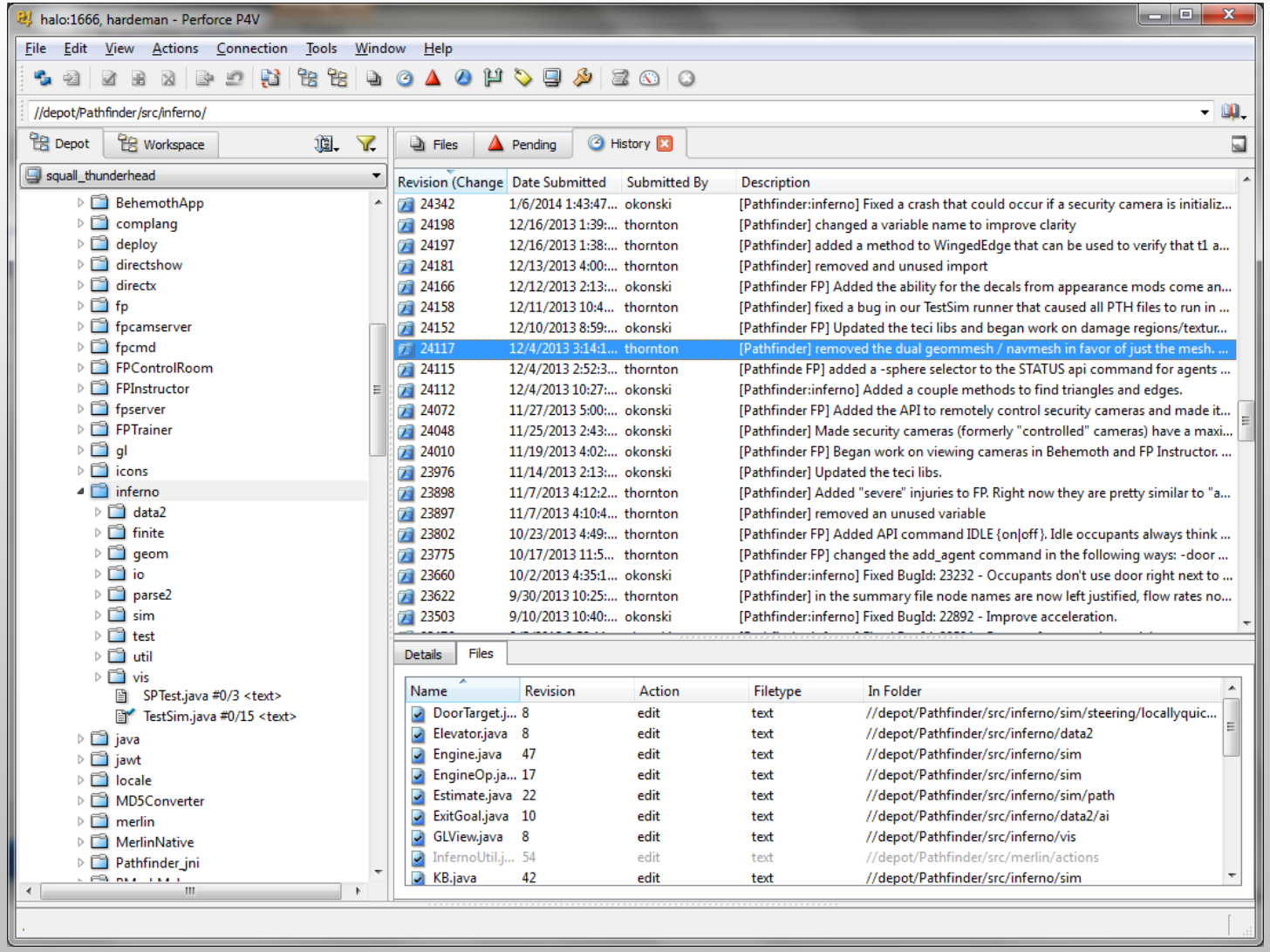
Pathfinder

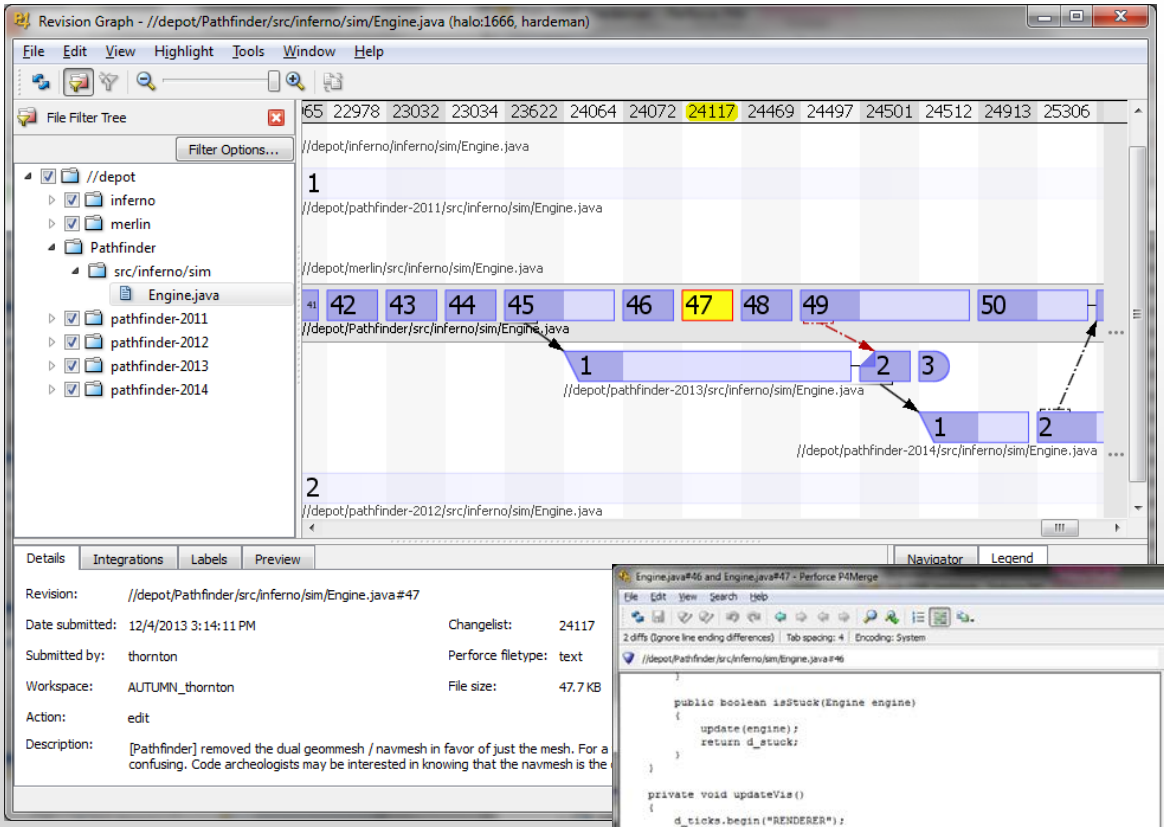
Pathfinder
Verification and Validation

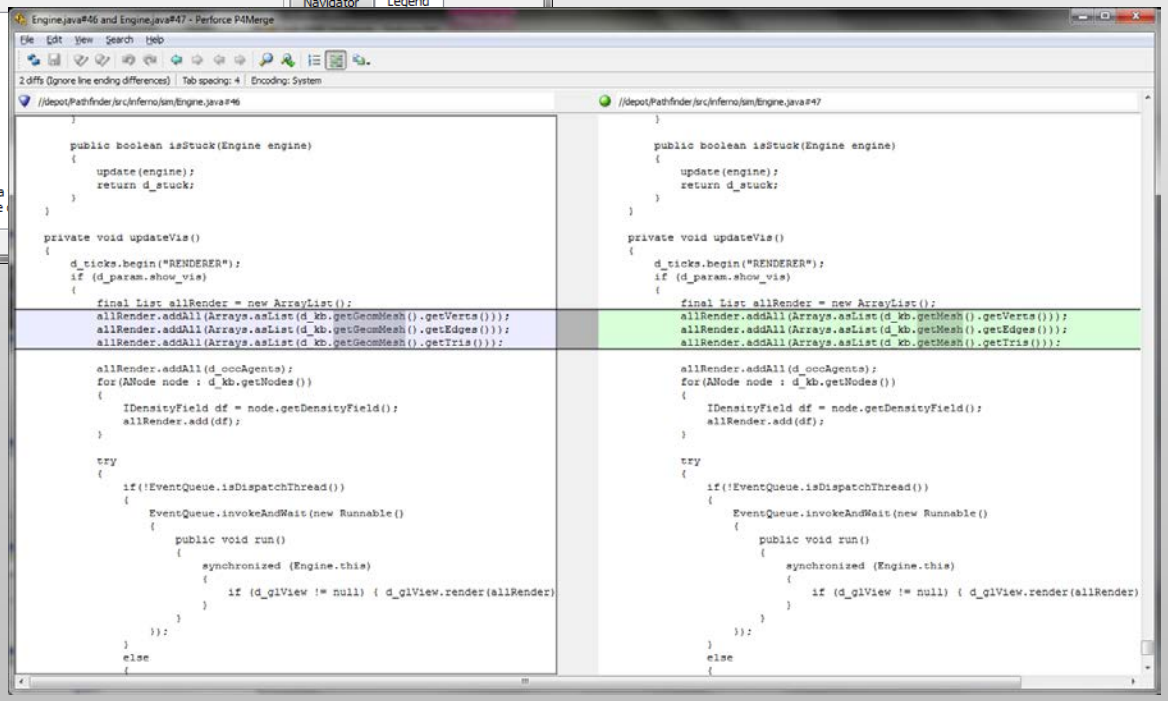
Quality Assurance Process

- Source Code Control
- Continuous Integration
  - Entire system rebuilt after every change
- Automated Testing
  - Tests run automatically after every build
  - 117 test cases in 2012
  - 308 test cases in 2014
- Testing Dashboard
- Automated Error Reporting
  - Reports categorized and scheduled weekly

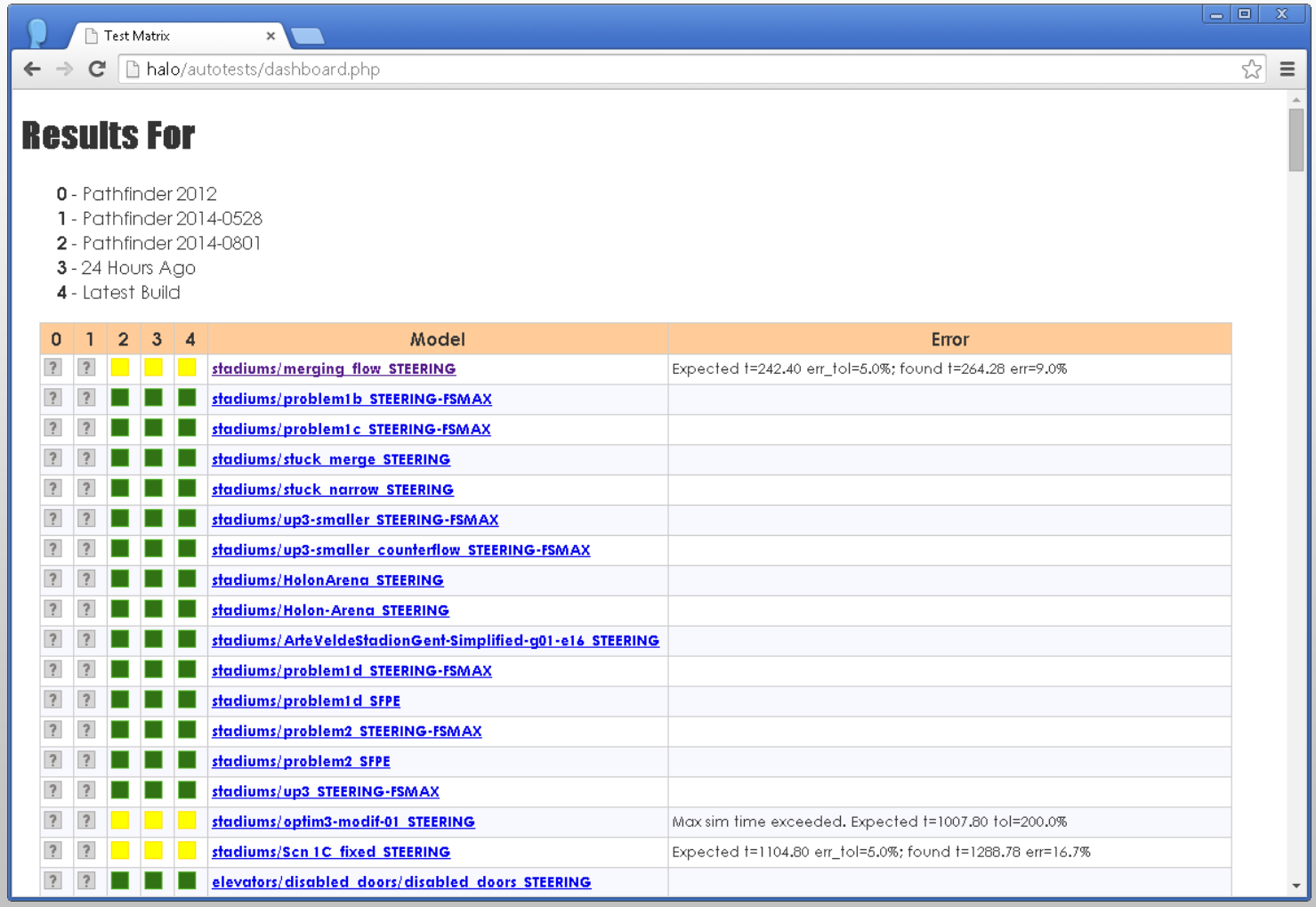
Source Control




Revision Graph - //depot/Pathfinder/src/inferno/sim/Engine.java (halo:1666, hardeman)
File Edit View Highlight Tools Window Help
File Filter Tree
Filter Options...
//depot
inferno
merlin
Pathfinder
src/inferno/sim
Engine.java
pathfinder-2011
pathfinder-2012
pathfinder-2013
pathfinder-2014
65 22978 23032 23034 23622 24064 24072 24117 24469 24497 24501 24512 24913 25306
//depot/inferno/inferno/sim/Engine.java
1
//depot/pathfinder-2011/src/inferno/sim/Engine.java
//depot/merlin/src/inferno/sim/Engine.java
41 42 43 44 45 46 47 48 49 50
//depot/Pathfinder/src/inferno/sim/Engine.java
1 2 3
//depot/pathfinder-2013/src/inferno/sim/Engine.java
1 2
//depot/pathfinder-2014/src/inferno/sim/Engine.java
2
//depot/pathfinder-2012/src/inferno/sim/Engine.java
Details Integrations Labels Preview
Navigator Legend
Revision: //depot/Pathfinder/src/inferno/sim/Engine.java#47
Date submitted: 12/4/2013 3:14:11 PM
Changelist: 24117
Submitted by: thornton
Perforce filetype: text
Workspace: AUTUMN_thornton
File size: 47.7 KB
Action: edit
Description: [Pathfinder] removed the dual geommesh / navmesh in favor of just the mesh. For a
confusing. Code archeologists may be interested in knowing that the navmesh is the


Engine.java#46 and Engine.java#47 - Perforce P4Merge
File Edit View Search Help
2 diffs (Ignore line ending differences) Tab spacing: 4 Encoding: System
//depot/Pathfinder/src/inferno/sim/Engine.java#46
//depot/Pathfinder/src/inferno/sim/Engine.java#47
public boolean isStuck(Engine engine)
{
update(engine);
return d_stuck;
}
}
private void updateVis()
{
d_ticks.begin("RENDERER");
if (d_param.show_vis)
{
final List allRender = new ArrayList();
allRender.addAll(Arrays.asList(d_kb.getGeomMesh().getVerts()));
allRender.addAll(Arrays.asList(d_kb.getGeomMesh().getEdges()));
allRender.addAll(Arrays.asList(d_kb.getGeomMesh().getTris()));
allRender.addAll(d_occAgents);
for(ANode node : d_kb.getNodes())
{
IDensityField df = node.getDensityField();
allRender.add(df);
}
try
{
if(!EventQueue.isDispatchThread())
{
EventQueue.invokeAndWait(new Runnable()
{
public void run()
{
synchronized (Engine.this)
{
if (d_glView != null) { d_glView.render(allRender)
}
}
});
}
else
{

Automated Tests - Dashboard



Results For

0 - Pathfinder 2012
1 - Pathfinder 2014-0528
2 - Pathfinder 2014-0801
3 - 24 Hours Ago
4 - Latest Build

0	1	2	3	4	Model	Error
?	?				stadiums/merging_flow_STEERING	Expected t=242.40 err_tol=5.0%; found t=264.28 err=9.0%
?	?				stadiums/problem1b_STEERING-FSMAX	
?	?				stadiums/problem1c_STEERING-FSMAX	
?	?				stadiums/stuck_merge_STEERING	
?	?				stadiums/stuck_narrow_STEERING	
?	?				stadiums/up3-smaller_STEERING-FSMAX	
?	?				stadiums/up3-smaller_counterflow_STEERING-FSMAX	
?	?				stadiums/HolonArena_STEERING	
?	?				stadiums/Holon-Arena_STEERING	
?	?				stadiums/ArteVeldeStadionGent-Simplified-g01-e16_STEERING	
?	?				stadiums/problem1d_STEERING-FSMAX	
?	?				stadiums/problem1d_SFPE	
?	?				stadiums/problem2_STEERING-FSMAX	
?	?				stadiums/problem2_SFPE	
?	?				stadiums/up3_STEERING-FSMAX	
?	?				stadiums/optim3-modif-01_STEERING	Max sim time exceeded. Expected t=1007.80 tol=200.0%
?	?				stadiums/Scn 1C_fixed_STEERING	Expected t=1104.80 err_tol=5.0%; found t=1288.78 err=16.7%
?	?				elevators/disabled_doors/disabled_doors_STEERING	

Verification and Validation Guide

Pathfinder

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Verification and Validation

Pathfinder 2014.2
Release 0730 x64

6 Comparisons to Experiments

This section presents Pathfinder models designed to reproduce experimental results.

6.1 Seyfried et al.

This validation test compares Pathfinder to a series of small-scale experiments (Seyfried, Passon, et al., Capacity Estimation for Emergency Exits and Bottlenecks 2007). The experiments were conducted in a room constructed with dividers and an adjustable-width corridor. Once occupants had exited the corridor they were clear of the experimental environment. Figure 37 illustrates the experimental setup.

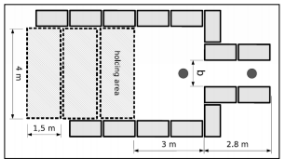


Figure 37: Experimental setup (Seyfried, Passon, et al., Capacity Estimation for Emergency Exits and Bottlenecks 2007).

Each holding area can accommodate 20 occupants, allowing for experiments to be run with 20, 40, and 60 occupants. The corridor width was adjusted in the range from 0.8 m to 1.2 m at 0.1 m intervals. These two variables provide for 15 test cases. Figure 38 shows the Pathfinder model used to simulate all 15 cases. Currently, only the bottom row of test cases can be compared because the experimental data available for direct comparison is limited to the N=60 cases.

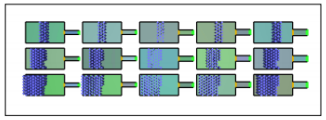


Figure 38: A Pathfinder model designed to replicate all 15 cases of the experiments.

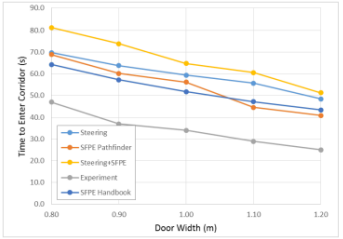


Figure 39: Comparison of times to exit room

In addition, we are able to compare the overhead camera footage in the experiment to the results visualization in Pathfinder. The exact scenario shown in the video at the left of Figure 40 is unknown, but based on the apparent door width and ability of occupants to form two distinct columns, the results video for a steering simulation using door width of 1.1 meters was selected for comparison (at right). The figure was created using the cylinder visualization that illustrates occupant orientation with an inset triangle.

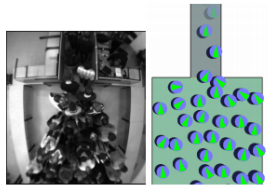
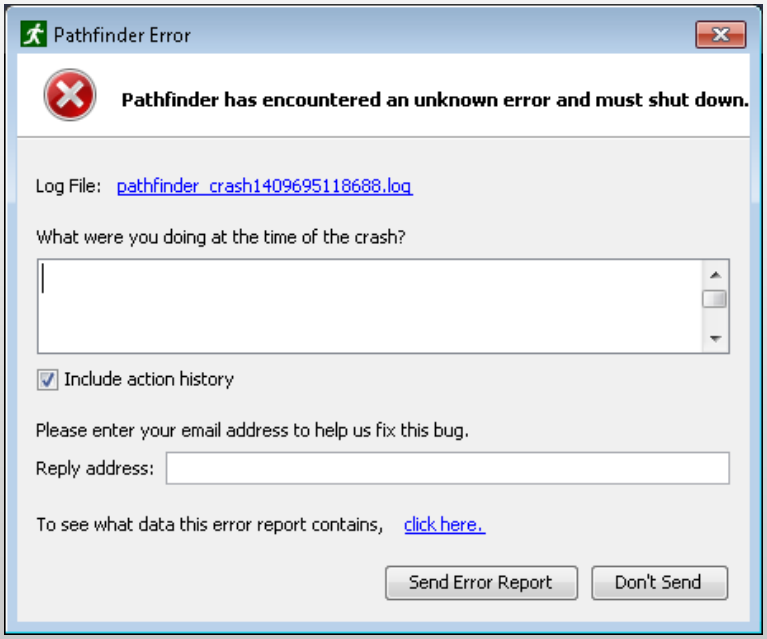
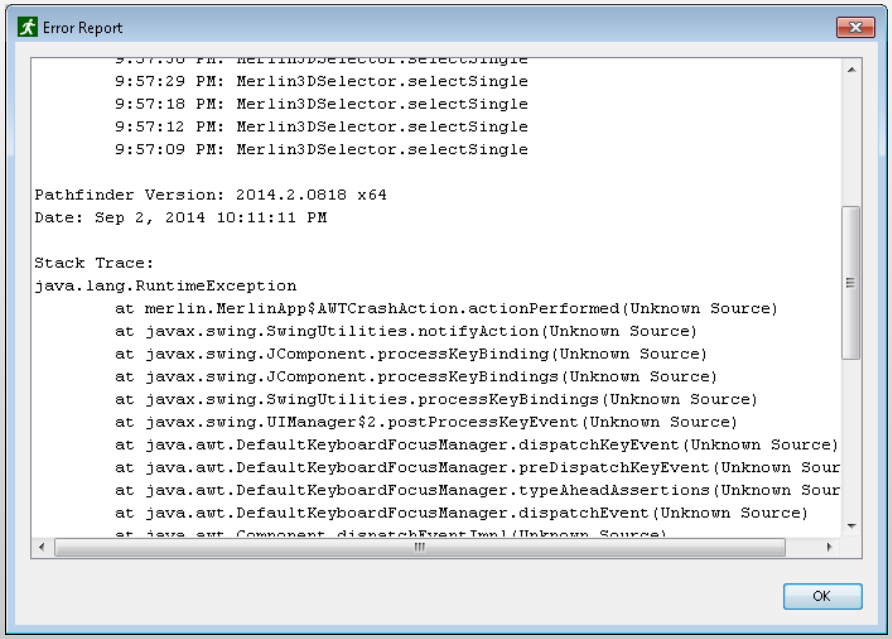


Figure 40: Experimental video (Seyfried, Passon, et al., Pedestrian and Evacuation Dynamics NETwork 2009) compared to Pathfinder visualization.

Error Handling



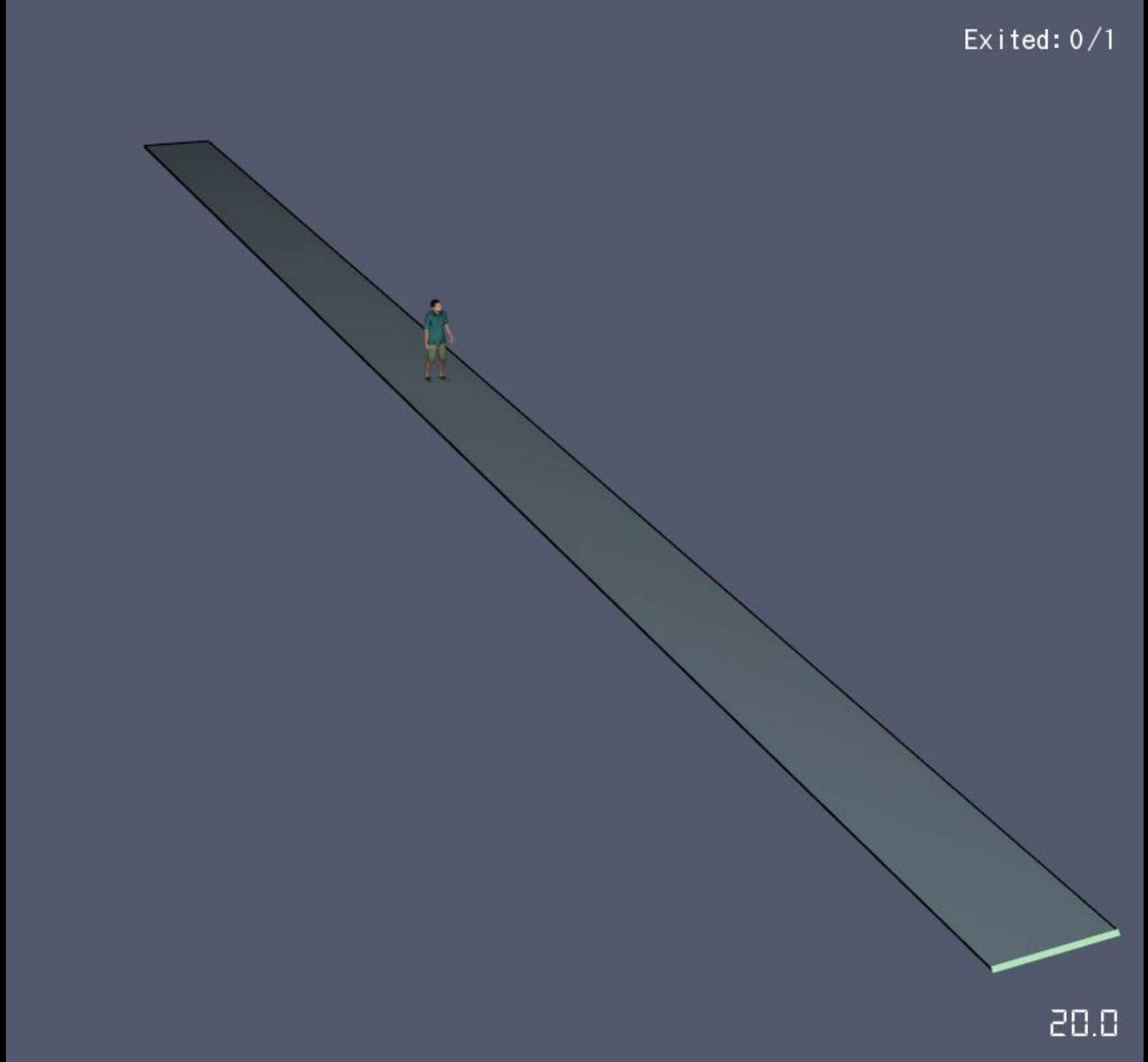


Verification Tests

- IMO
- RIMEA
- NIST Tech Note 1822
- SFPE Handbook

Verification Tests

- Locomotion
- Wayfinding
- Behavior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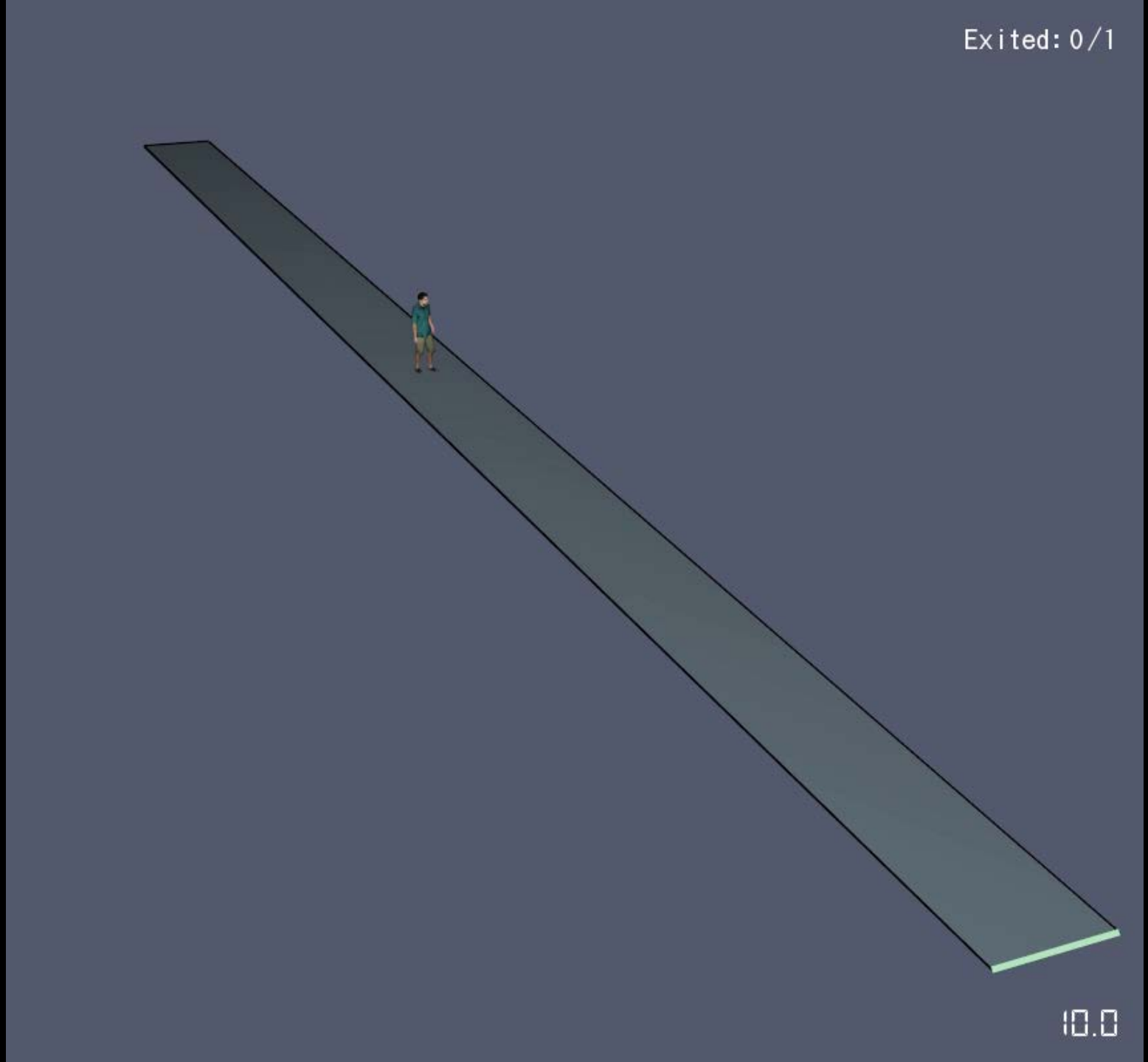
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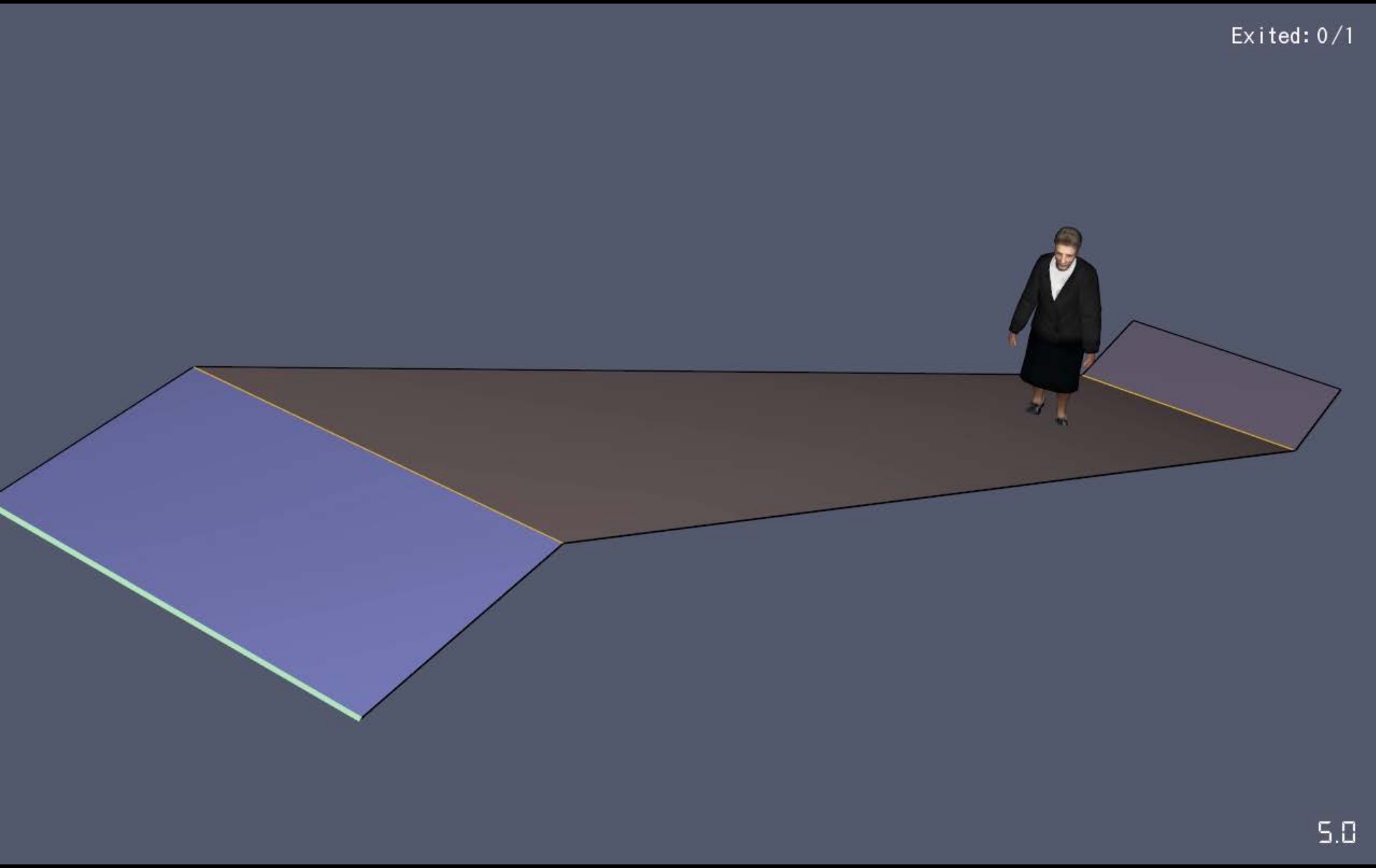
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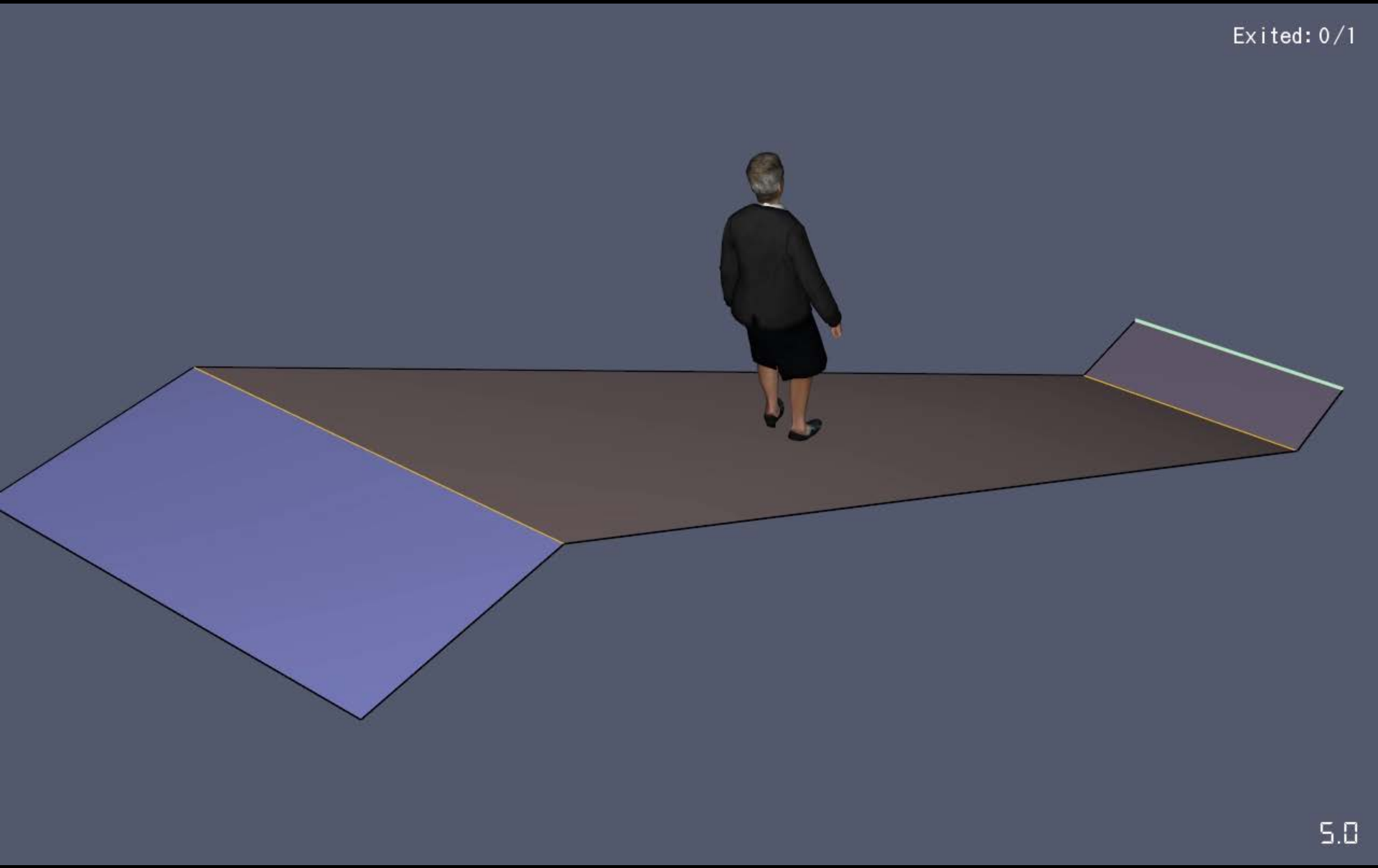
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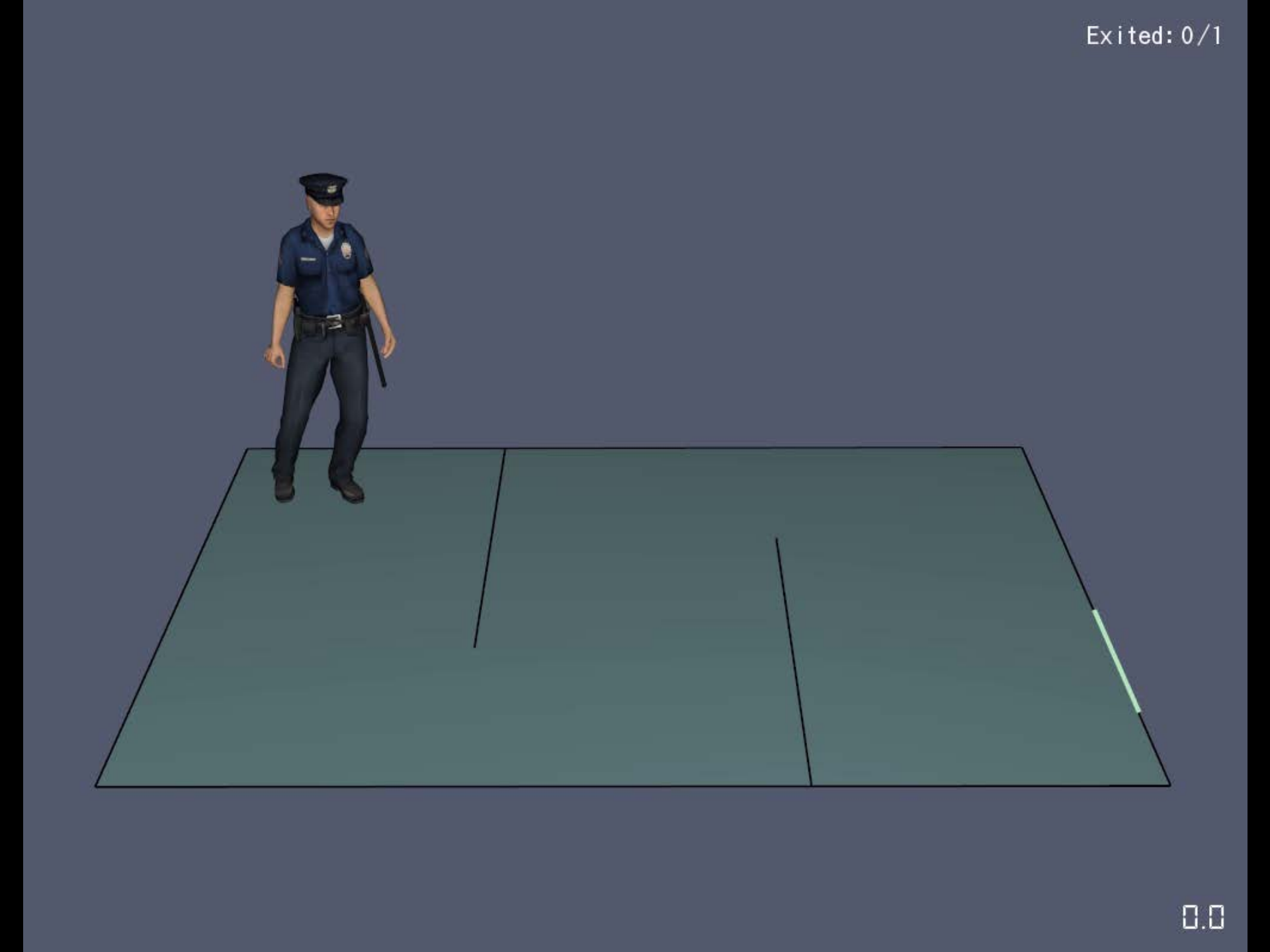
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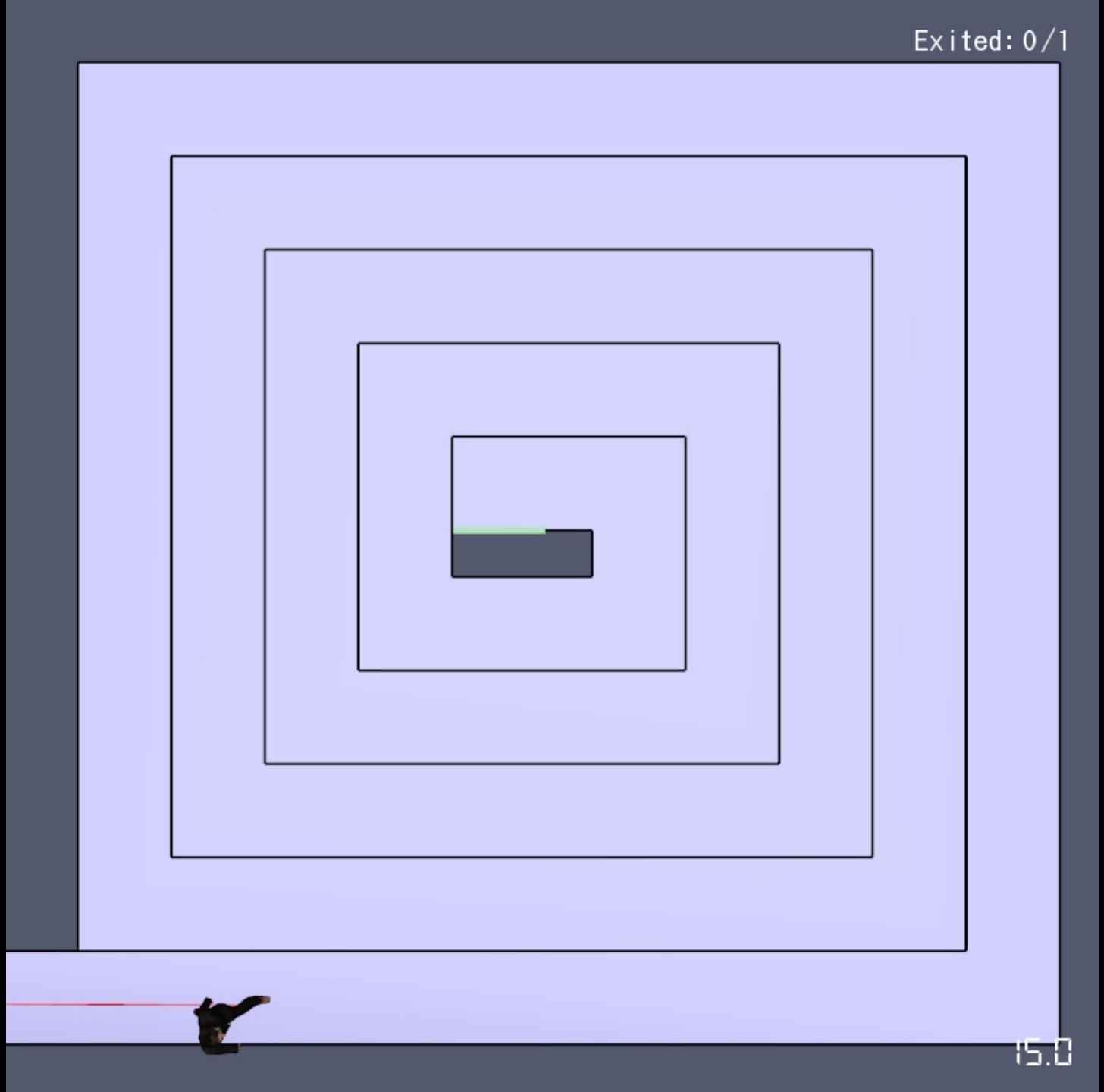
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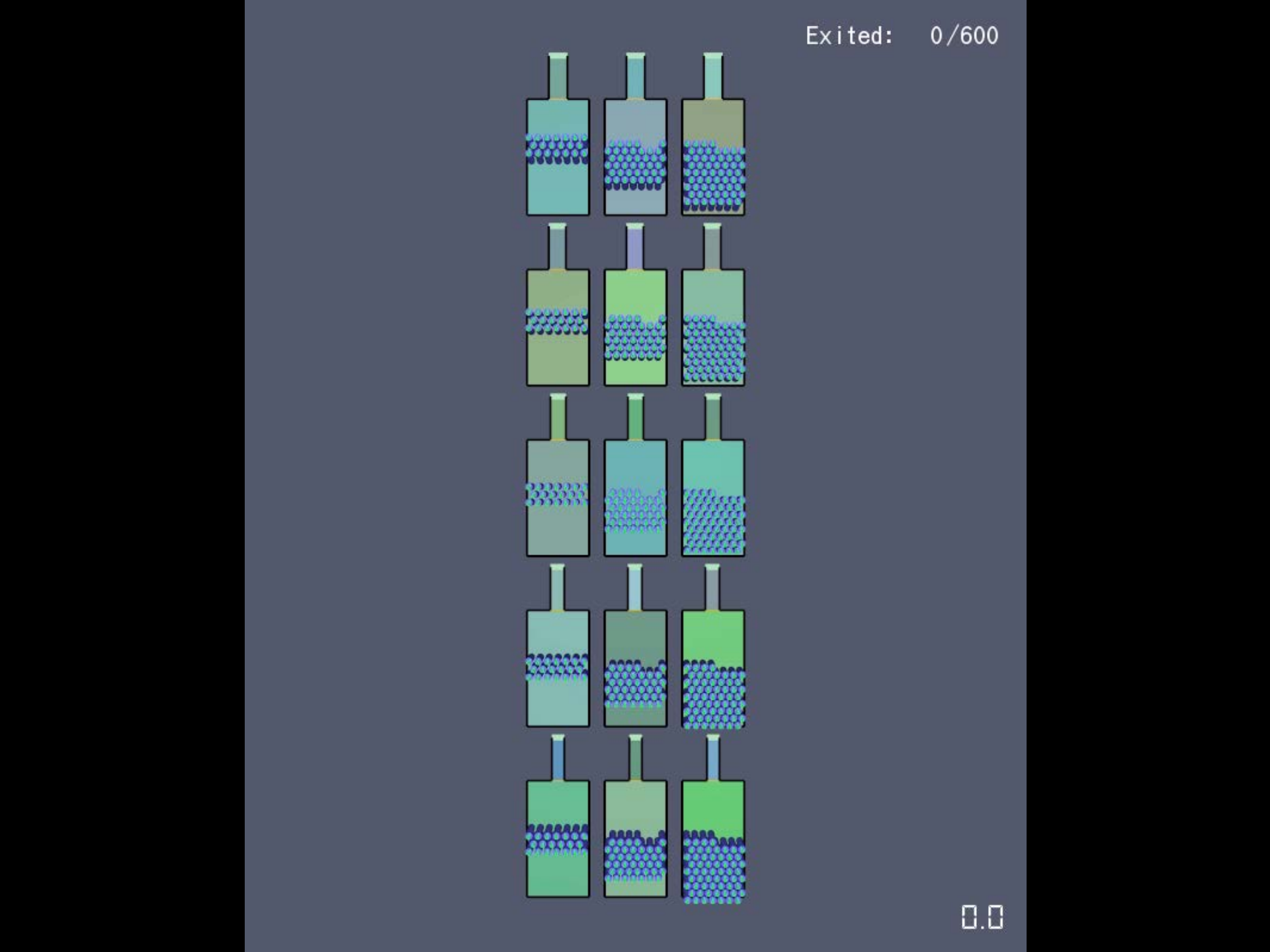
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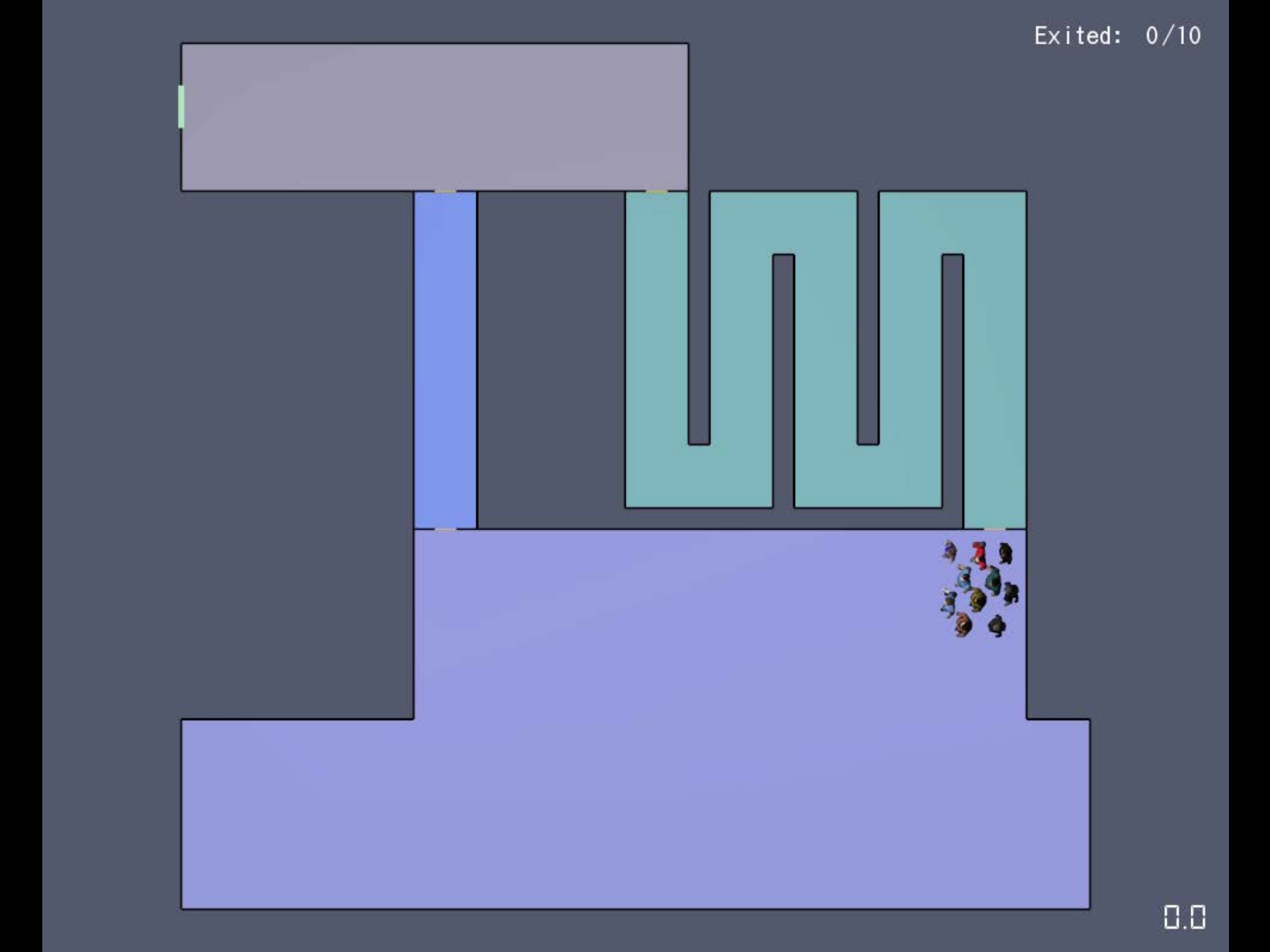
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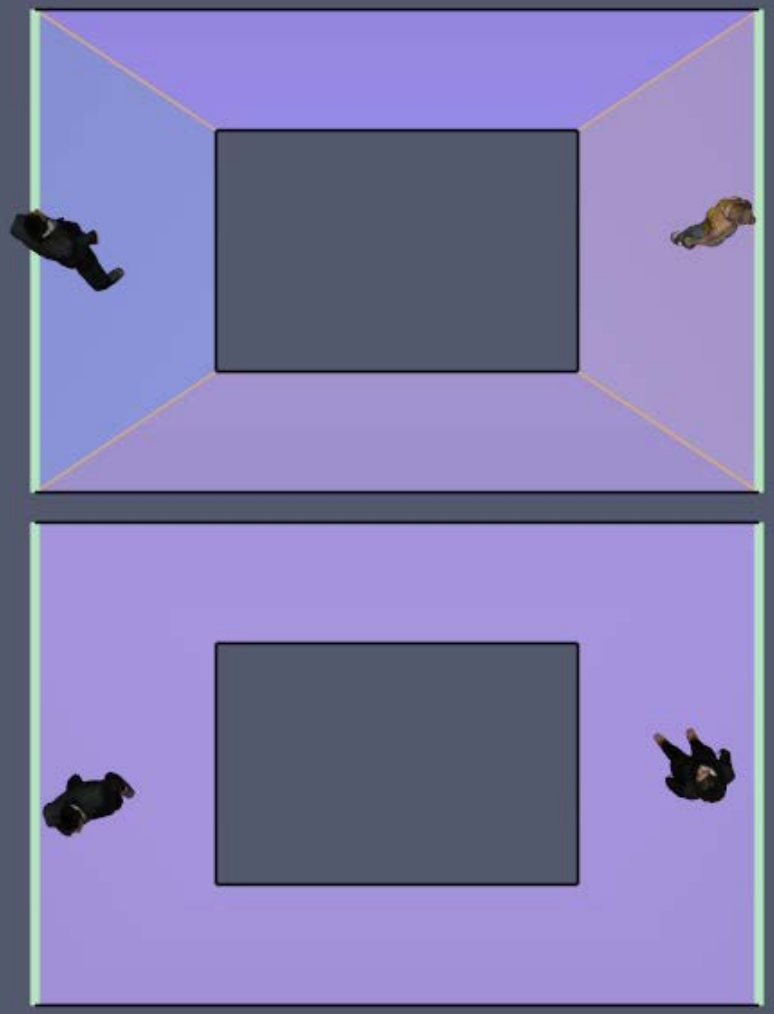
Exited: 0/4



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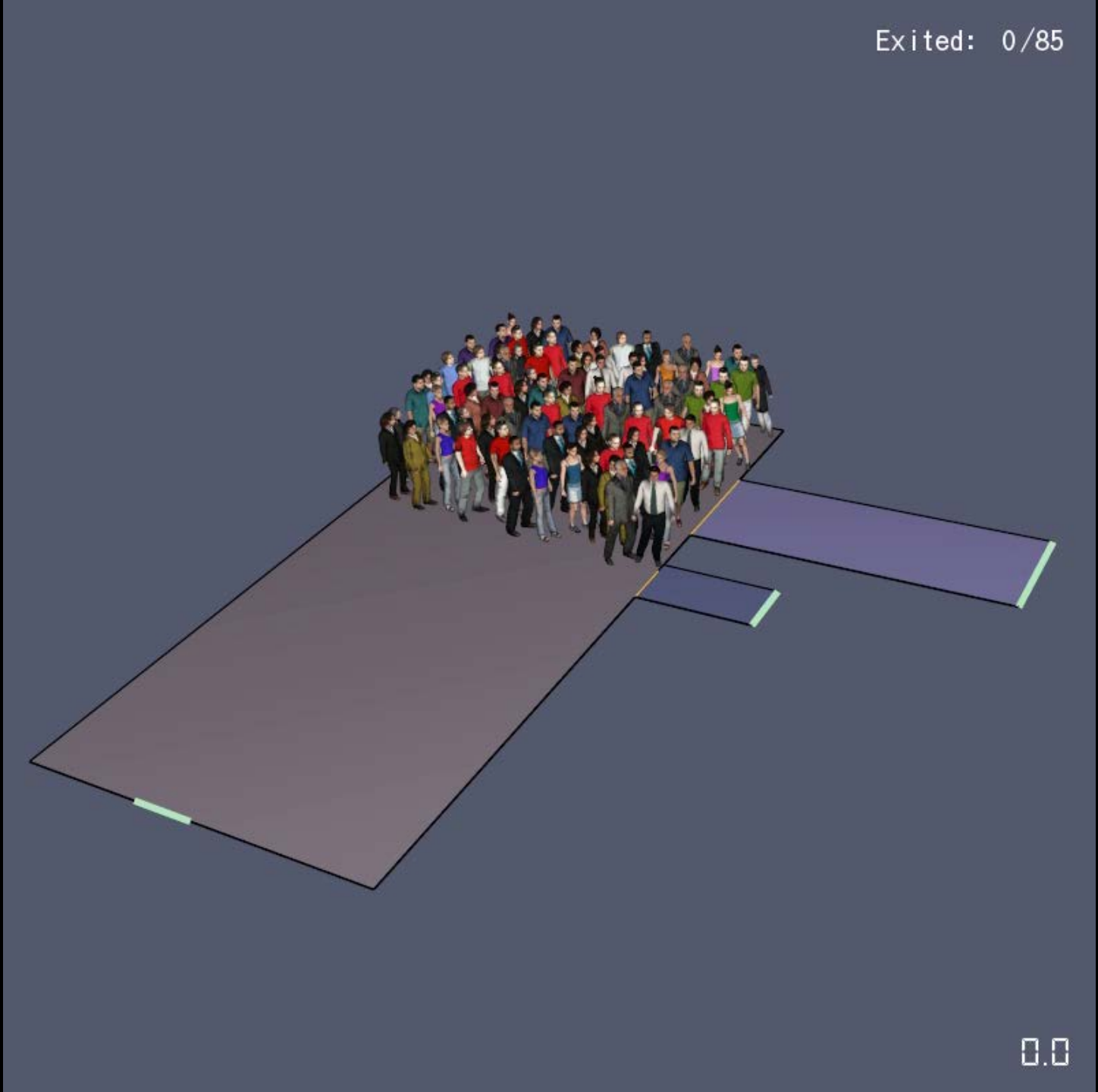
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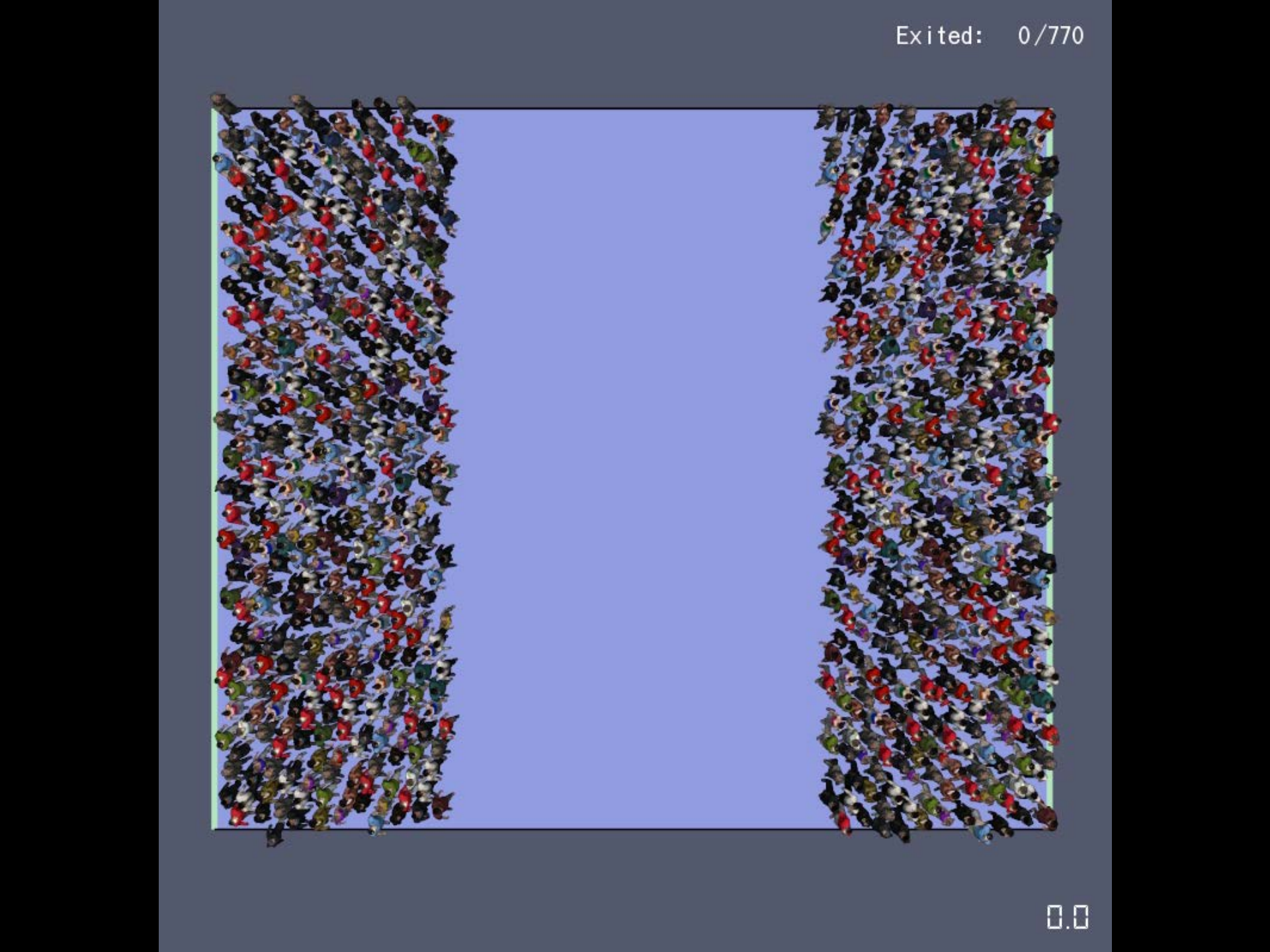
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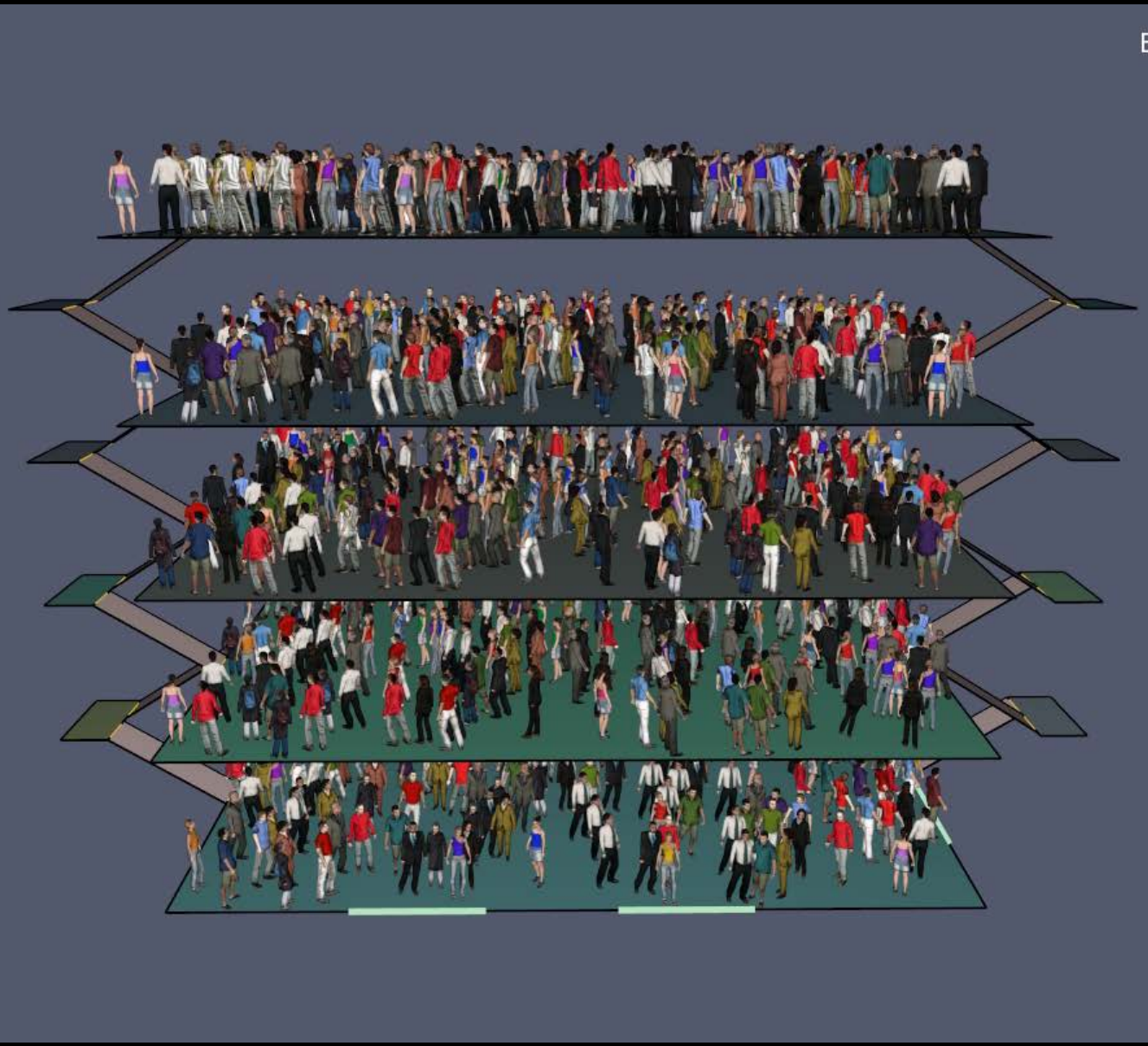
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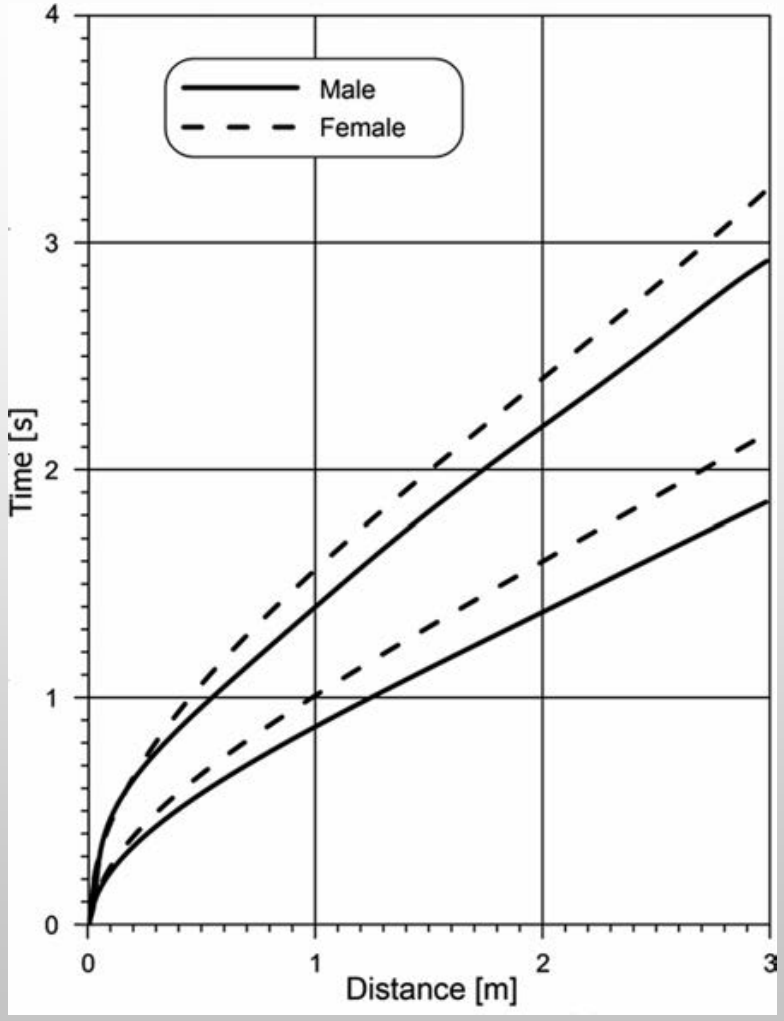
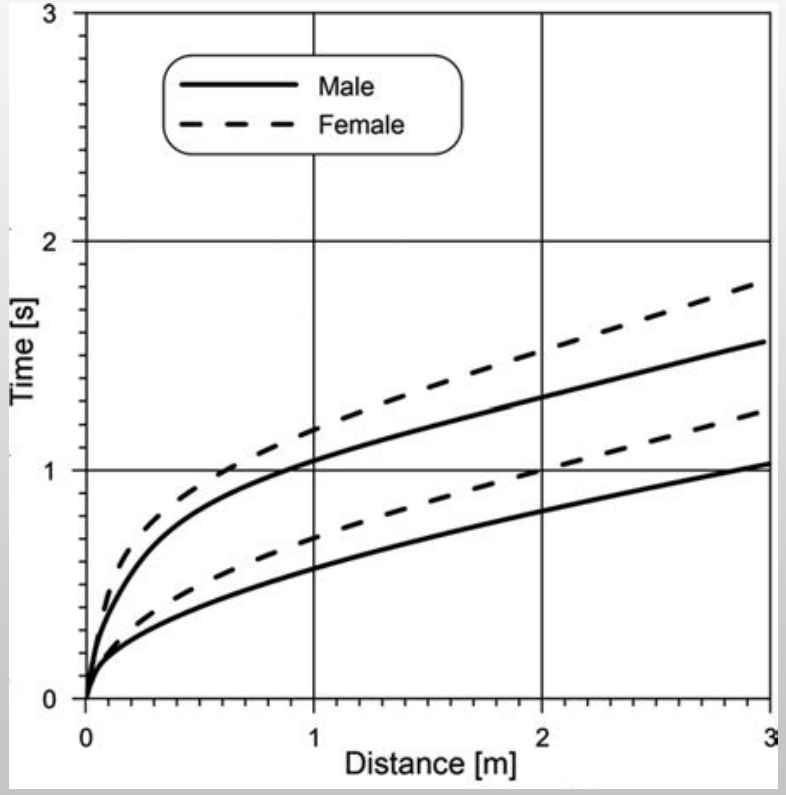
How do we apply this to development?

Pedestrian Acceleration

Problems of Forensic Sciences 2012, vol. 91
Jakub Zębala, Piotr Ciępka, Adam Reza
Institute of Forensic Research, Kraków, Poland

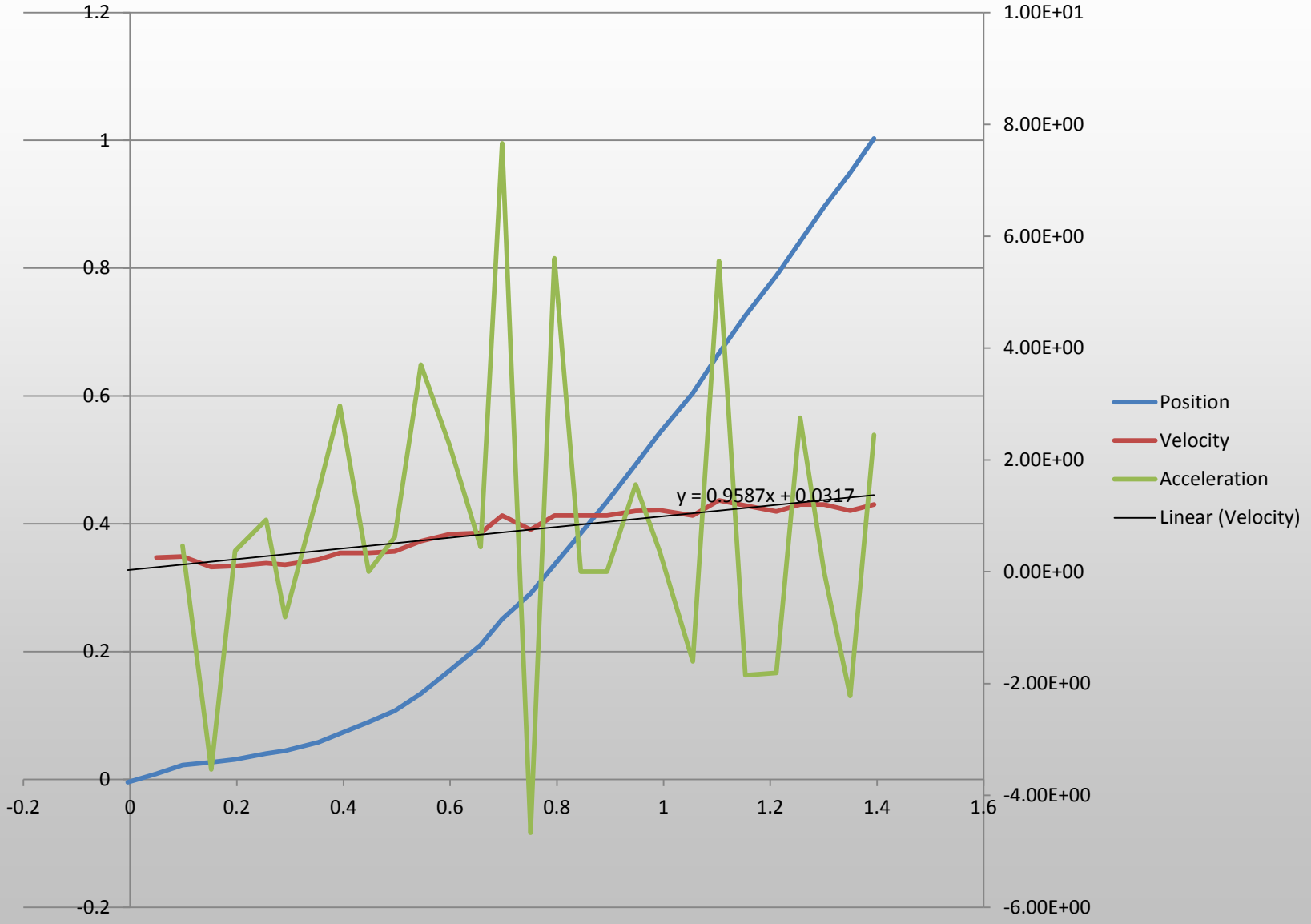


Walking

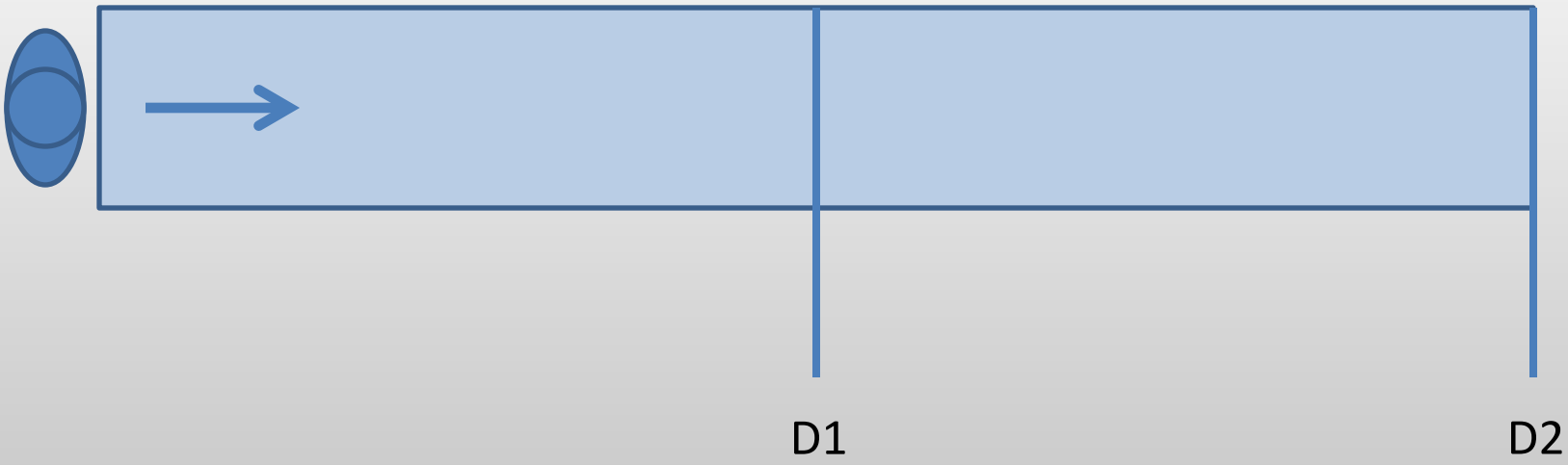


Sprinting

Acceleration to Ordinary Walking, Lower Bound



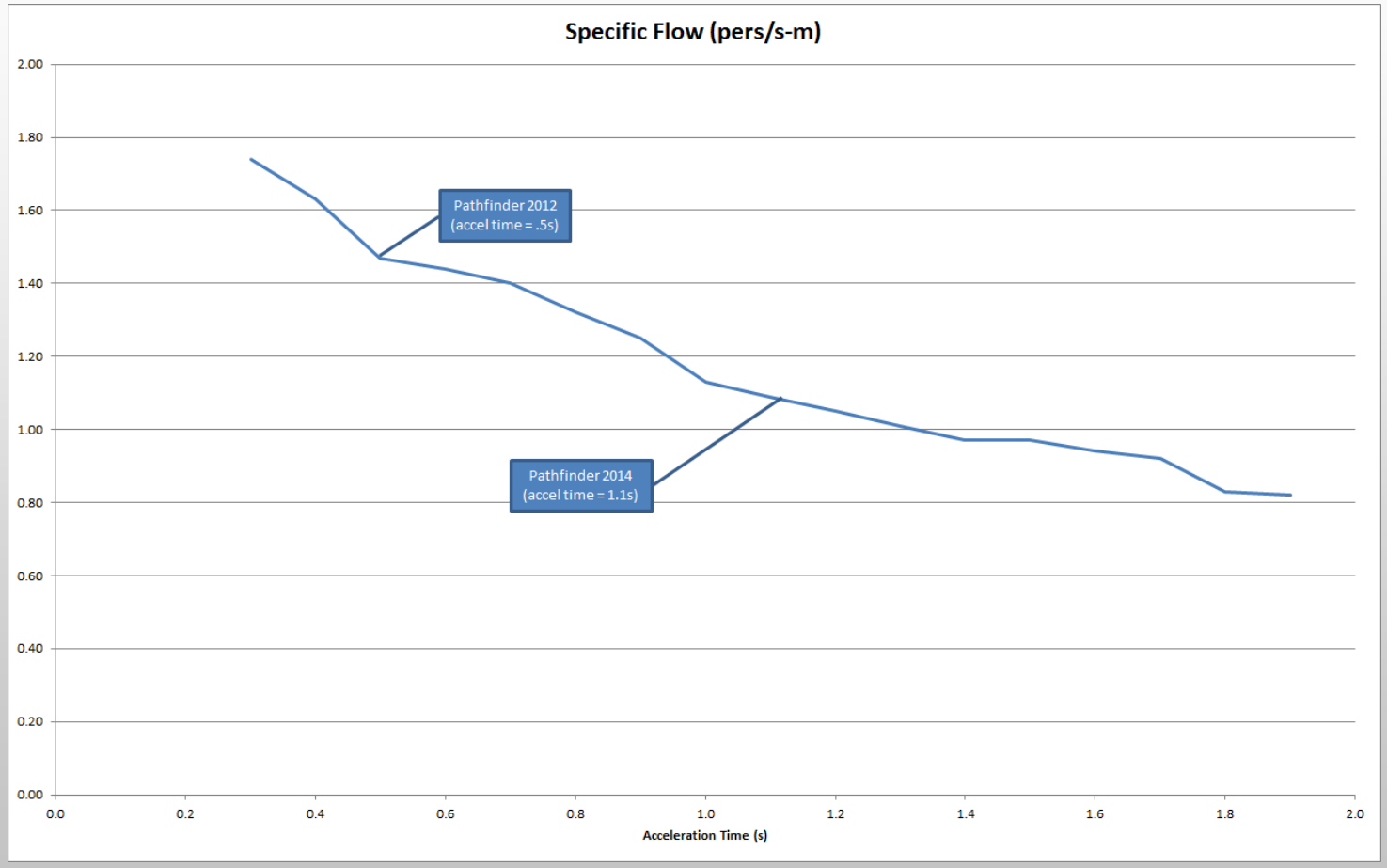
Hallway Experiment



Hallway Results

	D1	D2	t	v	a	a/v	t_accel
Richard1	4.24	3.55	7.79	1.3	0.9	0.7	1.4
Richard2	4.25	3.63	7.88	1.3	1.0	0.8	1.2
Richard3	4.4	3.9	8.3	1.2	1.2	1.0	1.0
Jon1	3.81	3.61	7.42	1.3	3.2	2.5	0.4
Jon2	4.11	3.55	7.66	1.3	1.1	0.9	1.1
Brian1	3.45	3.35	6.8	1.4	6.8	5.0	0.2
Brian2	3.67	3.11	6.78	1.5	1.3	0.9	1.1
Brian3	3.23	3.13	6.36	1.5	7.3	5.0	0.2
Charlie1	4.2	3.74	7.94	1.2	1.3	1.1	0.9
Charlie2	4.38	3.81	8.19	1.2	1.1	0.9	1.1
Joe	3.97	3.7	7.67	1.2	2.3	1.9	0.5
Dan1	3.83	3.25	7.08	1.4	1.2	0.9	1.2
Dan2	3.82	3.07	6.89	1.5	1.0	0.7	1.5
Average					**2.3**	**1.7**	**0.9**

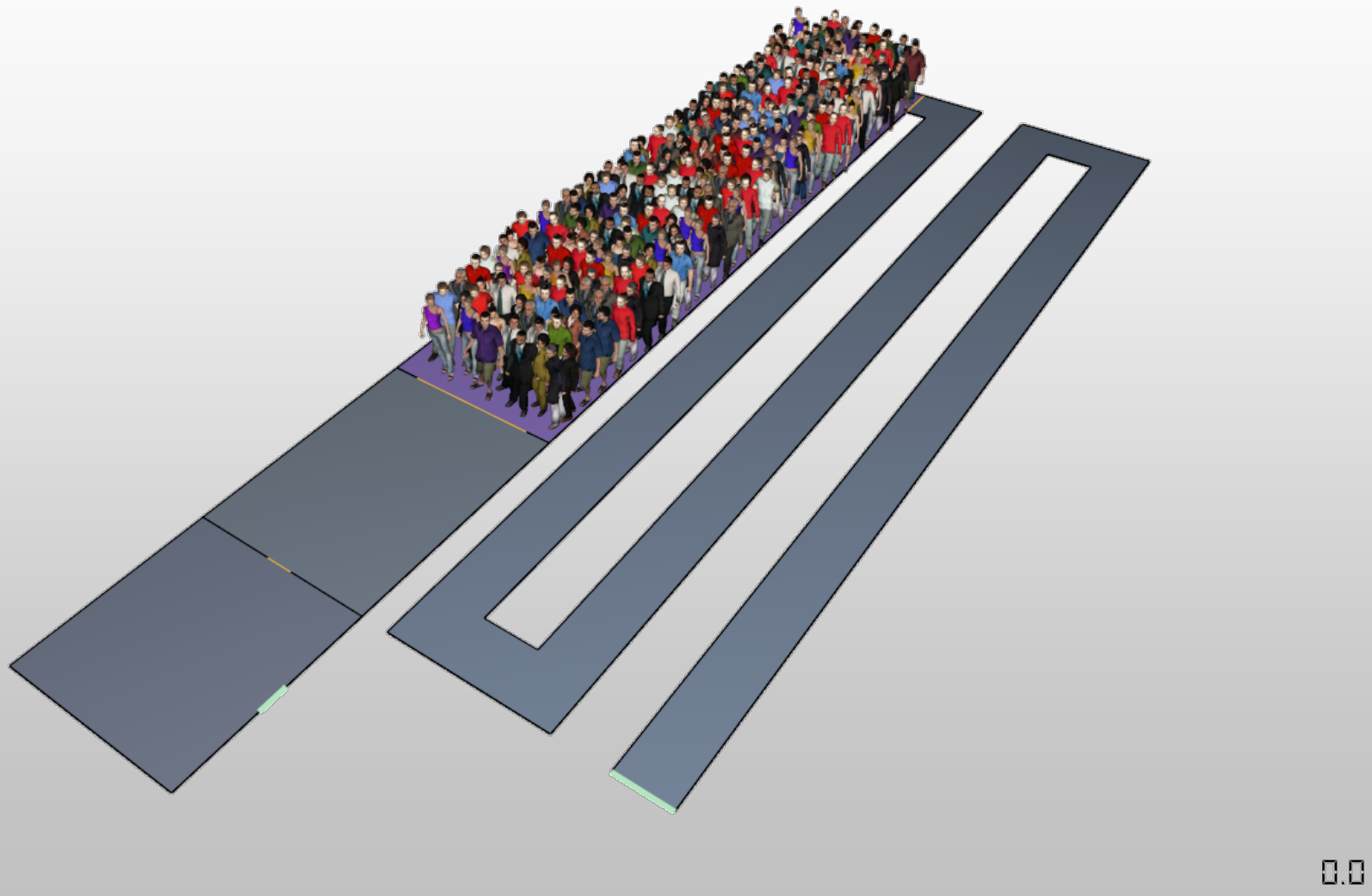
Flow vs. Acceleration

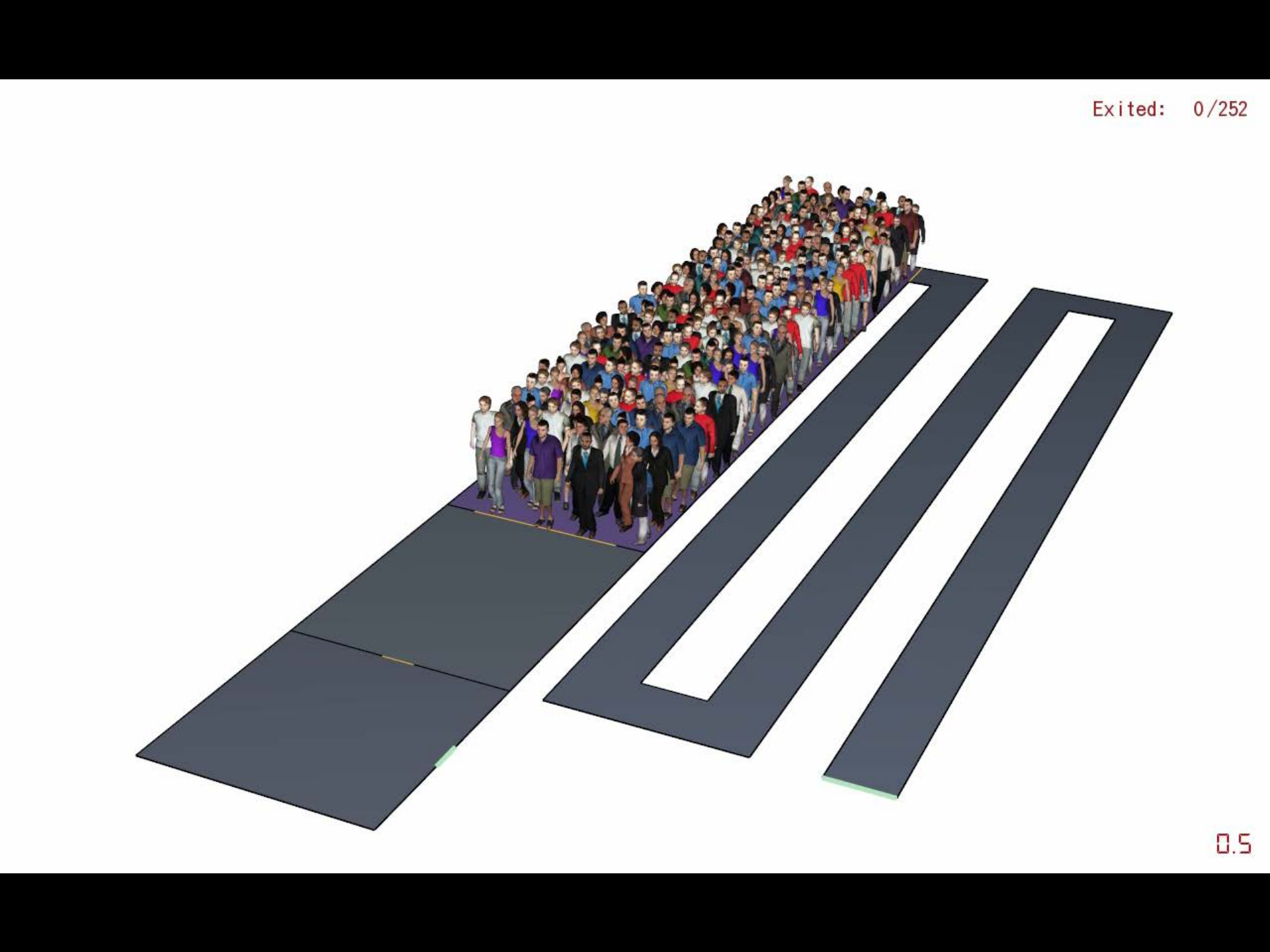


Agent Acceleration

- Changed default value
- Exposed parameter for user input
- Re-run verification problems
- Update tests with new results

Improving Locally-Quickest Door Choice

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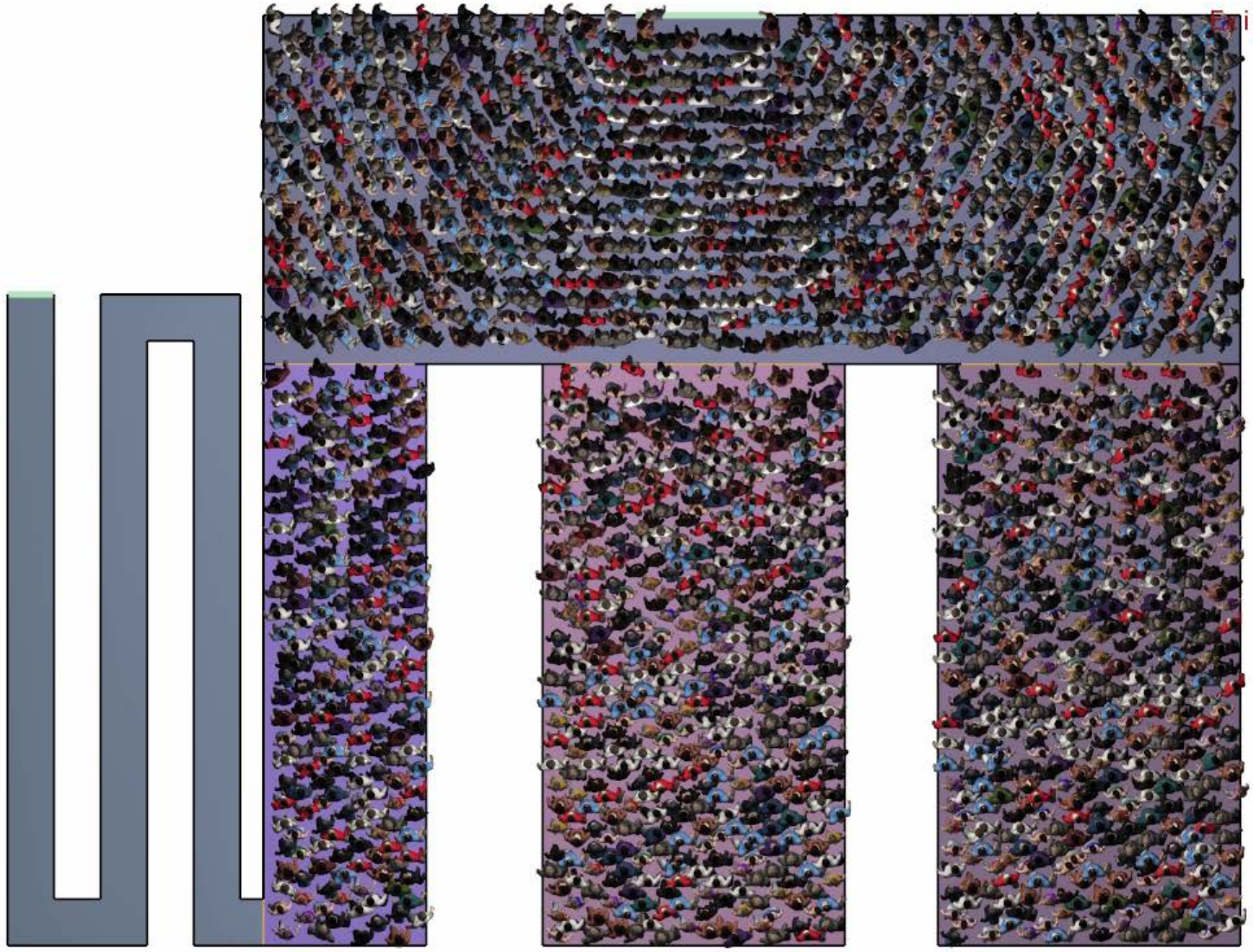
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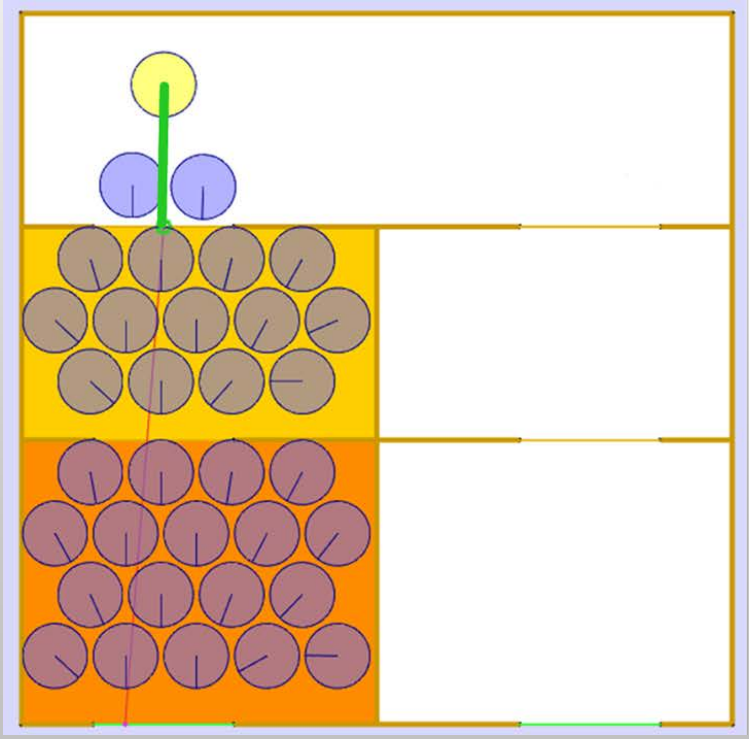
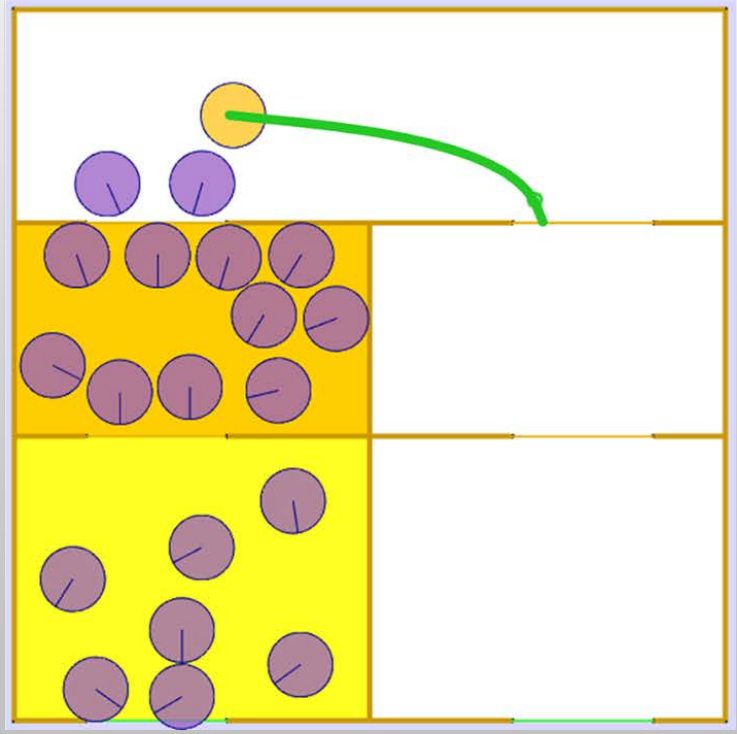
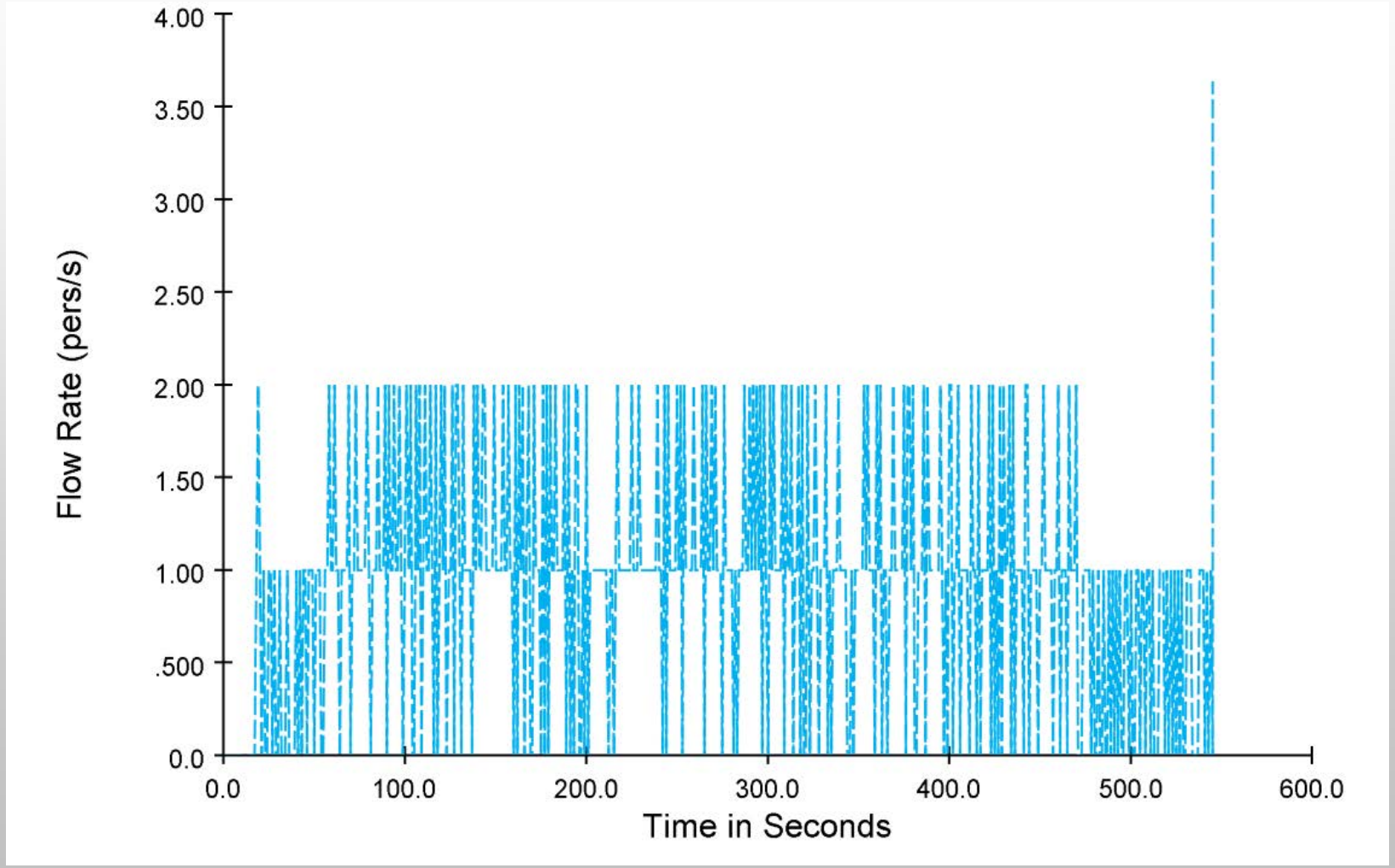
Proposed Solution

- Use actual door flowrates to estimate queue wait times

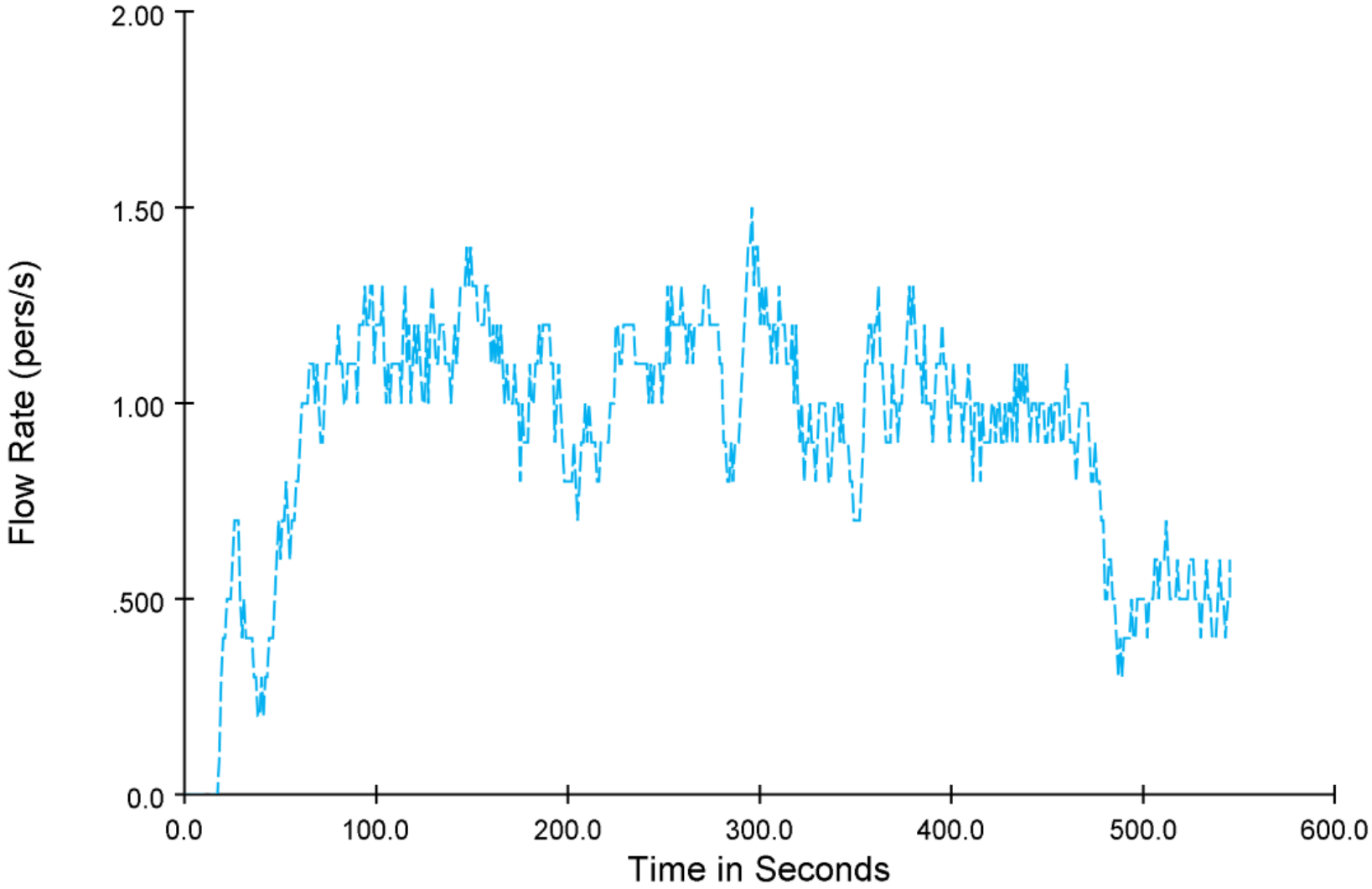




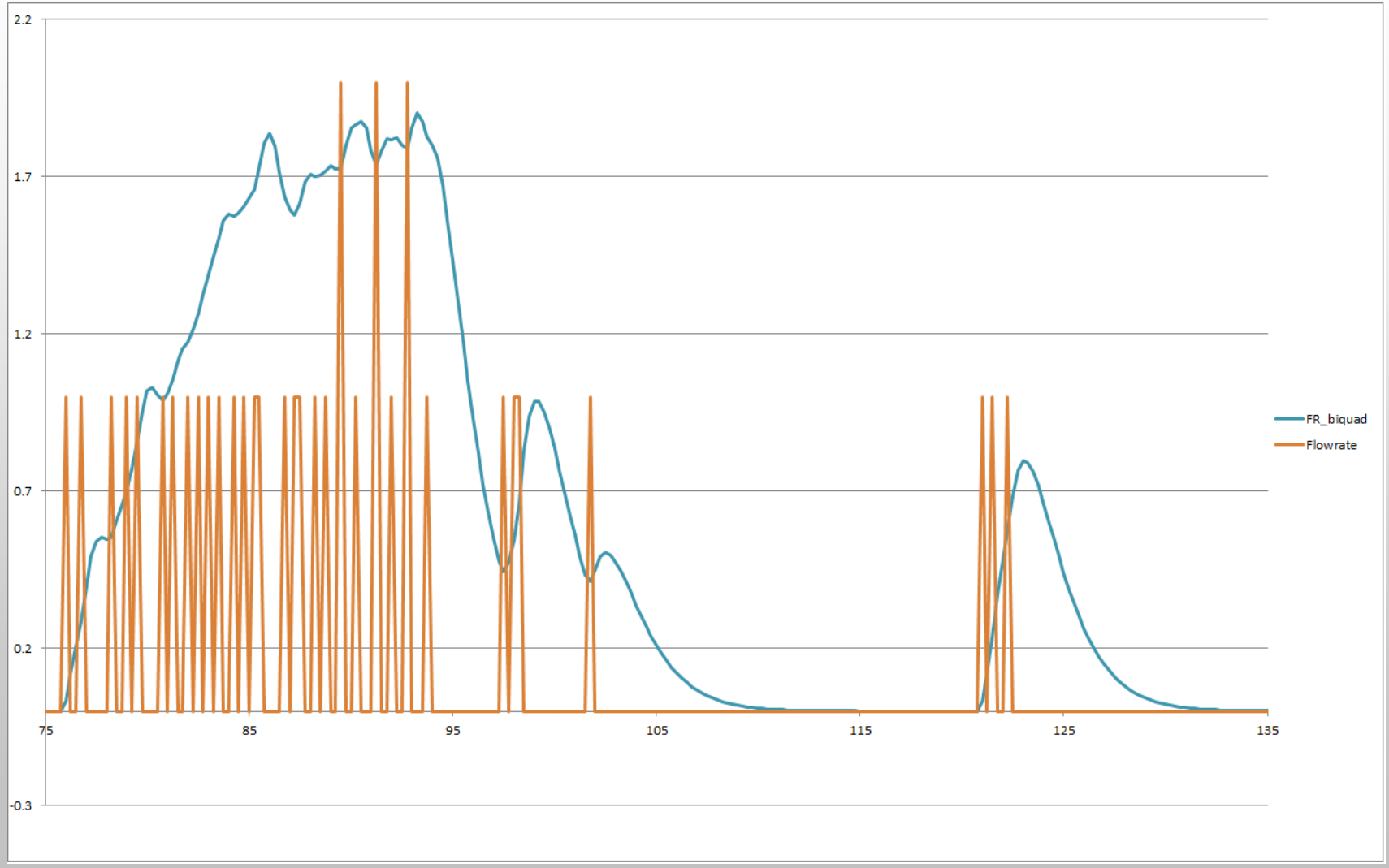
Measuring Flowrate



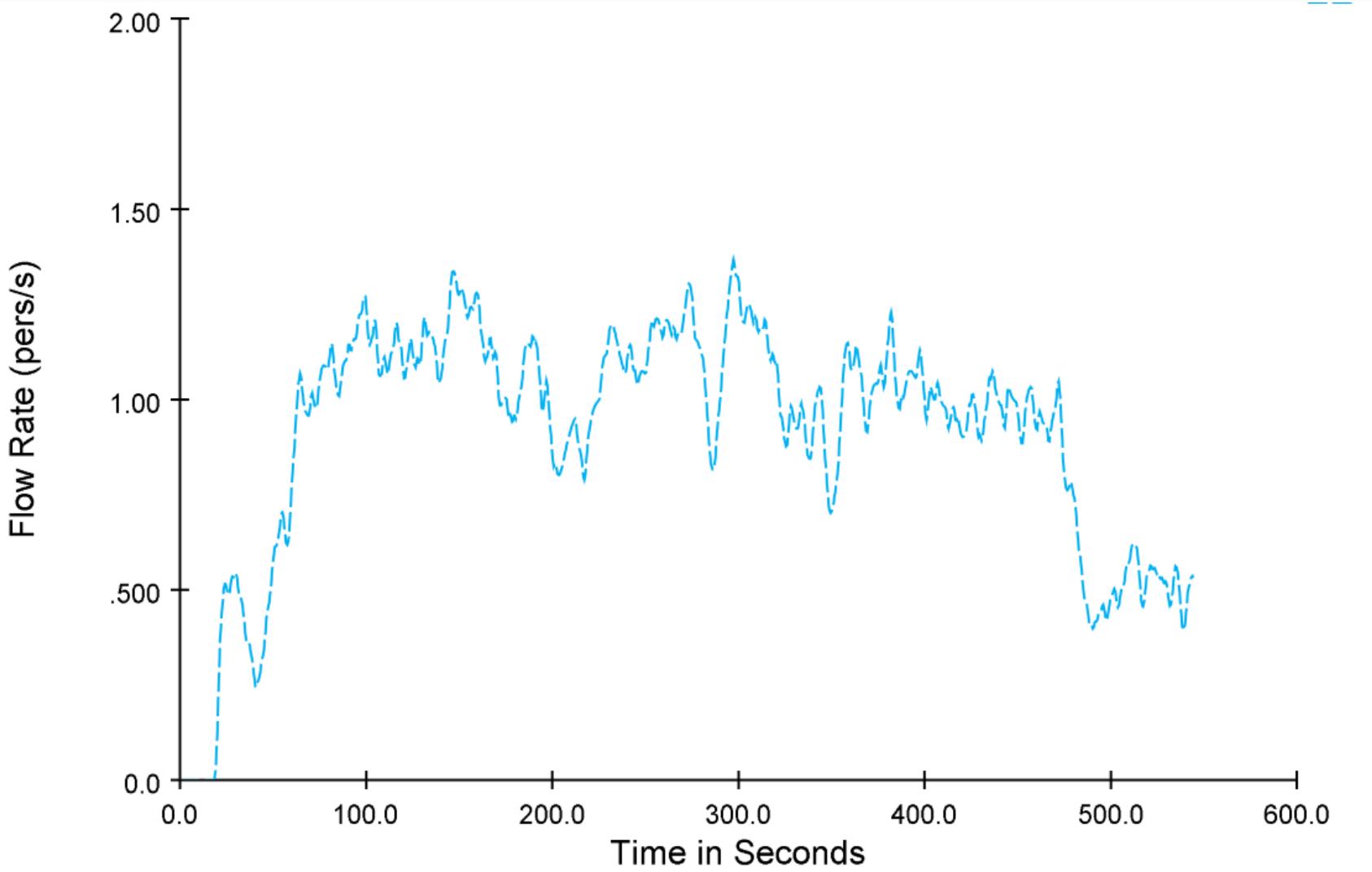
Moving Average



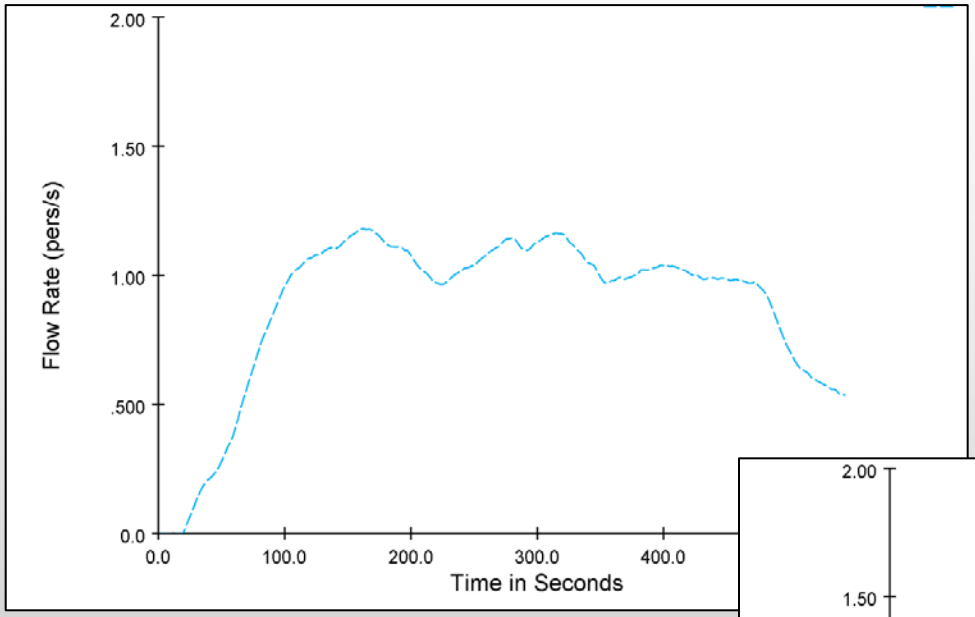
Low-Pass Filter

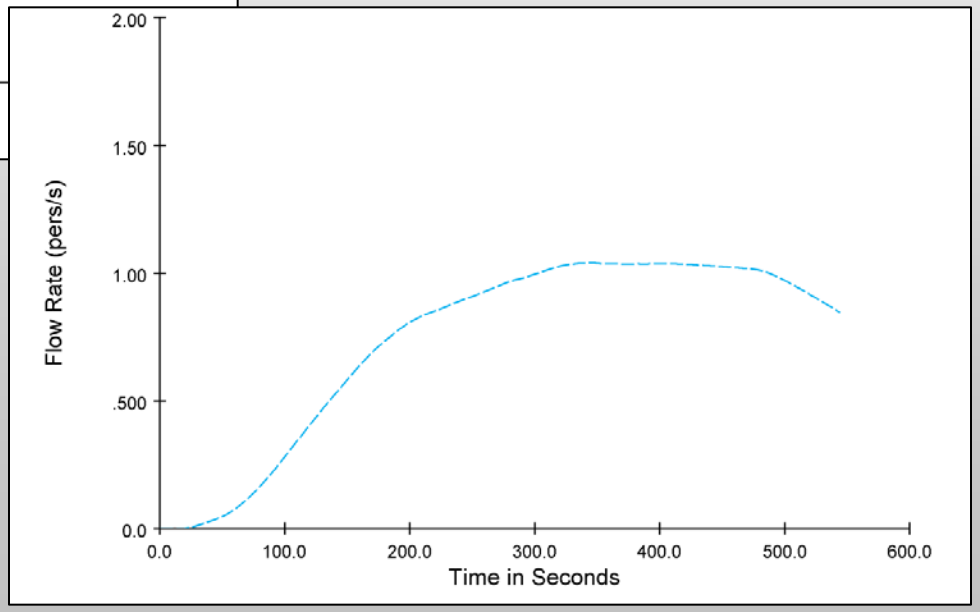


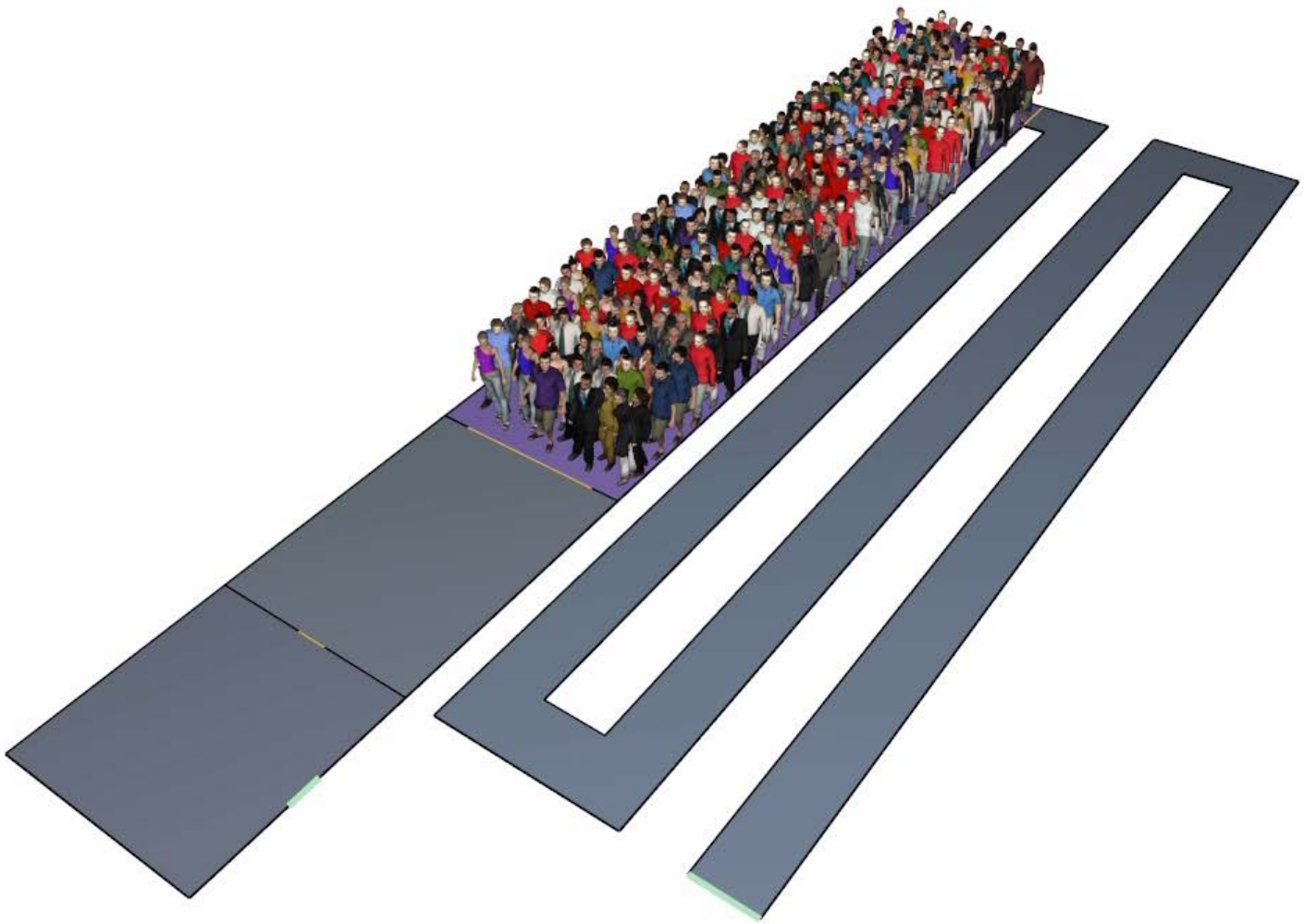
Low-Pass Filter



Low-Pass Filter



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Exited: 0/1879
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Door Choice Improvements

- Use actual flowrate to calculate local queue time
- Optimal flow used if no queue formed
- Re-run verification problems
- Update tests with new results

Thank You

Questions?