

Documentation for MAT-63506
Programming project
‘Project 3: Random Walk’

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1. Functionality

The application can show a random walk in two and three dimensions. The user can change the appearance of the visual representation and the behavior of the walk and the figure.

2. User Guide

The layout of the application can be seen in figure 1. Area 1 shows the random walk as a plot in two or three dimensions, area 2 shows the current coordinates of the walk, area 3 is the settings area, area 4 is used to determine the dimensions of the walk, and area 5 is used to control the walk.

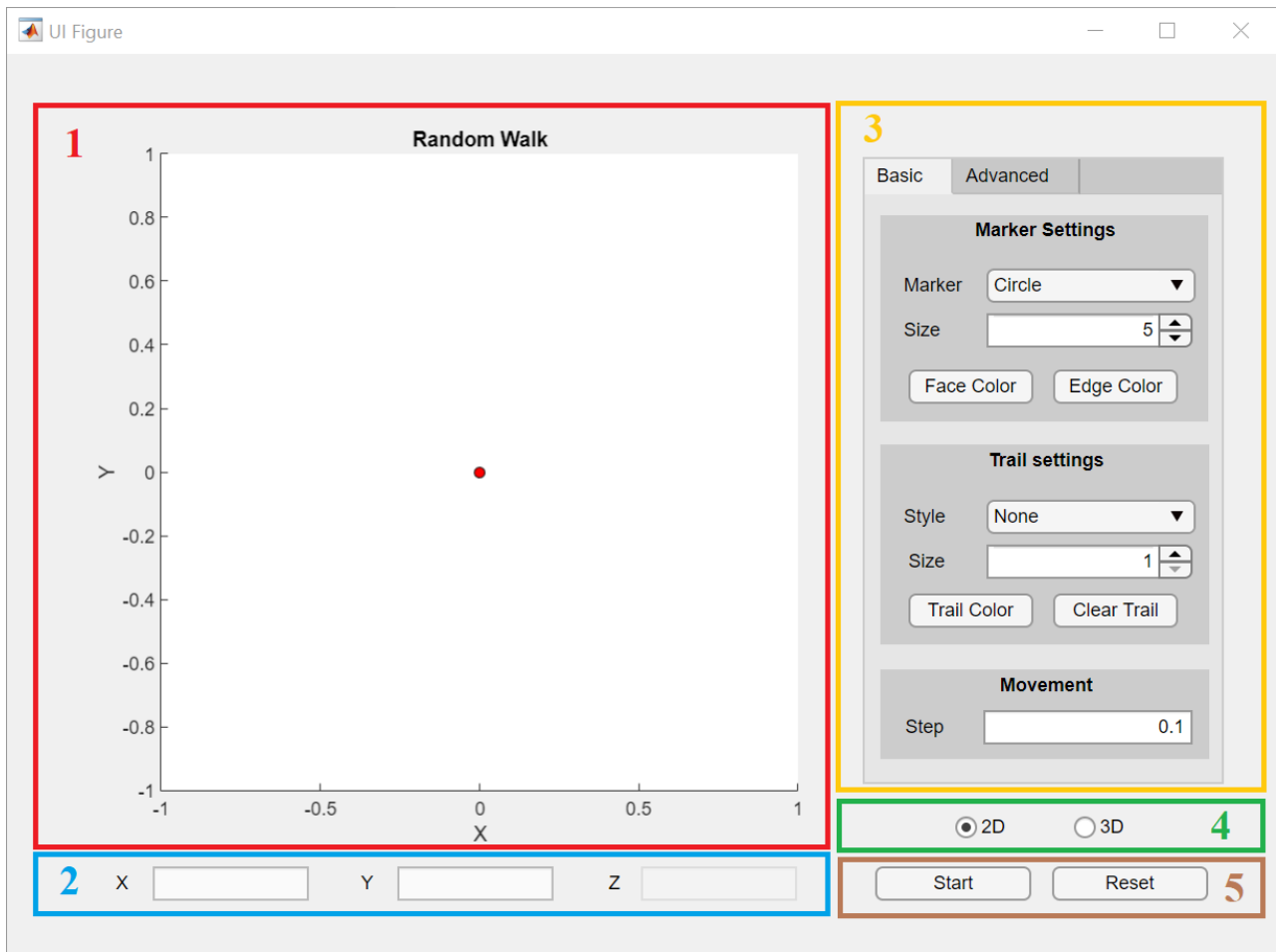


Figure 1. Application layout.

2.1. Plot area

The random walk can be observed in the plot in area 1. The plot can be rotated and zoomed using the mouse. The orientation of the plot is reset to 2D view when the walk is set to happen in 2D, but can be changed by dragging with the mouse.

2.2. Coordinate area

The coordinates of the walk can be seen in the coordinate area. The Z coordinate is constant and grayed out when the walk is set to happen only in 2D.

2.3. Settings area

There are two types of settings, basic and advanced. The basic settings have more to do with the appearance of the walk while advanced setting affect the figure and walk behavior.

2.3.1 Basic settings

The basic settings can be seen in figure 2. The settings 1-4 are marker settings, 5-8 trail settings and 9 is a movement setting.

The figure shows a settings window with two tabs: 'Basic' and 'Advanced'. The 'Basic' tab is active. It contains three main sections: 'Marker Settings', 'Trail settings', and 'Movement'.
1. 'Marker Settings':
- 'Marker' (1): A dropdown menu currently showing 'Circle'.
- 'Size' (2): A spinner box currently showing '5'.
- 'Face Color' (3): A button to open a color palette for the marker's face.
- 'Edge Color' (4): A button to open a color palette for the marker's edge.
2. 'Trail settings':
- 'Style' (5): A dropdown menu currently showing 'None'.
- 'Size' (6): A spinner box currently showing '1'.
- 'Trail Color' (7): A button to open a color palette for the trail.
- 'Clear Trail' (8): A button to clear the trail.
3. 'Movement':
- 'Step' (9): A spinner box currently showing '0.1'.

Figure 2. Basic settings layout.

The marker can be set using setting 'Marker' (1). The options for marker are 'Point', 'Circle', 'Plus' and 'None', 'Circle' being the default marker. The marker size can be set using the spinner 'Size' (2). The value can be set to any integer larger than zero. The face color of the marker can be set using the palette that can be opened by pressing button 'Face Color' (3) and edge color of the marker similarly with the button 'Edge Color' (4).

The user can also choose to see a trail of the random walk. This trail can be seen by setting the trail style to something other than 'None' (5). The other options are 'Solid line', 'Dashed line', 'Dotted line', and 'Dash-dotted line'. **The marker and trail style cannot be set to 'None' at the same time.** The thickness of the line can be set using the spinner 'Size' (6). The valid values for the thickness are values greater than or equal to one with 0.1 precision. The trail color can be set similarly to the marker colors using button 'Trail Color' (7). The trail can be cleared using the button 'Clear Trail' (8).

The amount to move with each iteration of the random walk can be set using the 'Step' edit field (9). The default value is 0.1 and the value can be set to anything starting from 0.001.

2.3.2. Advanced settings

The advanced settings can be seen in figure 3. The setting 1 is used to set the limits for the axis, 2-3 to set the behavior of the axis limits, and 4-5 to set the angle distribution.

Basic Advanced

Initial Axis Limits

X Limit 1

1 Y Limit 1

Z Limit 1

Boundary settings

2 Behavior Expanding ▼

X Delta 1

3 Y Delta 1

Z Delta 1

Angle Distribution settings

4 ☐ Discrete Angle Distribution

Number of Angles (2D) 4 5

Figure 3. Advanced settings layout.

The initial axis limits can be set using the edit fields ‘X Limit’, ‘Y Limit’ and ‘Z Limit’ (1). Valid inputs are any number greater than or equal to 0.1. The limits are set for each axis in the start and when the walk is reset as *-limit* and *limit*.

The behavior of the walk when the coordinates go outside of the figure can be set using the setting ‘Behavior’ (2) in ‘Boundary Settings’. The valid options are ‘Expanding’ and ‘Constant’. ‘Expanding’ being the default setting. When ‘Behavior’ is set to ‘Expanding’, the axis limits grow by the delta value determined for each axis when the walk goes outside of the current limits. These delta values can be set using the edit fields ‘X Delta’, ‘Y Delta’, and ‘Z Delta’ (3). The delta values can be set when ‘Behavior’ is set to expanding and can be any value larger than 0.01.

By default, the movement direction of the random walk is chosen from a uniform distribution. If the checkbox ‘Discrete Angle Distribution’ (4) is checked, the movement direction is chosen from a discrete distribution. For 3D, this discrete distribution is the rectangular discrete walk (directions up, down, left, right, forward, backward) but for 2D walk the amount of possible directions can be specified with the edit field ‘Number of Angles (2D)’ (5). The valid range for the possible directions is any integer larger than 2.

2.4. Dimensions area

The dimensions of the random walk can be chosen in area 4 with the radio buttons. The walk happens in two dimensions by default, but can be changed to three dimensions any time. In the beginning, the coordinates of the walk are (0, 0, 0). In 2D, only the x- and y-directions are changed and z is kept constant. In 3D, all three dimensions change. The figure is set to show the 2D view when the user switches to 2D and 3D view when the user switches to 3D. The view can, however, be rotated at any time freely by dragging with the mouse.

2.5. Control area

The walk can be started by pressing the ‘Start’ button in the control area. The walk can then be paused by pressing the same button again (now saying ‘Stop’). The user can reset the position and the figure by pressing the ‘Reset’ button.

3. Limitations

Only discrete walk available in 3D is the rectangular walk. This is because of the more complex nature of distributing directions discretely in 3D compared to 2D.

Trail line is cleared every time the point jumps across the plot with constant axis limits. This was done to keep the plot clear.