**1 Dimensional Force model**

Questions

Whether or not different distributions of parameters in force model affect bottleneck’s occurrence? If yes, why does the bottle neck occur?

Simulation

Simulate two pedestrians x and y moving from opposite directions on 1-dimension based on two following social force models; only consider pedestrians x and y are flat without radius. Its simplification aims to find out the fundamental reason why pedestrians stop.

First model

Update position by Euler method:

x(

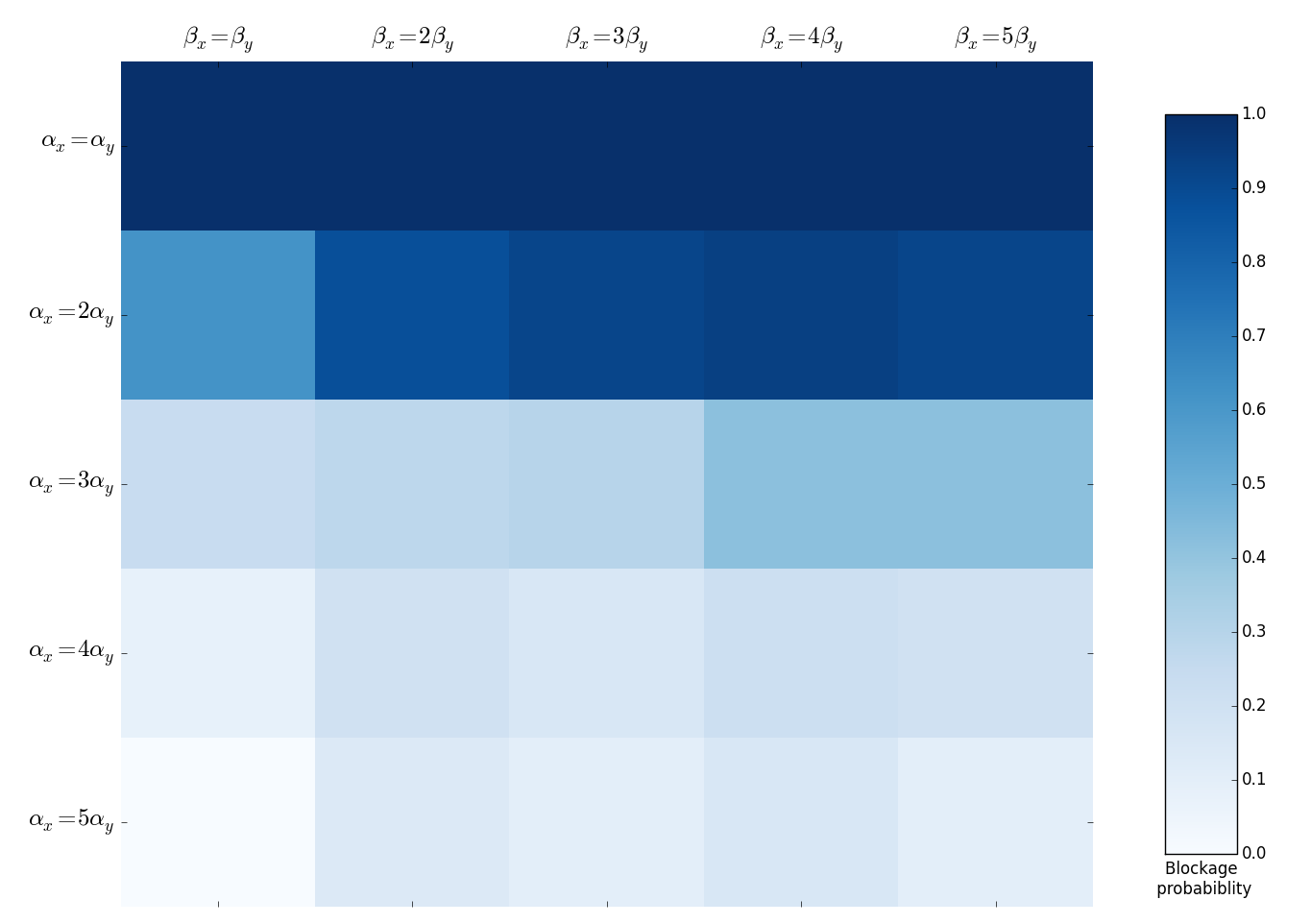
For each above model, answer the following question

“DO THEY STOP (NEVER, FREQUENTLY, RARERLY, OR ALWAYS)?” by

Bottleneck frequency over 50 simulation times, simulation duration = 50 (each run random placement) ( ( (value of elder people)

In first model

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
|  | 100% | 100% | 100% | 100% | 100% |
|  | 62% | 88% | 92% | 94% | 92% |
|  | 24% | 28% | 30% | 42% | 42% |
|  | 8% | 20% | 16% | 22% | 20% |
|  | 0% | 14% | 10% | 16% | 10% |



Why does the bottleneck happen?

In this model, bottleneck occurs when delta position is insignificant, it’s mean **integer of**

From (1), we found that, pedestrian y stops when

at time *t* is stop condition of pedestrian x

This condition can be pre-known because x is pre-known. When increase, constrain value of ( is wider if is small. Thus, people are easier to be stopped.

Looking at the diagonal, the more difference between two pedestrians, the fewer bottlenecks occur.

When B increase, more chances to get bottle neck because the increase rate of is higher than the increasing rate of

When increases, not easy to be stopped. Smaller we have, the fewer chances to have bottleneck.

Desire\_velocity is constant, people couldn’t move backward.

Second model

Update position by Euler method:

V(

Because we don’t allow people move backward, we set this rule

Experiment at ( ( and

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
|  | 4% | 0% | 10% | 4% | 0% |
|  | 0% | 0% | 0% | 6% | 0% |
|  | 0% | 0% | 0% | 0% | 0% |
|  | 0% | 0% | 0% | 0% | 0% |
|  | 0% | 0% | 0% | 0% | 0% |

Experiment at , and

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
|  | 6% | 0% | 4% | 6% | 0% |
|  | 0% | 0% | 0% | 0% | 0% |
|  | 0% | 0% | 0% | 0% | 0% |
|  | 0% | 0% | 0% | 0% | 0% |
|  | 0% | 0% | 0% | 0% | 0% |

Why does the bottleneck happen?

In this model, a person stops when

(3)

(4)

Comeback, the two prototype, it’s is easier to be bottleneck because the ratio of , it’s means in average prototype, std is wide, people can have higher desired velocity but lower interaction strength.

Bottle neck when two pedestrians satisfy