ISSN 2181-3187

ODDIY DIFFERENSIAL TENGLAMALARNI MAPLE TIZIMIDA ANIQ YECHIMLARINING TAHLILI

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Annotatsiya. Ushbu maqola Maple tizimida Oddiy differensial tenglamalarini aniq yechimlari ko'rsatib o'tilgan grafikda tahlili, strukturasi aniq va yetarli uslubda tahlil qilingan. Boshqa tizimlarga qaraganda aniq yechimi va grafigi soda va tushunarli.

Kalit so'zlar. >Restat, $y'' + y = x$ tenglamasi diff(y(x),x$2)+y(x)=x, >dsolve(differensial,y(x)), plot(aniq yechim, x=a..b, color=blue). >dsolve komandasi yordamida LN sistemasini ham yechish mumkin. Buning uchun uni >dsolve({sys},{x(t),y(t),…}), ko'rinishda yozib olish kerak, sys-ODT lar sistemasi, x(t),y(t) ,...-no'malum funktsiyalar sistemasi.

АНАЛИЗ ТОЧНЫХ РЕШЕНИЙ ОБЫКНОВЕННЫХ ДИФФЕРЕНЦИАЛЬНЫХ УРАВНЕНИЙ В СИСТЕМЕ MAPLE

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Абстрактный. В данной статье наглядно и достаточно анализируется строение и строение обыкновенных дифференциальных уравнений системы Maple. По сравнению с другими системами решение и график ясны и понятны.

Ключевые слова. >Restat, уравнение diff(y(x),x$2)+y(x)=x, >dsolve(дифференциал,y(x)), график(точное решение, x=a..b, цвет=синий). Систему LN также можно решить с помощью команды >dsolve. Для этого его

следует записать в виде >dsolve({sys},{x(t),y(t),…}), системы sys-ODT, x(t),y(t) ,.. .-система неизвестных функций.

ANALYSIS OF EXACT SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS IN THE MAPLE SYSTEM

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Abstract. This article analyzes the structure and structure of ordinary differential equations in the Maple system in a clear and sufficient manner. Compared to other systems, the solution and graph are clear and understandable.

Key words. >Restat, equation diff(y(x),x$2)+y(x)=x, >dsolve(differential,y(x)), plot(exact solution, x=a..b, color=blue). The LN system can also be solved using the >dsolve command. For this, it should be written in the form >dsolve({sys},{x(t),y(t),…}), a system of sys-ODTs, x(t),y(t) ,.. .-system of unknown functions.

Kirish

Maple da ODT ni analitik usulda echish uchun dsolve(eq,var,options) komandasi ishlatiladi, bu erda eq-tenglama, var-no'malum funktsiya, options-parametrlar. Parametrlar ODT ni echish usulini ko'rsatishi mumkin, masalan, sukut saqlash printsipiga asosan, analitik echim olish uchun typeqexact parametri beriladi. ODT da hrsilani berish uchun diff komandasi ishlatiladi. Masalan, $y'' + y = x$ tenglamasi diff(y(x),x$2)+y(x)=x ko'rinishda yoziladi. ODT ning umumiy echimi o'zgarmas sonlarni o'z ichiga oladi, masalan, yuqoridagi tenglama ikkita o'zgarmasni o'z ichiga oladi. O'zgarmaslar Maple da _C1, _C2 ko'rinishda belgilanadi.
Ma'lumki, chiziqli ODT bir jinsli (o'ng tomon 0) va bir jinsli bo'lmagan (o'ng tomon 0 emas) ko'rinishda bo'ladi. Bir jinsli bo'lmagan tenglama yechimi mos bir jinsli tenglamaning umumiy yechimi va bir jinsli bo'lmagan tenglamaning xususiy echimlari yig`indisidan iborat bo'ladi. Maple da ODT ning echimi ana shunday ko'rinishda chiqariladi, ya'ni o'zgarmaslarni o'z ichiga olgan qism bir jinsli tenglamaning umumiy yechimi bo'ladi, va o'zgarmas son ishtirok etmagan qismi bir jinsli bo'lmagan tenglamaning xususiy yechimi bo'ladi.

dsolve komandasi bergan yechim hisoblanmaydigan formatda beriladi. Yechim bilan kelajakda ishlash uchun, masalan grafik chizish uchun, uning o'ng tomonini rhs(%) komanda bilan ajratish kerak.

Adabiyotlar tahlili

A.Imomovning ilmiy ishlarida Maple tizimi yordamida elementar va oliy matematikaning deyarli barcha masalalarini yechish mumkin. Maple tizimida analitik va differensial geometriya, matematik analiz, algebra, differensial tenglamalar, hisoblash usullari, kompyuter grafikasi kabi fanlarda amaliy va laboratoriya darslarida hisoblashga doir masalalarni yechishda, kompyuter texnologiyalari asosida interaktiv darslar tashkil etishda foydalanish mumkin.

Tadqiqot metodologiyasi

1-rasm

Misollar. 1. $y' + y\cos x = \sin x \cos x$ tenglama yechilsin.

> restart;

> d1:=diff(y(x),x)+y(x)*cos(x)=sin(x)*cos(x);

$$d1 := \left(\frac{d}{dx}y(x)\right) + y(x)\cos(x) = \sin(x) * \cos(x)$$

> dsolve(d1,y(x)); $y(x) = \sin(x) - 1 + e^{(-\sin(x))}\_C1.$

ya'ni tenglamaning yechimi matematik tilda ushbu ko'rinishga ega:

$y(x) = C_1 e^{(-\sin(x))} + \sin(x) - 1.$

> restart;

> d1 := diff(y(x), x) + y(x)·cos(x) = sin(x)·cos(x);

$$d1 := \frac{d}{dx}y(x) + y(x)\cos(x) = \sin(x)\cos(x)$$

> dsolve(d1, y(x));

$$y(x) = \sin(x) - 1 + e^{-\sin(x)}\_C1$$

> restat;

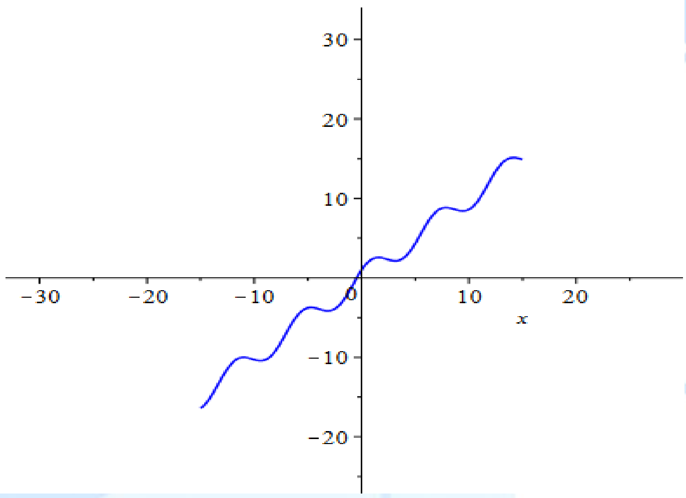
> d2 := diff(y(x), x$2) + y(x) = x

$$d2 := \frac{d^2}{dx^2}y(x) + y(x) = x$$

> dsolve(d2, y(x));

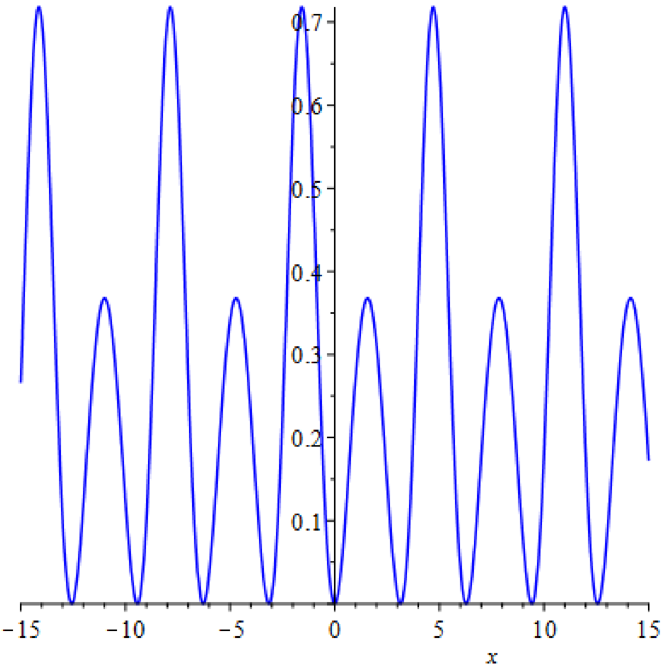
$$y(x) = \sin(x)\_C2 + \cos(x)\_C1 + x$$

> plot(sin(x) + cos(x) + x, x=−15 ..15, color = blue)



ISSN 2181-3187

> $plot\left(\sin(x) - 1 + e^{-\sin(x)}, x = -15..15, color = blue\right);$



2-rasm.

2. $y'' - 2y' + y = \sin x + e^{-x}$ tenglamaning umumiy yechimi topilsin.
> restart;
> d2:=diff(y(x),x$2)-2*diff(y(x),x)+y(x)=sin(x)+exp(-x);

$$d2 := \left(\frac{d^2}{dx^2} y(x)\right) - 2\left(\frac{d}{dx} y(x)\right) + y(x) = \sin(x) + e^{(-x)}$$

> dsolve(d2,y(x)); $y(x) = \_C1 e^x + \_C2 e^x x + \frac{1}{2}\cos(x) + \frac{1}{4} e^{(-x)}$

3. $y'' + k^2 y = \sin(qx)$ tenglamaning umumiy yechimi hollar uchun topilsin.

> restart; d2:=diff(y(x),x$2)+k²*y(x)=sin(q*x); $d2 := \left(\frac{d^2}{dx^2} y(x)\right) + k^2 y(x) = \sin(qx)$ s

> dsolve(d2,y(x));
y(x) = sin(k*x)*_C2+cos(k*x)*_C1+sin(q*x)/(k²-q²)

1.1. Fundamental (bazis) yechimlar sistemasi

dsolve komandasi ODT ning bazis yechimlar sistemasini ham topishda ishlatiladi. Uning uchun parametrlar bo’limida outputqbasis deb ko’rsatish kerak . Masalan, $y^{(4)} + 2y' + y = 0$ ODT ning bazis yechimlar sistemasini topaylik.
>d4:=diff(y(x),x$4)+2*diff(y(x),x$2)+y(x)=0;

$$d4 := \left(\frac{d^4}{dx^4} y(x)\right) + 2\frac{d^2}{dx^2} y(x) + y(x) = 0$$

> dsolve(d4, y(x), output=basis); s[cos(x), sin(x), xcos(x), xsin(x)]

Tahlillar va natijalar

1.2. Koshi yoki chegara masalani yechish

dsolve komandasi yordamida Koshi yoki chegara masalani ham echish mumkin. Buning uchun blshlang`ich yoki chegara shartlarni qo'shimcha ravishda berish kerak. Qo'shimcha shartlarda hosila differensial operator D bilan beriladi. Masalan, $y''(0)=2$ shart $(D@@2)(y)(0)=2$ ko'rinishda, $y'(0)=0$ shart $D(y)(1)=0$ ko'rinishda, $y^{(n)}(0)=k$ shart $(D@@n)(y)(0)=k$ ko'rinishda yozilishi kerak.

Misollar 1. $y^{(4)}+y''=2\cos x, y(0)=-2, y'(0)=1, y''(0)=0, y'''(0)=0$ Koshi masalasi yechilsin.

> d4:=diff(y(x),x$4)+diff(y(x),x$2)=2*cos(x);
> cond:=y(0)=-2, D(y)(0)=1, (D@@2)(y)(0)=0,
(D@@3)(y)(0)=0; $d4:=(\frac{\partial^4}{\partial x^4}y(x))+(\frac{\partial^2}{\partial x^2}y(x))=2\cos(x)$

> dsolve({d4,cond},y(x)); $y(x)=-2\cos(x)-x\sin(x)+x$

> d4 := diff(y(x), x$4) + diff(y(x), x$2) = 2 * cos(x);

$$d4 := \frac{d^4}{dx^4}y(x) + \frac{d^2}{dx^2}y(x) = 2\cos(x)$$

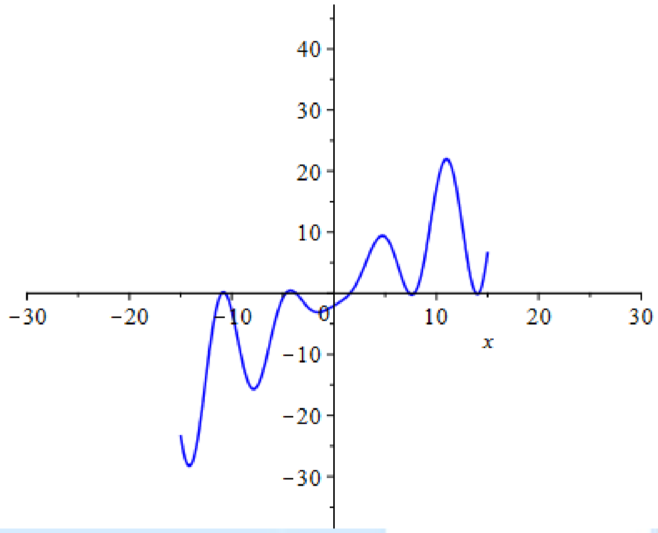
> cond := y(0) =-2, D(y)(0) = 1, (D@@2)(y)(0) = 0, (D@@3)(y)(0) = 0;

$$cond := y(0) = -2, D(y)(0) = 1, D^{(2)}(y)(0) = 0, D^{(3)}(y)(0) = 0$$

> dsolve({d4, cond}, y(x));

$$y(x) = -2\cos(x) - \sin(x)\,x + x$$

> plot(-2 cos(x) − sin(x) x + x, x =-15 .. 15, color = blue);



3-rasm.

2. $y^{(2)}+y=2x-\pi, y(0)=0, y(\frac{\pi}{2})=0$ chegara masala yechilishi.

> restart; d2:=diff(y(x),x$2)+y(x)=2*x-Pi; $d2:=(\frac{\partial^2}{\partial x^2}y(x))+y(x)=2x-\pi$

> cond:=y(0)=0,y(Pi/2)=0; $cond := y(0)=0, y(\frac{\pi}{2})=0$

ISSN 2181-3187

> dsolve({d2,cond},y(x)); $y(x)=2x-\pi+\pi\cos(x)$

> restart; d2 := diff(y(x), x$2) + y(x) = 2*x-Pi;

$$d2 := \frac{d^2}{dx^2}y(x)+y(x)=2x-\pi$$

> cond := y(0) = 0, y(Pi/2) = 0;

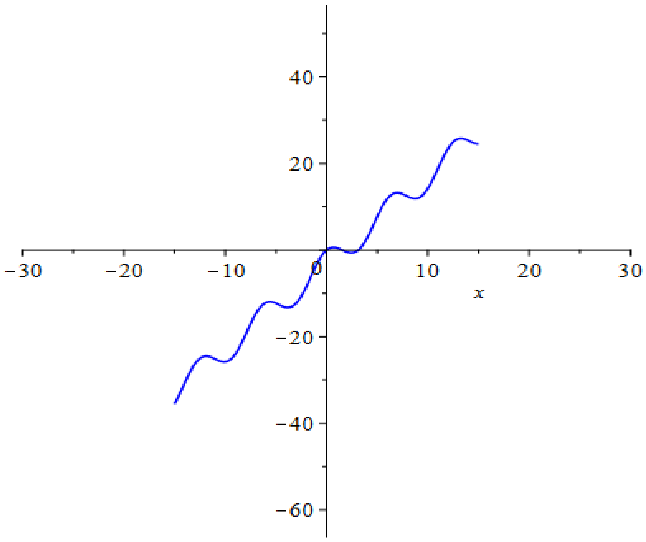
$$cond := y(0)=0, y\left(\frac{1}{2}\pi\right)=0$$

> dsolve({d2, cond}, y(x));

$$y(x)=\cos(x)\,\pi+2x-\pi$$

4-rasm.

> plot(cos(x) π + 2 x − π, x=−15 .. 15, color = blue);



5-rasm.

Yechim grafigini chizish uchun tenglama o‘ng tomonini ajratib olish kerak:
> y1:=rhs(%):plot(y1,x=-10..20,thicknessq2);

1.3. Oddiy differensial tenglamalar sistemasi

dsolve komandasi yordamida LN sistemasini ham yechish mumkin. Buning uchun uni dsolve({sys},{x(t),y(t),…}), ko’rinishda yozib olish kerak, sys-ODT lar sistemasi, x(t),y(t) ,...-no’malum funktsiyalar sistemasi.

Misollar 1.

$$\left\{x'=-4x-2y+\frac{2}{e^t-1},\ y'=6x+3y-\frac{3}{e^t-1}\right\}$$

> sys:=diff(x(t),t)=-4*x(t)-2*y(t)+2G’(exp(t)-1),
diff(y(t),t)=6*x(t)+3*y(t)-3G’(exp(t)-1):
> dsolve({sys},{x(t),y(t)});

$$\{x(t)=-3\_C1+4C1\_e^{(-t)}-2C2\_+2C2\_e^{(-t)}+2e^{(-t)}\ln(e^t-1),$$

$$\{y(t)=6\_C1-6C1\_e^{(-t)}+4C2\_+3C2\_e^{(-t)}-3e^{(-t)}\ln(e^t-1)$$

ISSN 2181-3187

Foydalanilgan adabiyotlar

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