qutb oʻqi bilan ustma-ust tushadigan musbat orientatsiyali (O, $\vec{\imath}, \vec{\jmath}$) dekart reperini kiritamiz. M

nuqtaning qutb koordinatalari r,φ, dekart koordinatalari esa x,y bo'lsin. O'z navbatida M nuqtaning qutb koordinatalari r,φ ni uning dekart koordinatalari x,y orqali topish mumkun:

$$r=\sqrt{x^2+y^2},\quad tg\,\varphi=\frac{y}{x},\quad \varphi=arctg\frac{y}{x}, \qquad (2)$$

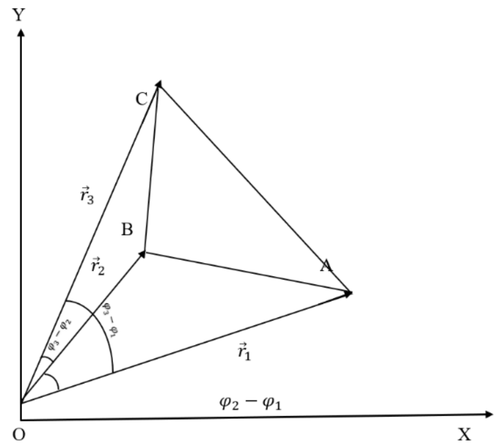
$$x=r\cdot \cos\varphi;\quad y=r\cdot \sin\varphi; \qquad (3)$$

(2) formulani Dekartdan Qutb koordinatalar sistemasiga o'tish, (3) ni esa Qutb koordinatalar sistemasidan Dekart koordinatalar sistemasiga o'tish formulasi deyiladi.

Endi quyidagi masalani qaraylik:

Masala 2. Qutb koordinatalar sistemasida uchlari $A(r_1;\varphi_1)$, $B(r_2:\varphi_2)$, $C(r_3;\varphi_3)$nuqtalarda bo'lgan uchburchak yuzini toping?

Yechish:



Istalgan ko'pburchak yuzi uni tashkil qiluvchi bir-birini qoplamaydigan ko'pburchaklar yuzalari yig'indisiga teng. Yuqoridagi chizma bo'yicha Δ *ABC* yuzini topamiz. Uning qiymati quyidagiga tengligi ravshan:

$$\Delta s_{ABC}=\Delta s_{AOC}-(\Delta s_{OBC}+\Delta s_{OBA}) \qquad (4)$$

Uchburchakning 2 tomoni va ular orasidagi burchagi berilganda uning yuzi:

$$\Delta s_{AOC}=\frac{1}{2}\cdot|\vec{r}_3|\cdot|\vec{r}_1|\cdot sin(\varphi_3-\varphi_1) \qquad (5)$$

$$\Delta s_{OBC}=\frac{1}{2}\cdot\ |\vec{r}_3|\cdot\ |\vec{r}_2|\cdot sin(\varphi_3-\varphi_2) \qquad (6)$$

$$\Delta s_{OBA}=\frac{1}{2}\cdot\ |\vec{r}_1|\cdot\ |\vec{r}_2|\cdot sin(\varphi_2-\varphi_1) \qquad (7)$$

formulalardan topilishi bizga ravshan.

Endi har bir ifodani o'z o'rniga qo'yib soddalashtirsak :

$$\Delta s_{ABC}=\frac{1}{2}\cdot\ |\vec{r}_3|\cdot\ |\vec{r}_1|\cdot \sin(\varphi_3-\varphi_1)\text{-}\left[\frac{1}{2}\cdot\ |\vec{r}_3|\cdot\ |\vec{r}_2|\cdot \sin(\varphi_3-\varphi_2)+\frac{1}{2}\cdot\ |\vec{r}_1|\cdot |\vec{r}_2|\cdot sin(\varphi_2-\varphi_1)\right]$$

$\Delta s_{ABC}=\frac{1}{2}\cdot[|\vec{r}_3|\cdot|\vec{r}_1|\cdot sin(\varphi_3-\varphi_1)+|\vec{r}_3|\cdot |\vec{r}_2|\cdot sin(\varphi_2-\varphi_3)+|\vec{r}_1|\cdot|\vec{r}_2|\cdot sin(\varphi_1-\varphi_2)]$ (8)

(8) formulaga ega bo‘lamiz.

(8) Formula uchlari $A(r_1;\varphi_1), B(r_2:\varphi_2), C(r_3;\varphi_3)$ nuqtalarda bo‘lgan uchburchak yuzini topish formulasi deb ataladi.

Bizga triganometriya kursidan malumki,quyidagi qo‘shish formulalari o‘rinlidir:

$sin(\varphi_3-\varphi_1)=sin\,\varphi_3\,cos\,\varphi_1-sin\,\varphi_1\,cos\,\varphi_3$

$sin(\varphi_2-\varphi_3)=sin\,\varphi_2\,cos\,\varphi_3-sin\,\varphi_3\,cos\,\varphi_2$

$sin(\varphi_1-\varphi_2)=sin\,\varphi_1\,cos\,\varphi_2-sin\,\varphi_2\,cos\,\varphi_1$

Aynan shu masalani yuqorida isbotlab chiqqan (1) formula bo‘yicha ishlab chiqsak :

Avval uchburchakning har bir koordinatalarini dekart koordinatalar sistemasiga o‘tib biz isbotlagan (1) ga qo‘yib, yuqoridagi trigonometrik formulalarni qo‘llab kerakli shakl almashtirishlar bajarilsa ham (8) formulaga kelib qolishi aniq va ravshandir.

XULOSA: Dekart koordinatalar sistemasida uchlari $A(x_1;y_1), B(x_2:y_2), C(x_3;y_3)$ nuqtalarda bo‘lgan uchburchak yuzi:

$S=\frac{1}{2}\cdot|[x_1\cdot(y_3-y_2)+x_2\cdot(y_1-y_3)+x_3\cdot(y_2-y_1)]|$;

Qutb koordinatalar sistemasida uchlari $A(r_1;\varphi_1), B(r_2:\varphi_2), C(r_3;\varphi_3)$ nuqtalarda bo‘lgan uchburchak yuzi:

$S=\frac{1}{2}\cdot[|\vec{r}_3|\cdot|\vec{r}_1|\cdot sin(\varphi_3-\varphi_1)+|\vec{r}_3|\cdot |\vec{r}_2|\cdot sin(\varphi_2-\varphi_3)+|\vec{r}_1|\cdot|\vec{r}_2|\cdot sin(\varphi_1-\varphi_2)]$

formulalardan topiladi.

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