GRAPHS OF EXACT SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS IN MAPLE

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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.

Keywords: >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.

Introduction

In Maple, to solve an ODT analytically, the dsolve(eq,var,options) command is used, where eq is an equation, var is an unknown function, and options are parameters. The parameters can indicate the method of solving the ODT, for example, the typeqexact parameter is given to obtain an analytical solution based on the principle of keeping the default. The diff command is used to give the hrsil in the ODT. For example, $y'' + y = x$ equation diff(y(x),x$2)+y(x)=x

The general solution of an ODT involves constants, for example, the equation above involves two constants. Constants in Maple _C1, _C2 is marked in appearance.

It is known that linear ODTs come in homogeneous (right-hand side 0) and non-homogeneous (right-hand side non-0) forms. The solution to a non-homogeneous equation is the sum of the general solution of the corresponding homogeneous equation and the particular solutions of the non-homogeneous equation. In Maple, the solution to the ODT is expressed in this form, that is, the part containing the constants is the general solution of the homogeneous equation, and the part not containing the constant is the particular solution of the non-homogeneous equation. The solution given by the dsolve command is given in a non-calculated format. To work with the solution in the future, for example, to draw a graph, you need to separate its right side with the rhs(%) command.

Literature Analysis

A. Imomov's scientific works show that almost all problems of elementary and higher mathematics can be solved using the Maple system. The Maple system covers such areas as analytical and differential geometry, mathematical analysis, algebra, differential equations, computational methods, and computer graphics. It can be used in solving calculation problems in practical and laboratory classes in sciences, and in organizing interactive lessons based on computer technologies.

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

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

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> dsolve(d2, y(x));
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$$y(x) = \sin(x)\ \_C2 + \cos(x)\ \_C1 + x$$

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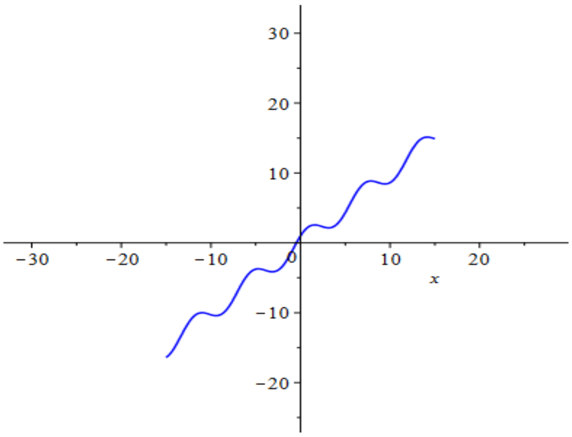


1-rasm

Research Methodology

Examples. 1. $y' + y\cos x = \sin x \cos x$ solve the equation.

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

that is, the solution to the equation looks like this in mathematical language:

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

> restart;

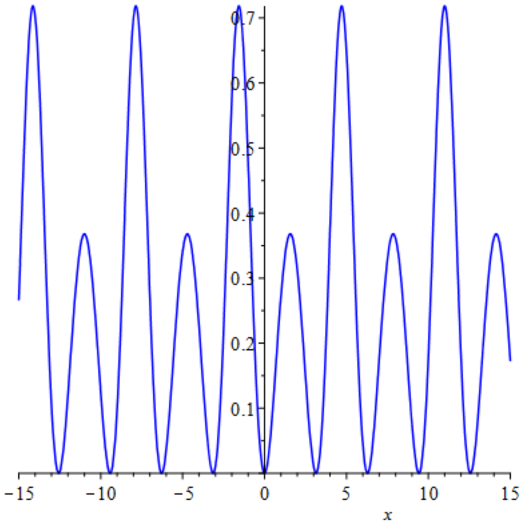
> $d1 := diff(y(x), x) + y(x) \cdot \cos(x) = \sin(x) \cdot \cos(x);$

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

> dsolve(d1, y(x));

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

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



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2. $y'' - 2y' + y = \sin x + e^{-x}$ find the general solution of the equation.

> restart;

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

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

> dsolve(d2,y(x)); $y(x) = \_C1e^x + \_C2e^x x + \frac{1}{2}\cos(x) + \frac{1}{4} e^{(-x)}$

3. $y'' + k^2 y = \sin(qx)$ Find the general solution of the equation for the cases.

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

> dsolve(d2,y(x));

y(x) = sin(k*x)*_C2+cos(k*x)*_C1+sin(q*x)/(k^2-q^2)

1.1. Fundamental (basis) solution system

1.2.The dsolve command is also used to find the fundamental solution system of the ODT. For this, you need to specify outputqbasis in the parameters section. For example, $y^{(4)} + 2y' + y = 0$ Let's find the basic solution system of the ODT.

>d4:=diff(y(x),x$4)+2*diff(y(x),x$2)+y(x)=0; $d4 := (\frac{d^4}{dx^4} y(x)) + 2\frac{d^2}{dx^2} y(x) + y(x) = 0$

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

Analyses and Results

1.3. Solving a Cauchy or Boundary Problem. You can also solve a Cauchy or boundary problem using the dsolve command. To do this, you need to provide additional initial or boundary conditions. In additional conditions, the derivative is given by the differential operator D. For example, $y''(0)=2$ a must $(D@@2)(y)(0)=2$ in appearance, $y'(0)=0$ a must $D(y)(1)=0$ in appearance, $y^{(n)}(0)=k$ a must $(D@@n)(y)(0)=k$ should be written in the form.

Examples 1. $y^{(4)}+y''=2\cos x, y(0)=-2, y'(0)=1, y''(0)=0, y'''(0)=0$ Let the Koshi problem be solved.

> 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);

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

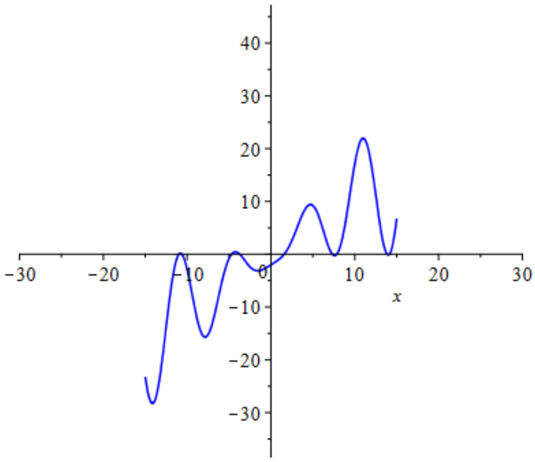
> cond := y(0) =-2, D(y)(0) = 1, (D@@2)(y)(0) = 0, (D@@3)(y)(0) = 0;

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

> 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. $y^{(2)}+y=2x-\pi, y(0)=0, y(\frac{\pi}{2})=0$ solving the boundary problem.

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

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

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

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

```
> cond := y(0) = 0, y(Pi/2) = 0;
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$$cond := y(0) = 0, y\left(\frac{1}{2}\pi\right) = 0$$

```
> 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);
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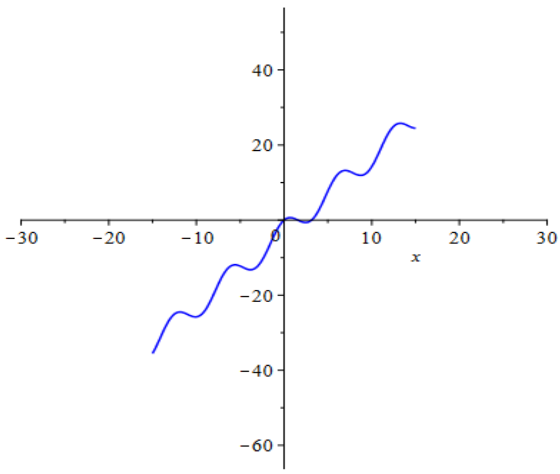

5-rasm.

To graph the solution, you need to isolate the right side of the equation:
> y1:=rhs(%):plot(y1,x=-10..20,thicknessq2);

1.3. The system of ordinary differential equations

The LN system can also be solved using the dsolve command. To do this, it must be written in the form dsolve({sys},{x(t),y(t),…}), where sys is a system of ODTs, and x(t),y(t) ,... is a system of unknown functions.

Examples 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)});

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

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

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