

Slope Field of Ordinary Differential Equations

MATLAB Implementation

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slope_field

Draws the slope field of a first-order, univariate, ordinary differential equation.

Syntax

```
slope_field(f,[xmin,xmax],[ymin,ymax])  
slope_field(f,[xmin,xmax],[ymin,ymax],density,color,width)  
fig = slope_field(__)
```

Description

`slope_field(f,[xmin,xmax],[ymin,ymax])` draws the slope field of a differential equation $dy/dx = f(x,y)$, where `f` is the function handle of $f(x,y)$, and where `[xmin,xmax]` and `[ymin,ymax]` define the domain $D = \{(x,y) \mid x_{\min} \leq x \leq x_{\max}, y_{\min} \leq y \leq y_{\max}\}$ for which the slope field is drawn.

`slope_field(f,[xmin,xmax],[ymin,ymax],density,color,width)` draws the slope field of a differential equation $dy/dx = f(x,y)$, where `f` is the function handle of $f(x,y)$, and where `[xmin,xmax]` and `[ymin,ymax]` define the domain $D = \{(x,y) \mid x_{\min} \leq x \leq x_{\max}, y_{\min} \leq y \leq y_{\max}\}$. Additionally, `density` defines the number of lines to draw in the horizontal direction (effectively controlling how many lines are drawn to create the slope field), and `color` and `width` define the color and line width, respectively, of the lines.

`fig = slope_field(__)` draws the slope field and also returns the figure handle of the slope field. You can use any of the input arguments in the previous syntaxes.

Examples

Example 1

Draw the slope field of

$$\frac{dy}{dx} = \frac{y}{3-x}$$

on the domain

$$D = \{(x,y) \mid 0 \leq x \leq 10, -5 \leq y \leq 5\}$$

■ SOLUTION

First, we define the domain for plotting the slope field.

```
xmin = 0;  
xmax = 10;  
ymin = -5;  
ymax = 5;
```

Next, we define the differential equation as an anonymous function.

```
f = @(x,y) y/(x-3);
```

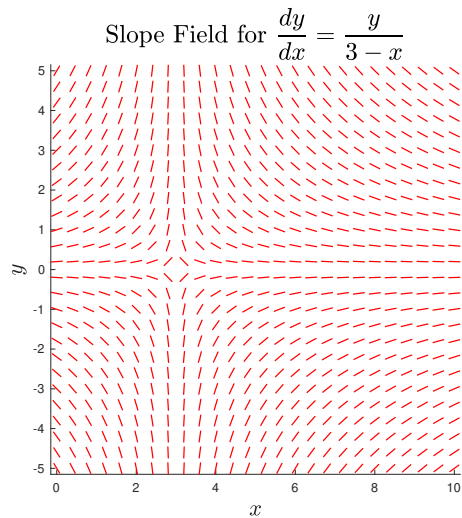
First, we plot the slope field with a line density of 25 and red lines with a line width of 1.

```
slope_field(f,[xmin,xmax],[ymin,ymax],25,'r',1)
```

Adding axes labels and a title,

```
xlabel('$x$', 'interpreter', 'latex', 'fontsize', 18);
ylabel('$y$', 'interpreter', 'latex', 'fontsize', 18);
title('Slope Field for $\displaystyle\frac{dy}{dx}=\frac{y}{3-x}$', ...
      'interpreter', 'latex', 'fontsize', 20);
```

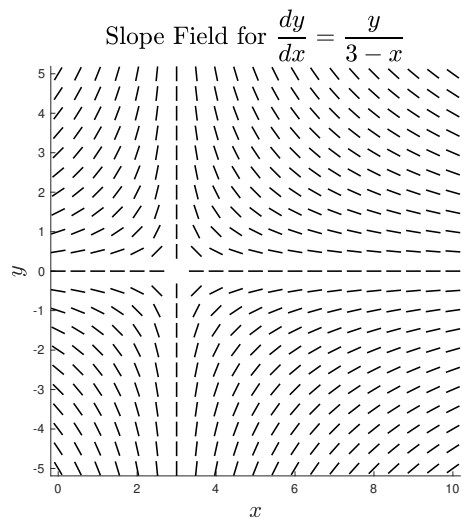
This yields the slope field



We can plot the same slope field with the default settings.

```
slope_field(f,[0,10],[-5,5]);
xlabel('$x$', 'interpreter', 'latex', 'fontsize', 18);
ylabel('$y$', 'interpreter', 'latex', 'fontsize', 18);
title('Slope Field for $\displaystyle\frac{dy}{dx}=\frac{y}{3-x}$', ...
      'interpreter', 'latex', 'fontsize', 20);
```

This yields the slope field



Links

MATLAB® Central's File Exchange:

https://www.mathworks.com/matlabcentral/fileexchange/85433-slope-field-generator-for-odes-slope_field

GitHub®:

https://github.com/tamaskis/slope_field-MATLAB