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Pathfinder Monte Carlo User Manual

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Chapter 1. Monte Carlo Simulations

Pathfinder comes with a set of scripts to help you run Pathfinder from the command line. This document focuses on these scripts used to generate variations of an initial Pathfinder model for testing the effect of variability on the simulation results. Using this utility might be useful for testing the sensitivity to initial conditions (starting position, profile parameter assignment, etc.) and/or to help with validation of distributions (normal, uniform, log-normal, etc.) used for input parameters to the model.

1.1. Usage

A typical usage of the Monte Carlo system is a three step process:

1. Run `montecarlo_createcases.bat` from the command prompt to generate some variations of a source model (as well as utility BAT files for running the models and collecting results).

2. Run all simulations by double-clicking the `_run.bat` script.

3. View results by clicking the `_results.bat` script.

The following examples are for different simulation scenarios that we used for testing the Monte Carlo utility. The reference to `model.pth` is just an example file name, you would need to create a simple model of your own.

1.1.1. Example 1: Randomize All Occupants

This command generates 20 variations of myfile.pth with randomized positions and profiles for all occupants.

```
"C:\Program Files\Pathfinder 2024\montecarlo_createcases.bat" myfile.pth 20
```

1.1.2. Example 2: Using an Exclude Filter

This command generates 20 variations of myfile.pth with randomized positions and profiles for all occupants except those under the "Base_Floor" group.

```
"C:\Program Files\Pathfinder 2024\montecarlo_createcases.bat" myfile.pth 20
--exclude=Occupants/Base_Floor
```

1.1.3. Example 3: Specifying Scenarios

This command generates 20 variations of Scenario01 in myfile.pth and 20 variations of Scenario02

in myfile.pth with randomized positions and profiles for all occupants.

```
"C:\Program Files\Pathfinder 2024\montecarlo_createcases.bat" myfile.pth 20 Scenario01
Scenario02
```

```
==== Example 4: Combining Multiple Options
```

This command generates 20 variations of myfile.pth with randomized profiles for all occupants, and randomized positions for all except those under the Occupant sub groups "First_floor" and "Rooftop".

```
"C:\Program Files\Pathfinder 2024\montecarlo_createcases.bat" myfile.pth 20
--exclude_pos=Occupants/First_floor --exclude_pos=Occupants/Rooftop
```

1.2. Known Limitations

You cannot modify model geometry or parameters related to it (stair width, rise/run, door width, etc.)

1.3. Previous Version

A previous version of this tool (released prior to *Pathfinder 2020.1.0219*) did not randomize any occupants directly under the **Occupants** node on the tree (only occupants in subgroups were randomized). This was to allow some basic level of control on which occupants were randomized, but this feature has been replaced by include/exclude filters (Chapter 3) in more recent versions of Pathfinder.

Chapter 2. Process Overview

2.1. Generate Variations

Open a command window in the location of the .pth file (current working directory).

NOTE	You can type `cmd` in the Windows File Explorer address bar to open a command prompt at that location.

The basic command structure is:

```
<montecarlo_createcases.bat> <pathfinder filename> <number of variations> <addl. opts>
<scenarios...>
```

Example:

```
"C:\Program Files\Pathfinder 2024\montecarlo_createcases.bat" myfile.pth 20
--exclude=Occupants/First_Floor Scenario01 Scenario02
```

This command will generate 20 cases for both Scenario01 and Scenario02. 40 cases will be created in total. If no scenarios are specified, cases will be generated from the **<default>** scenario.

This command will exclude any occupant whose ID contains the text "**Occupants/First_Floor**". An occupant's ID is determined by its position in the Pathfinder tree (Navigation View). The separator for groups and object nodes is a forward slash.

2.1.1. Terminal Output

When the script is finished you will see output to the Terminal showing the status of every occupant in the model as shown in Figure 1.

Each ID string will be followed by three `yes` or `no` values:
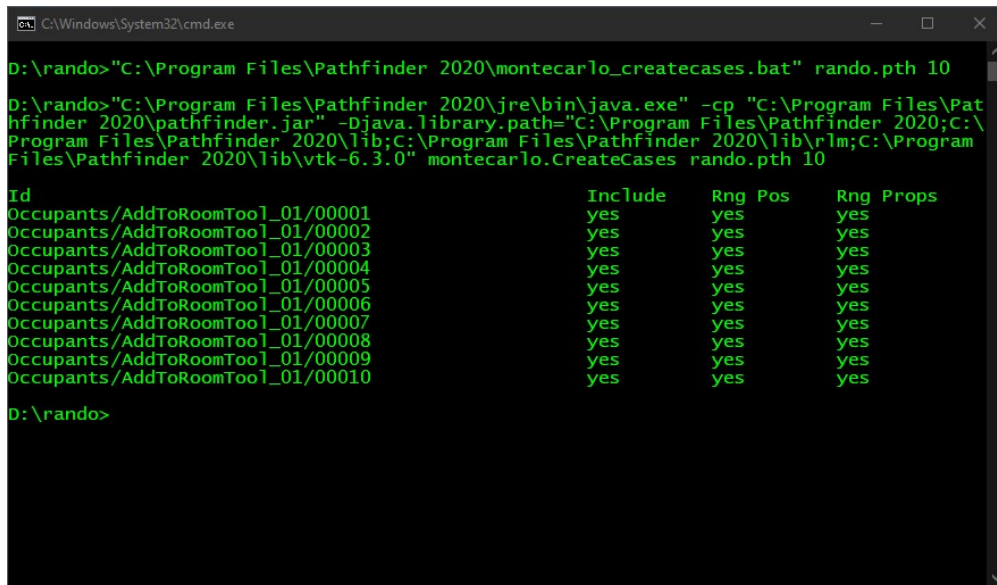
Include

 If this occupant included in the randomization process or not.

Rng Pos

 If this occupant's position will be randomized or not.

Rng Props

If this occupant's profile and behavior properties will be randomized or not.

Figure 1. Example of output from montecarlo_createcases.bat script.

2.1.2. Variations Folder

A new variations folder `<pathfinder filename>_variations` (Figure 2), containing all of the new cases and two batch script files.

If multiple scenarios were generated, subfolders will be created for each scenario. Each subfolder will contain the new cases for that scenario and two batch script files specific to that scenario. The `<pathfinder filename>_variations` folder will still contain batch files that run all scenarios.
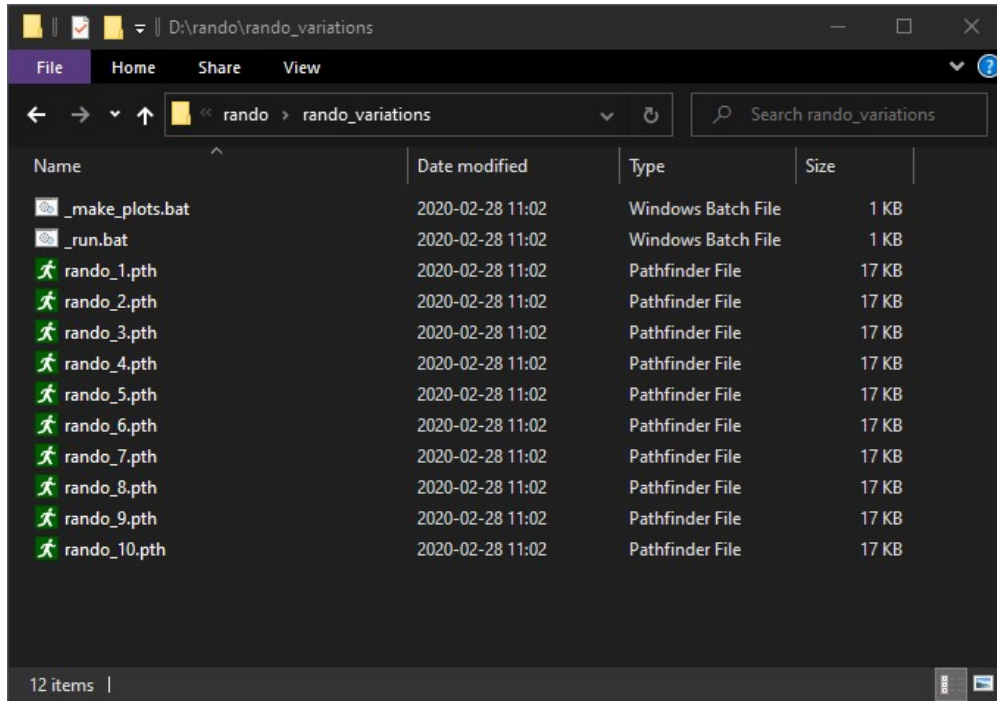
Figure 2. Example of variations directory contents

2.2. Run All Variations

To run all of the cases at once, navigate into the `<pathfinder filename>_variations` folder in File Explorer and double-click the `_run.bat` file. This will start a process to run all of the simulations in numerical order. Each simulation will output a brief summary to the Terminal window as shown in Figure 3. When the simulations are complete, the Terminal window will close.

Figure 3. Example summary output from the `_run.bat` script.

2.3. Plot Results

To create and view plots of Completion Times for All Occupants Figure 4 and Travel Distances for All Occupants Figure 5 double-click `_make_plots.bat`. The `_make_plots.bat` file will generate the following files:

Completion Times for All Occupants (s).csv

This file contains data on the completion times of occupants across all variations. Each column's data is described below.

- **ID**: Model name and unique identifier for each variation. If multiple scenarios were plotted, this will begin with the name of the scenario.

- **MIN**: The minimum completion time for all occupants, as reported in the Summary Report.

- **MAX**: The maximum completion time for all occupants, as reported in the Summary Report.

- **LOW**: The AVG completion time minus one Standard Deviation.

- **HIGH**: The AVG completion time plus one Standard Deviation.

- **AVG**: The AVG completion time for all occupants.

- **STDDEV**: The standard deviation about the average.

Travel Distances for All Occupants (m).csv

This file contains data on the total travel distances for all occupants across all variations. Each column's data is described below.

- **ID**: Model name and unique identifier for each variation. If multiple scenarios were plotted, this will begin with the name of the scenario.

- **MIN**: The minimum travel distance for all occupants, as reported in the Summary Report.

- **MAX**: The maximum travel distance for all occupants, as reported in the Summary Report.

- **LOW**: The AVG travel distance minus one Standard Deviation.

- **HIGH**: The AVG travel distance plus one Standard Deviation.

- **AVG**: The AVG travel distance for all occupants.

- **STDDEV**: The standard deviation about the average.

Completion Times for All Occupants (s).html

This file contains a plot of the data written to `Completion Times for All Occupants (s).csv`. Double-clicking this file will open the plot, shown in Figure 4, in your default browser window. For each variation, the thin plotted line plots the range of the MIN to MAX completion times for all occupants, while the thick plotted line plots the range of the LOW to HIGH completion times.

Travel Distances for All Occupants (m).html

This file contains a plot of the data written to `Travel Distances for All Occupants (m).csv`. Double-clicking this file will open the plot, shown in Figure 5, in your default browser window. For each variation, the thin plotted line plots the range of the MIN to MAX travel distances for all occupants, while the thick plotted line plots the range of the LOW to HIGH travel distances.
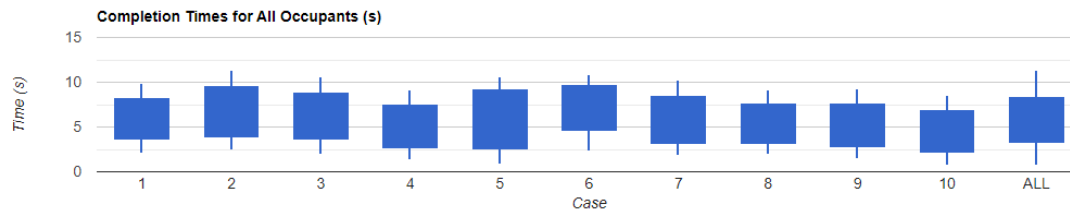

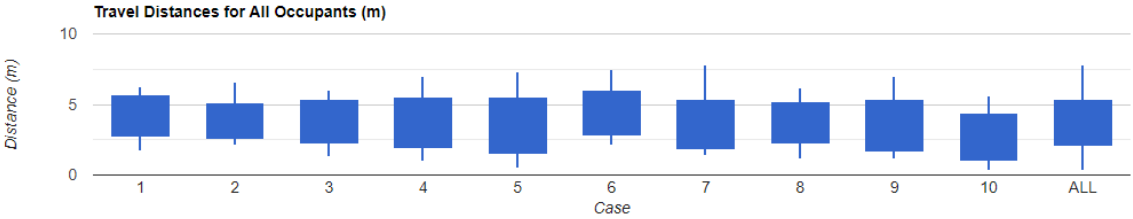**Figure 4. Example Completion Times plot**

Travel Distances for All Occupants (m)

Figure 5. Example Travel Distance plot

Chapter 3. Additional Options

There are additional options that you can specify to change how the simulations are run and what information is included or excluded from the simulation.

See the additional options processing order diagram (Figure 6) to visualize the flow. Include is processed before exclude in all cases. Position and properties are processed separately.

Multiple paths can be specified with each option. To list more than one path for any option repeat the option name for each additional path.

--include=TEXT, --exclude=TEXT

Used to indicate sections of the occupant tree or specific occupants to include or exclude completely from the randomization. The entire path does not need to be included, since the filtering tests if any part of the occupant's path contains the typed input.

--include_pos=TEXT, --exclude_pos=TEXT

Used to indicate sections of the occupant tree or specific occupants that will be included or excluded from the **position** randomization.

--include_props=TEXT, --exclude_props=TEXT

Used to indicate sections of the occupant tree or specific occupants that will be included or excluded from the **profile** randomization, which includes distributed profile and behavior parameters (e.g. speed when entered as a uniform distribution).

--room_rule=n

When randomizing position, this parameter controls which rooms an occupant is eligible to occupy.
Room options (n):
0 - (default) stay in current room
1 - all position randomized agents' current rooms
2 - any non-disabled occupiable room

--uniform_dist

Use this flag to change the positional distribution from random (default) to uniform, for debugging.

--rseed=s

Used to specify the value of the initial seed for the random number generator. The initial seed is used to randomize distributed profile and behavior properties.

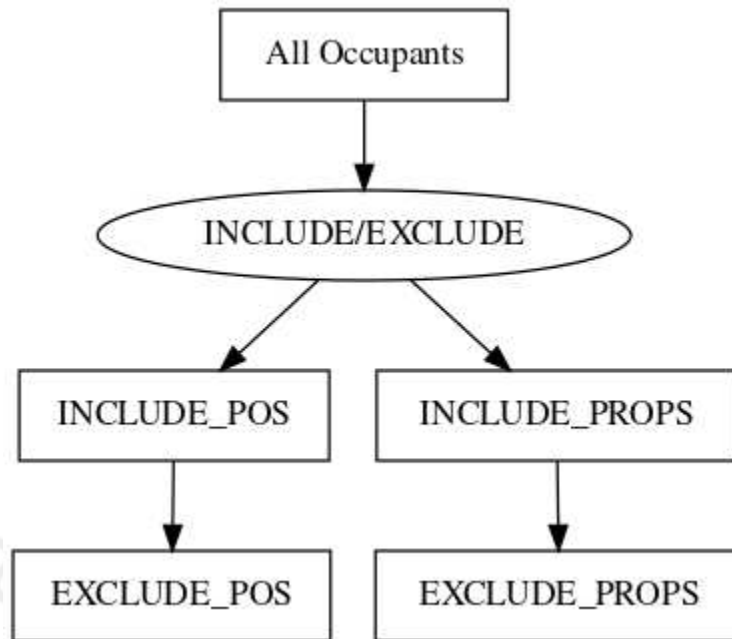**TIP**   Occupant filters can be verified by the console output.

Figure 6. Additional Options Processing Order

Chapter 4. Support

Please email support@thunderheadeng.com if you have any questions about how to use this utility, or for new feature requests.