Intersection of Two Lines

MATLAB Implementation

Tamas Kis | kis@stanford.edu

TAMAS KIS
https://github.com/tamaskis

LICENSE

Contents

1 Download and Installation

1.1 Download from MATLAB File Exchange

The `line_intersection` function is available for download on MATLAB® Central's File Exchange at https://www.mathworks.com/matlabcentral/fileexchange/85428-intersection-of-two-lines-line_intersection.

1.2 Download from GitHub

The `line_intersection` function is available for download on GitHub® at https://github.com/tamaskis/line_intersection-MATLAB.

1.3 Files Included With Download

There are **five** files included in the downloaded `zip` file:

1. `EXAMPLE.M` – *example for using the* `line_intersection` *function*
2. `Intersection of Two Lines - MATLAB Implementation.pdf` – *this PDF*
3. `LICENSE` – *license for the* `line_intersection` *function*
4. **`line_intersection.m` – *MATLAB function to find the intersection of two lines***
5. `README.md` – *markdown file for GitHub documentation*

1.4 Accessing the `line_intersection` Function in a MATLAB Script

There are **four** options for accessing the `line_intersection` function in a MATLAB script:

1. Copy the `line_intersection` function to the *end* of your MATLAB script.
2. Place the `line_intersection.m` file in the same folder as the MATLAB script.
3. Place the `line_intersection.m` file into whatever folder you want, and then use the `addpath(folderName)` command[1] where the `folderName` parameter is a string that stores the filepath of the folder that `line_intersection.m` is in *relative to* the folder that your script is in.
4. Make a toolbox by first opening `line_intersection.m`, then going to the `HOME` tab in MATLAB, and finally selecting `Package Toolbox` in the drop-down menu under `Add-Ons`. Once you package the `line_intersection` function as a toolbox, you can use it in any script.

[1] https://www.mathworks.com/help/matlab/ref/addpath.html

2 line_intersection

Syntax

```
[x,y] = line_intersection([m1,b1],[m2,b2])
[x,y] = line_intersection([x1,y1,m1],[x2,y2,m2])
```

Description

`[x,y] = line_intersection([m1,b1],[m2,b2])` returns the intersection (x, y) of two lines given in slope-intercept form:

1. $y_1 = m_1 x + b_1$
2. $y_2 = m_2 x + b_2$

`[x,y] = line_intersection([m1,b1],[m2,b2])` returns the intersection (x, y) of two lines given in point-slope form:

1. $y - y_1 = m_1(x - x_1)$
2. $y - y_2 = m_2(x - x_2)$

Example

Example 2.1

Find the intersection of $y = 5x + 2$ and $y - 4 = 7(x - 10)$.

■ ***SOLUTION***

To find the intersection point, we just have to note that for the first line, we have $m_1 = 5$ and $b_1 = 2$, while for the second line, we have $x_2 = 10$, $y_2 = 4$, and $m_2 = 7$.

```
% line 1 parameters
m1 = 5;
b1 = 2;

% line 2 parameters
x2 = 10;
y2 = 4;
m2 = 7;
```

```
% finds intersection point
[x_int,y_int] = line_intersection([m1,b1],[x2,y2,m2])
```

This yields the result

```
x_int =

    34


y_int =

   172
```

3 Intersection of Two Lines

Consider the following two lines given in point-slope form:

$$y - y_1 = m_1 (x - x_1)$$

$$y - y_2 = m_2 (x - x_2)$$

If these two lines intersect at $(x_{\text{int}}, y_{\text{int}})$, then

$$y_{\text{int}} - y_1 = m_1 (x_{\text{int}} - x_1) \tag{1}$$

$$y_{\text{int}} - y_2 = m_2 (x_{\text{int}} - x_2) \tag{2}$$

Solving Eqs. (1) and (2) for y_{int},

$$y_{\text{int}} = y_1 + m_1 (x_{\text{int}} - x_1) \tag{3}$$

$$y_{\text{int}} = y_2 + m_2 (x_{\text{int}} - x_2) \tag{4}$$

Equating Eqs. (3) and (4),

$$y_1 + m_1 (x_{\text{int}} - x_1) = y_2 + m_2 (x_{\text{int}} - x_2)$$

Solving for x_{int},

$$\boxed{x_{\text{int}} = \frac{(m_1 x_1 - m_2 x_2) - (y_1 - y_2)}{m_1 - m_2}} \tag{5}$$

To obtain y_{int}, we can use either line. We choose to use line 1.

$$\boxed{y_{\text{int}} = y_1 + m_1 (x_{\text{int}} - x_1)} \tag{6}$$