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Farg‘ona davlat universiteti “Matematik analiz va differensial tenglamalar” kafedrasi, dotsent, fizika-matematika fanlari nomzodi **Abdurasul Rafikov** taqrizi ostida

IKKINCHI TARTIBLI EGRI CHIZIQ TENGLAMASINI QUTB KOORDINATALAR SISTEMASIDA ANIQLASH VA MAPLE TIZIMIDA QURISH

Аннотация

Analitik geometriyaning ikkinchi tartibli egri chiziqlari muxandislik masalalaridagi ajoyib jarayonlarni ifodalovchi harakat yo’llarini aniqlash va taxlil qilishga yordam beruvchi chziqlar hisoblanadi. Qutb koordinatalar sistemasida bu chiziqlarning barcha holatlarini aniqlashda va qurishda MAPLE dasturlaridan foydalanish imkoniyatlari ko’rsatilgan.

Kalit so‘zlarlar

qutb, koordinata, egri chiziq, animatsiya, plot, polar, symbol, display.

ОПРЕДЕЛЕНИЕ УРАВНЕНИЯ КРИВОЙ ВТОРОГО ПОРЯДКА В ПОЛЯРНОЙ СИСТЕМЕ КООРДИНАТ И ЕГО ПОСТРОЕНИЕ В СИСТЕМЕ MAPLE

Аннотация

Кривые второго порядка аналитической геометрии — это линии, которые помогают определять и анализировать траектории движения, представляющие собой важные процессы в инженерных задачах. Показаны возможности использования программ MAPLE для определения и построения всех случаев этих линий в полярной системе координат.

Ключевые слова

полюс, координата, кривая, анимация, график, полярный, символ, отображение

DEFINITION OF THE EQUATION OF A SECOND-ORDER CURVE IN A POLAR COORDINATE SYSTEM AND ITS CONSTRUCTION IN THE MAPLE COORDINATE SYSTEM

Abstract

Second-order curves of analytical geometry are lines that help define and analyze trajectories of motion, which are important processes in engineering problems. The potential of using MAPLE programs to define and plot all instances of these lines in a polar coordinate system is demonstrated.

Keywords

pole, coordinate, curve, animation, graph, polar, symbol, display

KIRISH. Maple kabi ixtisoslashtirilgan matematik dasturiy ta'minot paketlari kompyuterlarda muhandislik hisob-kitoblari uchun tobora ko'proq qo'llanilmoqda. Eng so'nggi versiyada raqamli va ramziy shakllarda matematik hisob-kitoblarni amalga oshirish imkonini beruvchi sun'iy intellekt tizimi mavjud. Maple interfeysi sodda va intuitiv, ulardan foydalanish oson va Windows standartlariga to'liq mos keladi.

ASOSIY QISM. 1)**Parabola**. Fokusi qutb boshida bo‘lgan parabol(1*a*–rasm) ustidag $M(x;y)$ nuqtaning x koordinatasini aniqlovchi $x=\frac{p}{2}+r\cos\varphi$ va bu nuqta fakal radius $r=x+\frac{p}{2}$ laridan r ni topamiz:

$$r=\frac{p}{1-\cos\varphi}.$$

2)**Ellips**. Chap fokusi qutb boshida bo‘lgan ellips(1*b*–rasm) ustidagi $M(x;y)$ nuqtaning x koordinatasini aniqlovchi $x=-c+r\cos\varphi$ (bunda $c=\sqrt{a^2-b^2}$) va $r=a+\varepsilon x$ fakal radiuslaridan x ni yo‘qotib va hosil bo‘lgan

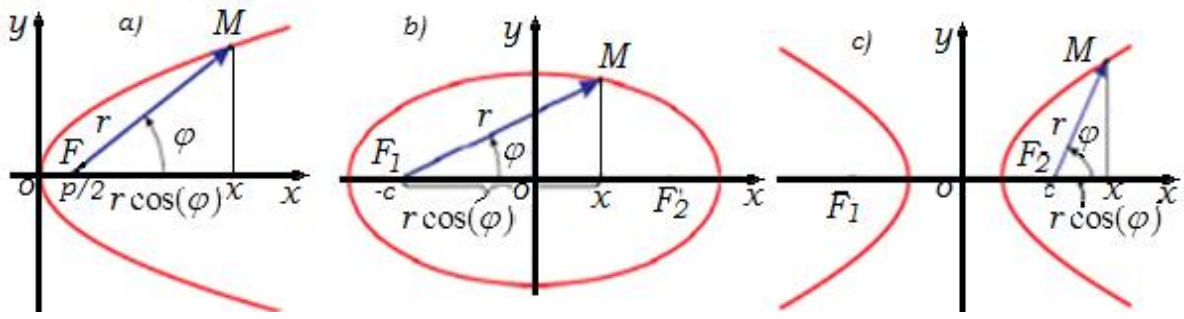
$$r=a+\varepsilon(r\cos\varphi-c),$$

$$r(1-\varepsilon\cos\varphi)=a-\varepsilon c=a-\frac{c}{a}c=\frac{a^2-c^2}{a}=\frac{b^2}{a}=p$$

tenglamani r ga nisbatan yechib, ellipsning qutb koordinatalar sistemasidagi tenglamasini topamiz:

$$r=\frac{p}{1-\varepsilon\cos\varphi}$$

bunda $p=\frac{b^2}{a}$, $\varepsilon=\frac{c}{a}<1$.



1–rasm.

3)**Giperbola**. O‘ng fokusi qutb boshida bo‘lgan giperbolaning (1*c*–rasm) $M(x;y)$ nuqtasini x koordinatasini aniqlovchi $x = c + r\cos\varphi$ (bunda $c = \sqrt{a^2 + b^2}$) va $r = \varepsilon x - a$ fakal radiusidan x ni yo‘qotib va hosil bo‘lgan

$$r = \varepsilon(r\cos\varphi + c) - a,$$

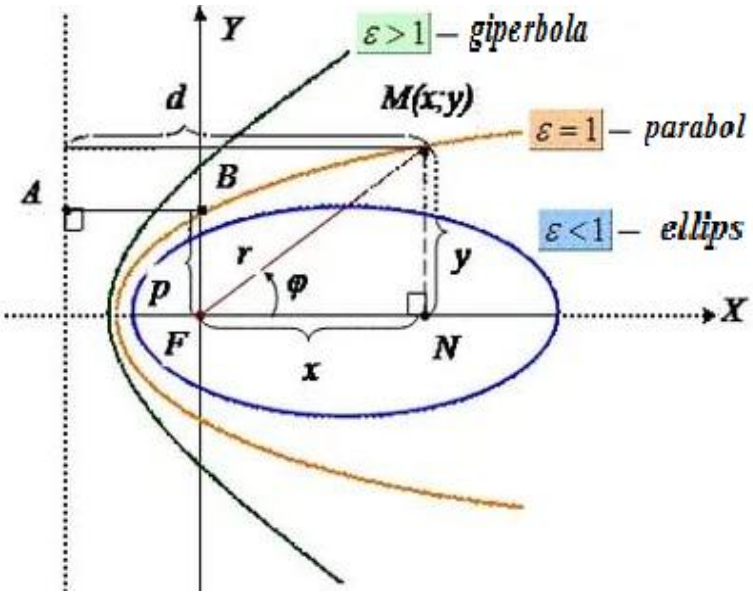
$$r(1 - \varepsilon\cos\varphi) = \varepsilon c - a = \frac{c}{a}c - a - = \frac{c^2 - a^2}{a} = \frac{b^2}{a} = p$$

tenglamani r ga nisbatan yechib, giperbolaning qutb koordinatalar sistemasidagi tenglamasini topamiz:

$$r = \frac{p}{1 - \varepsilon\cos\varphi}$$

bunda $p = \frac{b^2}{a}$, $\varepsilon = \frac{c}{a} > 1$.

Ikkinchi tartibli chiziqlardan ellips, giperbola va parabolalarning xossalaridan foydalanib, ularning qutb koordinatalar sistemasida topilgan tenglamasini grafik taxlili(2–rasm).



2–rasm.

Qutb koordinatalar sistemasida ellips, giperbola, parabola chiziqlarini bitta koordinata sistemasida qurish:

M a p l e d a s t u r i:

> restart; with(plots):

> a:=5:b:=4: p:=b^2/a; $p := \frac{16}{5}$

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> r1:=subs(e1=sqrt(a^2-b^2)/a,

p/(1-e1*cos(varphi))); $r1 := \frac{16}{5\left(1 - \frac{3\cos(\varphi)}{5}\right)}$

> r2:=subs(e2=sqrt(a^2+b^2)/a,

p/(1-e2*cos(varphi))); $r2 := \frac{16}{5\left(1 - \frac{\sqrt{41}\cos(\varphi)}{5}\right)}$

> r3:=subs(e3=1, p/(1-e3*cos(varphi)));

$r3 := \frac{16}{5(1 - \cos(\varphi))}$

> P:= plot([[r1,varphi,varphi=0..2*Pi],[r2,varphi, varphi=0..2*Pi],[r3,varphi,varphi=0..2*Pi]],

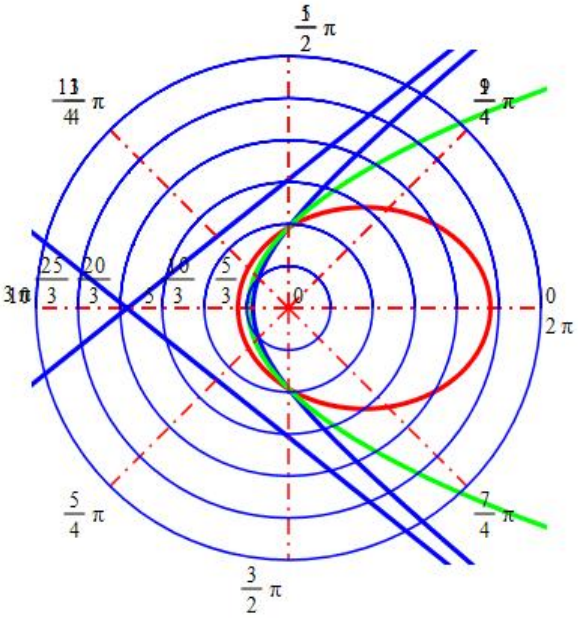
thickness=3,color=[red,blue,green]):

> eg:=changecoords(P,polar):

> Qks:= coordplot(polar,[0..10,0..3*Pi], labelling=true):

> display([eg,Qks],view=[-10..10,-10..10]);

(3–rasm)



3–rasm

$$r = \frac{p}{1 - \varepsilon \cos \varphi} \qquad (*)$$

bu yerda ε – ekssentrisitet, r –fakal radius, p –ellips va giperbola uchun fokuslar o‘qiga perpendikulyar vatar yarimining uzunligi $p=b^2/a$, parabola uchun p–parametr. Agar(2–rasm):

a) ε=0 bo‘lsa, (*) tenglama *aylanani* aniqlaydi va φ bu holda $0<\varphi<\pi$ oraliqdagi barcha qiymatlarni qabul qiladi;

b) $0<\varepsilon<1$ bo‘lsa, (*) tenglama *ellipsni* aniqlaydi va φ bu holda $0<\varphi<\pi$ oraliqdagi barcha qiymatlarni qabul qiladi;

c) ε = 1 bo‘lsa, (*) tenglama *parabolani* aniqlaydi va φ bu holda $0<\varphi<2\pi$

oraliqdagi barcha qiymatlarni qabul qiladi;

d) $\varepsilon>1$ bo‘lsa, (*) tenglama *giperbolani* aniqlaydi. Bu holda φ qaysi oraliqda o‘zgarishi quyidagicha aniqlanadi. $2\varphi_0$ – asimptotalar orasidagi tarmoq joylashgan burchak bo‘lsin, u holda qaralayotgan tarmoq uchun:

$$\varphi_0 < \varphi < 2\ \pi - \varphi_0.$$

Qutb koordinatalar sistemasida 2–tartibli egri chiziqni qurish**.** Ko‘rsatilgan holatlar bo‘yicha ε ga $0\le\varepsilon\le1$ oraliqda qiymatlar berib tuzilgan funktsiyalar bo‘yicha grafiklarini quramiz(3–rasm).

M a p l e d a s t u r i:

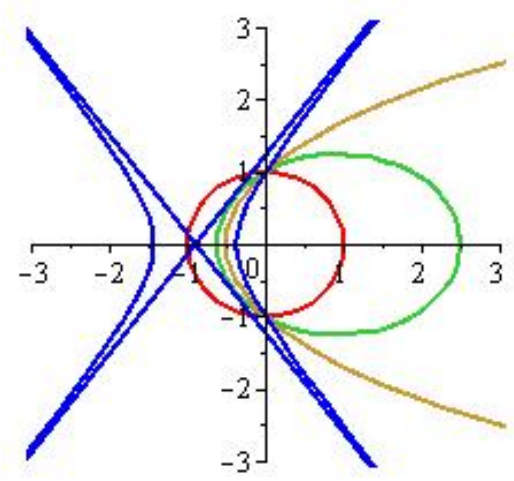
```
> restart; with(plots):

> plot({1/(1–0*cos(theta)),1/(1–0.6*cos(theta)),

1/(1–0.97*cos(theta)),1/(1–1.7*cos(theta))}, theta=0..2*Pi, coords=polar,thickness=2,

view=[–3..3,–3..3]);
```

(4–rasm).



4–rasm.

Olingan natijalarni tahlil qilish. Malpe tizimi Oliy matematikaning analitik geometriya va matematik analiz sohalarida masalalarni tez, aniq va sifatli yechish uchun ishlatilishi mumkin, shuningdek, 2D va 3D formatlarida animatsion grafikalar va raqamlarni o'z ichiga olgan muhandislik masalalarini hal qilish imkonini beradi [1,2,3].

Xullosa. Bugungi kunda kompyuter yordamida ko‘plab masalalarni, matematik modulini tuzishda va bu masalalarni katta tezlikda hal qilishga xizmat qiluvchi Maple matematik paketi mavjud bo‘lib, murakkab geometri shaki va grafiklarni 2D va 3D farmatlarida tez, aniq va sifatli tasvirlashda Maple tizimi dasturlaridan foydalanish qulay va samarali ekanligi ko‘ramiz[7,8].

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