

**Dwell Time Estimation
by Passenger Flow Simulation
on a Station Platform
based on a Multi-Agent Model**

**T. Kamizuru, T. Noguchi, N. Tomii
Chiba Institute of Technology**

Outline

- 1. Background**
- 2. Aim**
- 3. Multi-agent simulator**
- 4. Application**
- 5. Conclusion**

Background

- Many passengers use High Speed Rail (Shinkansen)
 - A lot of passengers get on and off
 - Platforms are very congested



Background

- Many passengers use High Speed Rail (Shinkansen)
 - A lot of passengers get on and off
 - Platforms are very congested
 - Dwell times exceed the planned time -> Delay !
 - Note: Dwell times = 1min. – 2 min.

Background

- **Many passengers use High Speed Rail (Shinkansen)**
 - A lot of passengers get on and off
 - Platforms are very congested
 - Dwell times exceed the planned time -> Delay!
 - Note: Dwell times = 1min. – 2 min.
 - **Platform screen gate**

Background

- Many passengers use High Speed Rail (Shinkansen)
 - A lot of passengers get on and off
 - Platforms are very congested
 - Dwell times exceed the planned time -> Delay!
 - Note: Dwell times = 1min. – 2 min.
 - Platform screen gate



Outline

1. Background
2. Aim
3. Multi-agent simulator
4. Application
5. Conclusion

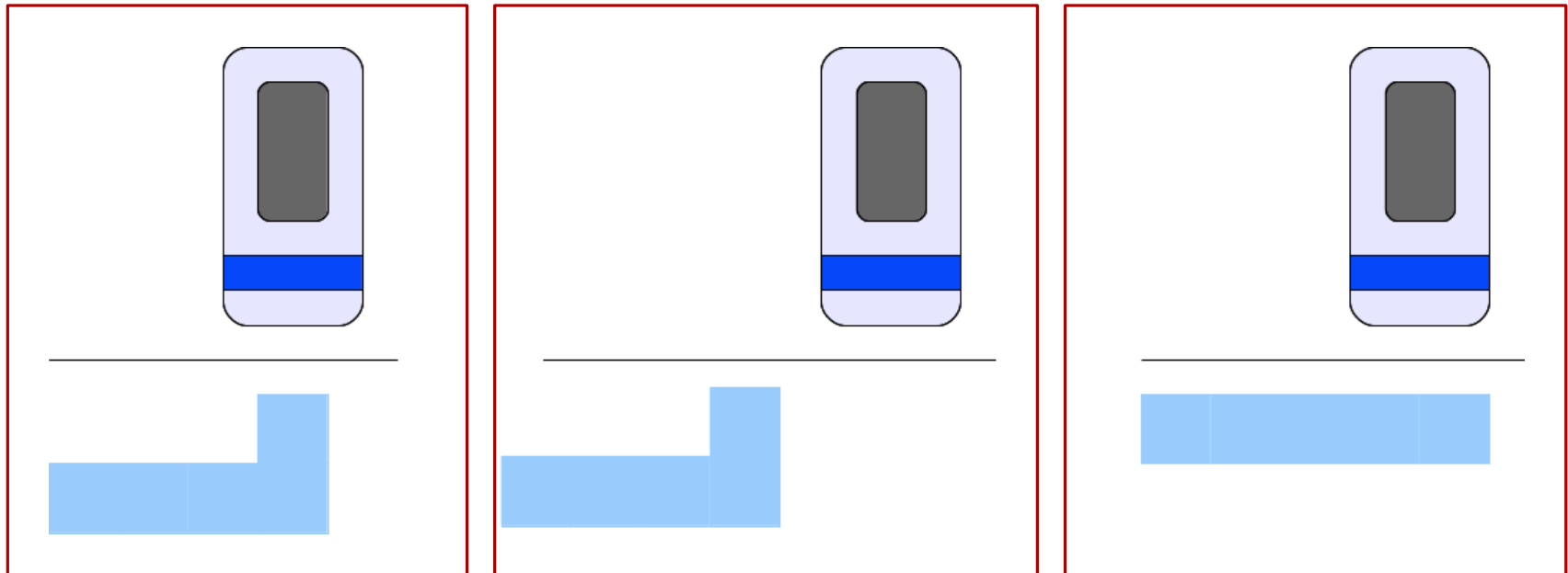
Aim

- We want to make dwell times of Shinkansen as short as possible
 - Shape of waiting queues (alignment area)



Aim

- We want to make dwell times of Shinkansen as short as possible
 - Shape of waiting queues (alignment area)

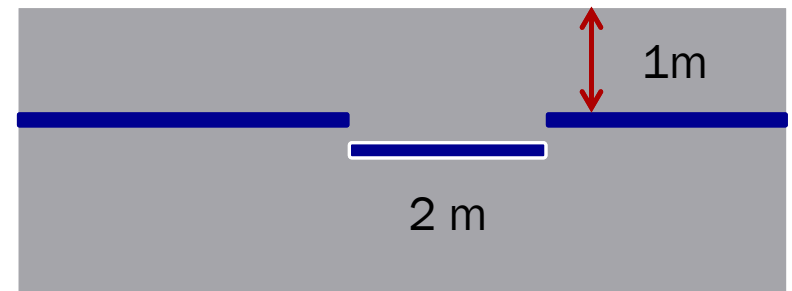
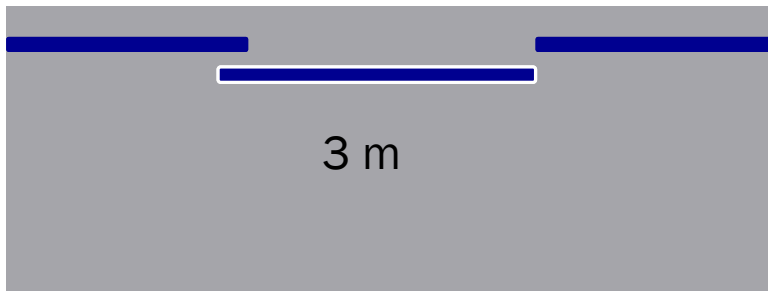


Aim

- We want to make dwell times of Shinkansen as short as possible
 - Shape of waiting queues (alignment area)
 - Influence of platform screen gates
 - Positions of platform screen gates

Aim

- We want to make dwell times of Shinkansen as short as possible
 - Shape of waiting queues (alignment area)
 - Influence of platform screen gates
 - Positions of platform screen gates



Aim

- We want to foresee **quantitatively** how effective these countermeasures are to shorten dwell times
- **Multi-agent simulator**
 - Passengers who get on and who get off
 - One passenger = an agent
 - Passengers' trolley bag = an agent

Aim

- We want to foresee quantitatively how effective these countermeasures are to shorten dwell times
- Multi-agent simulator
 - Passengers who get on and who get off
 - One passenger = an agent
 - Passengers' trolley bag = an agent
 - obstacle to other passengers

Aim

- We want to foresee quantitatively how effective these countermeasures are to shorten dwell times
- Multi-agent simulator
 - Passengers who go
 - One passenger = a
 - Passengers' trolle
 - obstacle to other



Outline

1. Background
2. Aim
- 3. Multi-agent simulator**
- 4. Application**
- 5. Conclusion**

Model

■ Environment

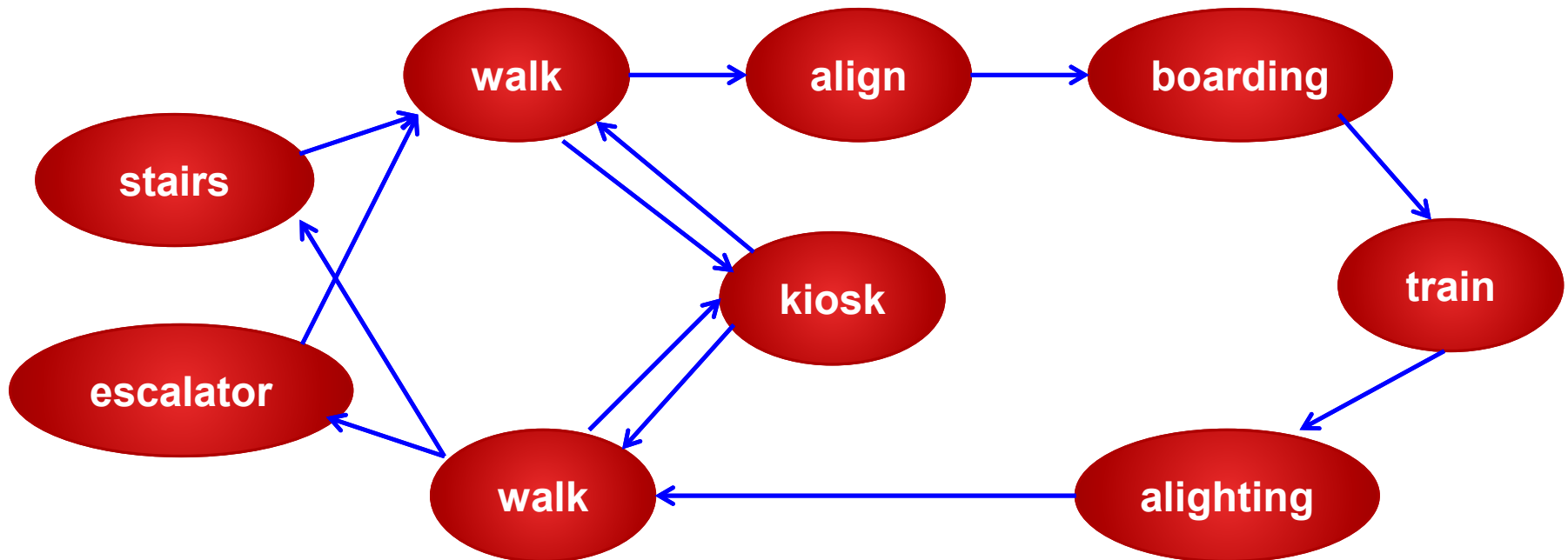
- Platform
- Train
- Pillars, Walls, Kiosk, Benches, Trash boxes

■ Agent

- Passenger
 - alight
 - board
 - wait
 - walk
- Passenger's baggage

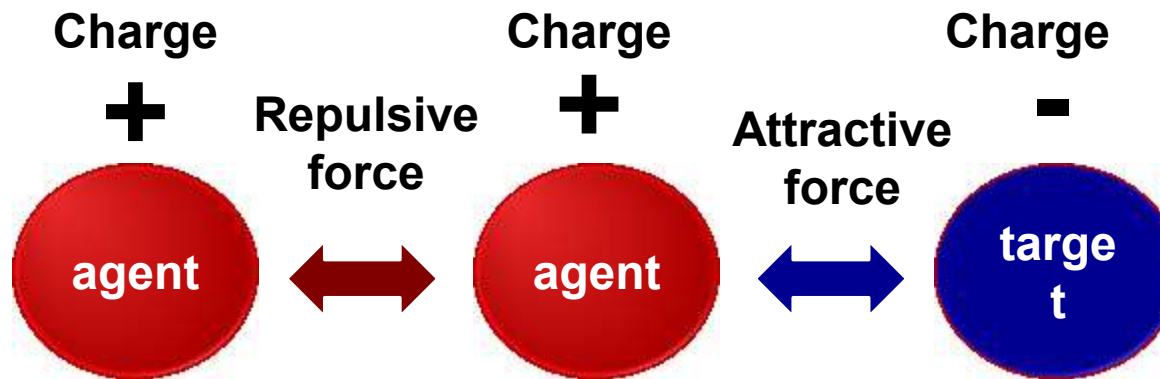
Model

■ State transition of Passenger Agent



Model

■ Potential model

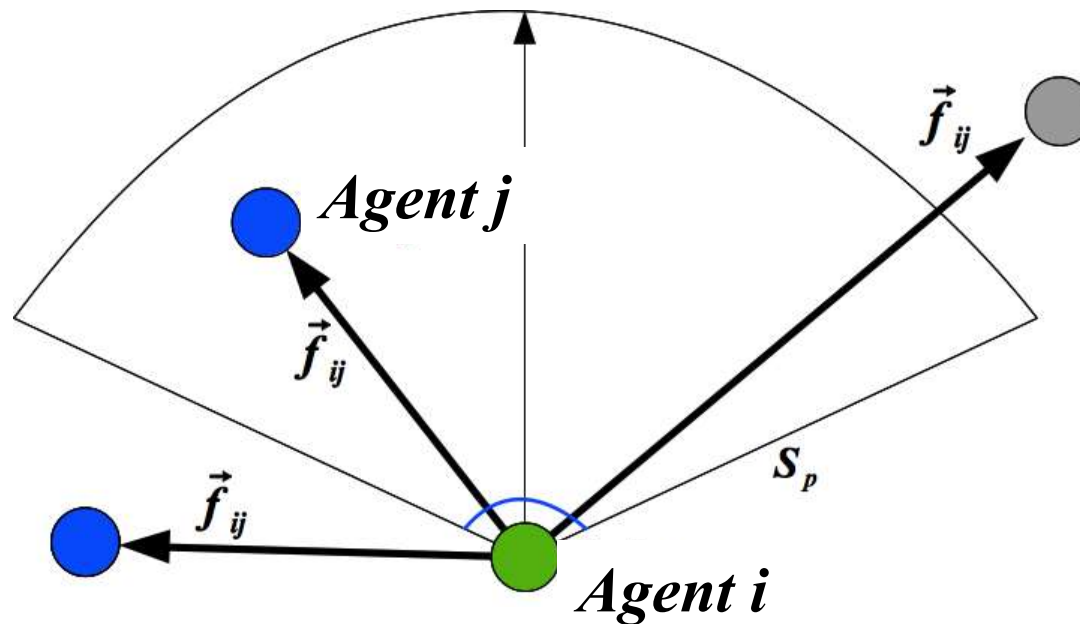


Model

- **Passenger agent walk avoiding other agents and obstacles**
 - **Calculate**
 - **Repulsive force from agents in the scope**
 - **Repulsive force from obstacles in the scope**
 - **Attractive force from the target**

Model

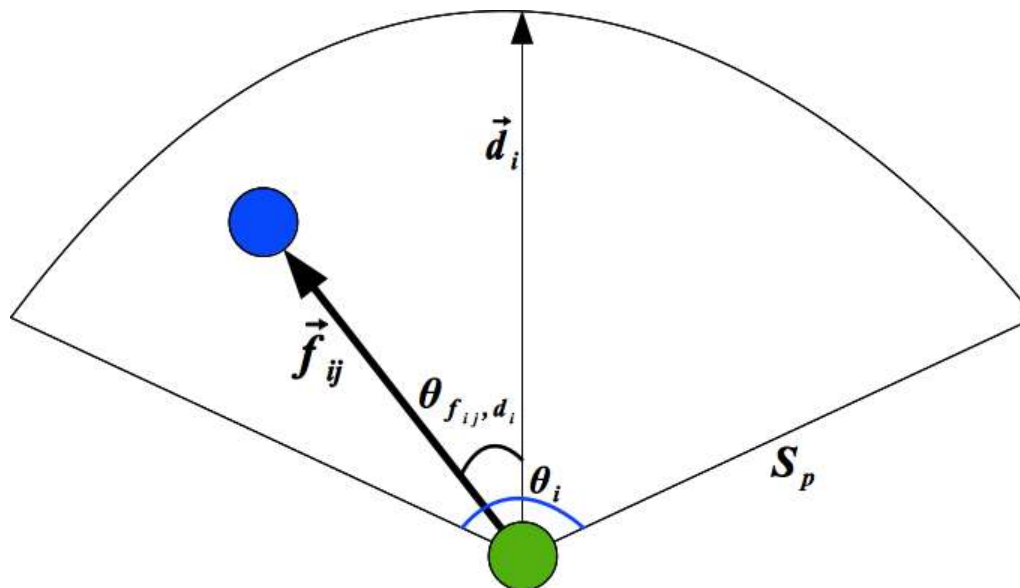
■ Scope of an agent and obstacles



Model

■ Repulsive force from an agent

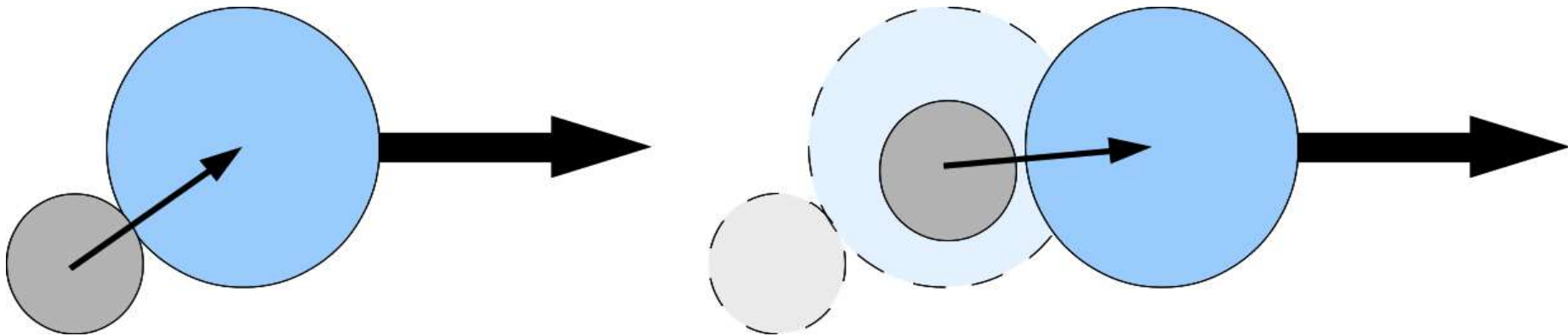
$$\vec{F}_i = \sum_j^n \left(\frac{Q_j}{\|\vec{f}_{ij}\|^2} \cdot \frac{\vec{f}_{ij}}{\|\vec{f}_{ij}\|} \cdot \cos \theta_{\vec{d}_i \vec{d}_j} \right)$$



Model

■ Baggage agent

- follows its owner (passenger agent)



Outline

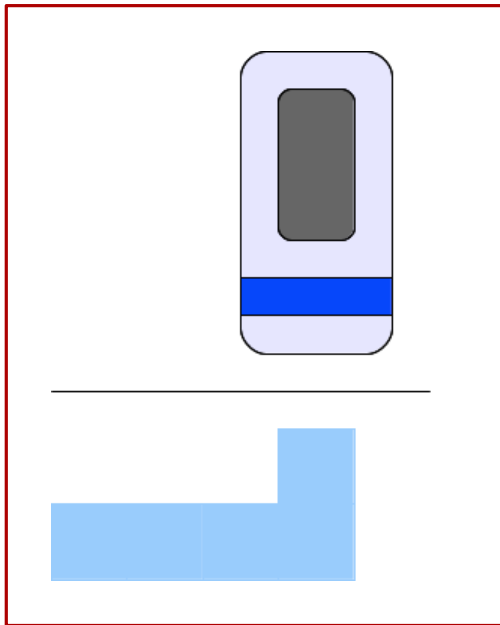
- 1. Background**
- 2. Aim**
- 3. Multi-agent simulator**
- 4. Application**
- 5. Conclusion**

Numerical Experiments

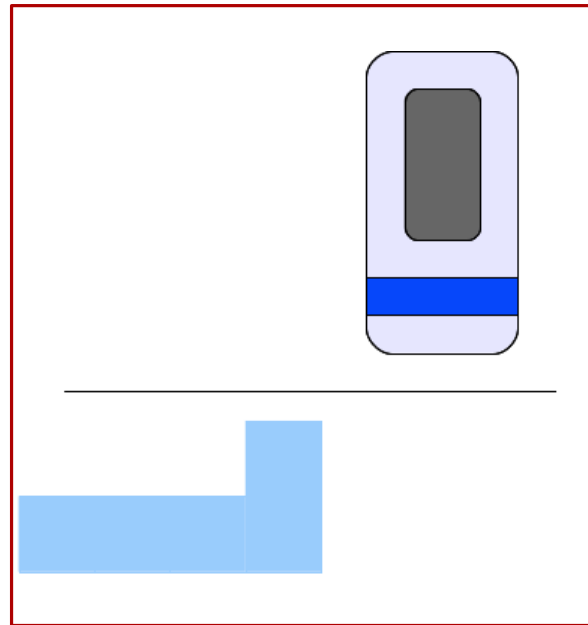
- **Intermediate station : a lot of passengers get on and off**



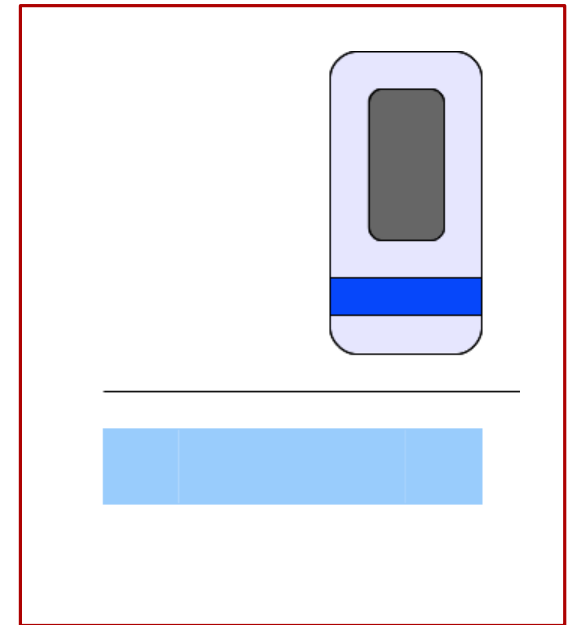
Experiment 1 – Alignment area



Alignment1
(L shaped)

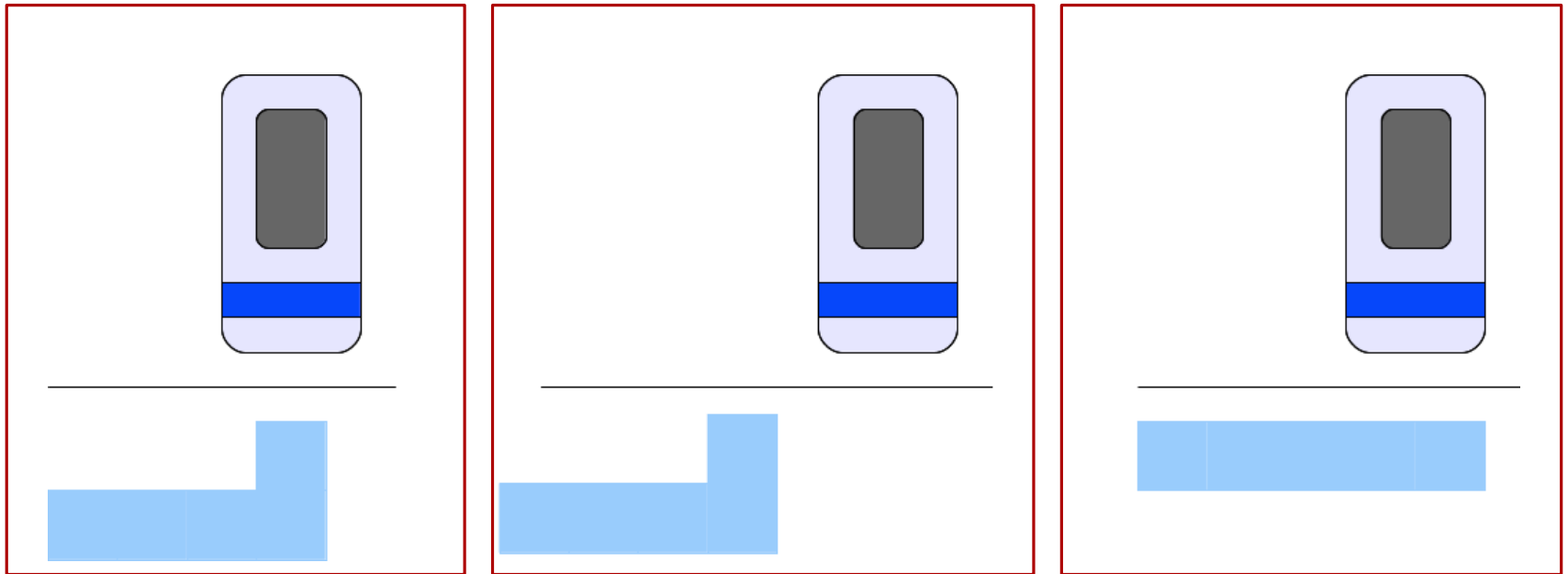


Alignment 2
(L shaped with distance)



Alingment3
(I shaped)

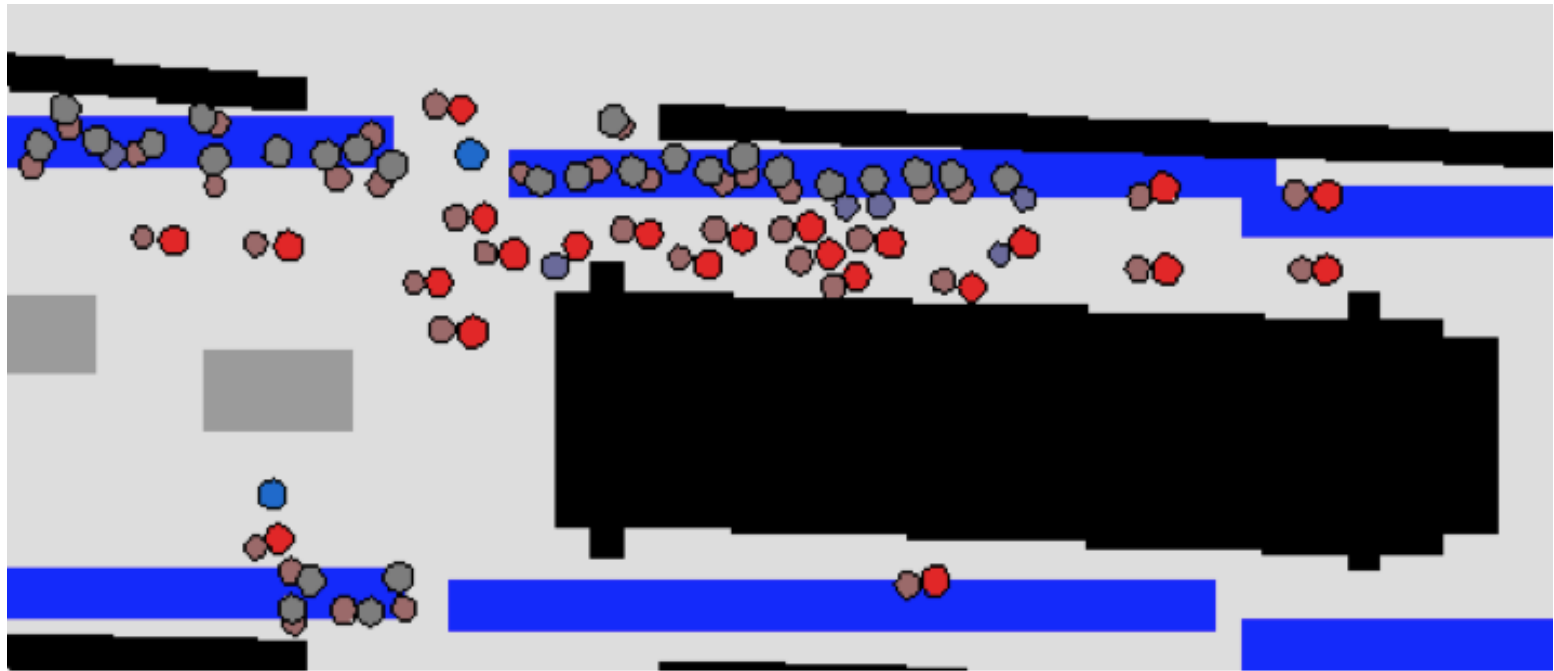
Results



	Align + Board (sec.)	Disappear (sec.)
Alignment 1	78	232
Alignment 2	74	204
Alignment 3	78	197

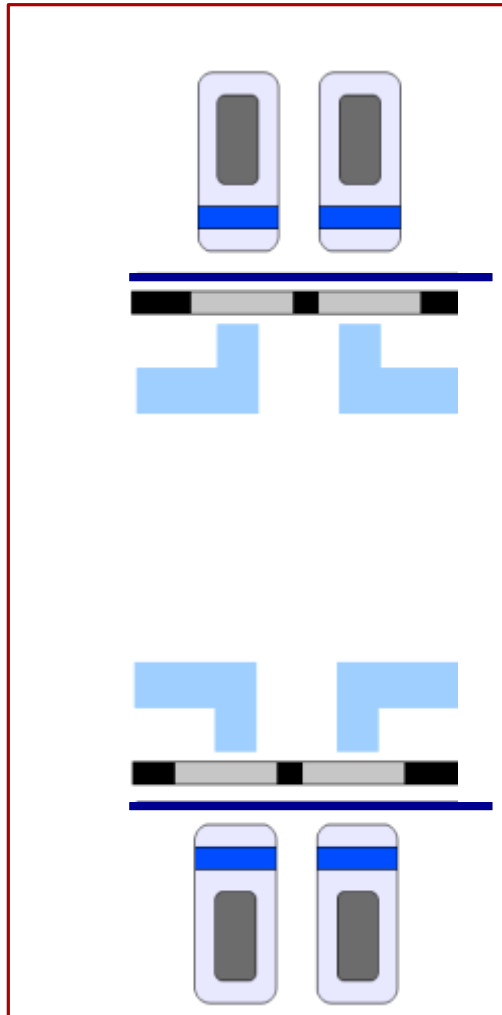
Alignment 3

- Enough space for passengers walk freely

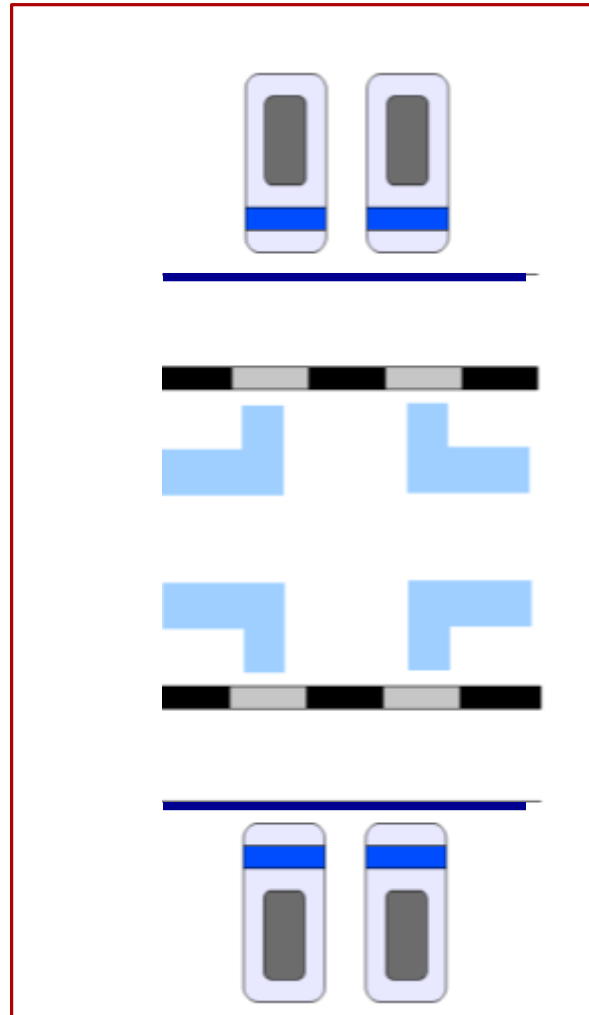


Experiment 2 – Platform screen

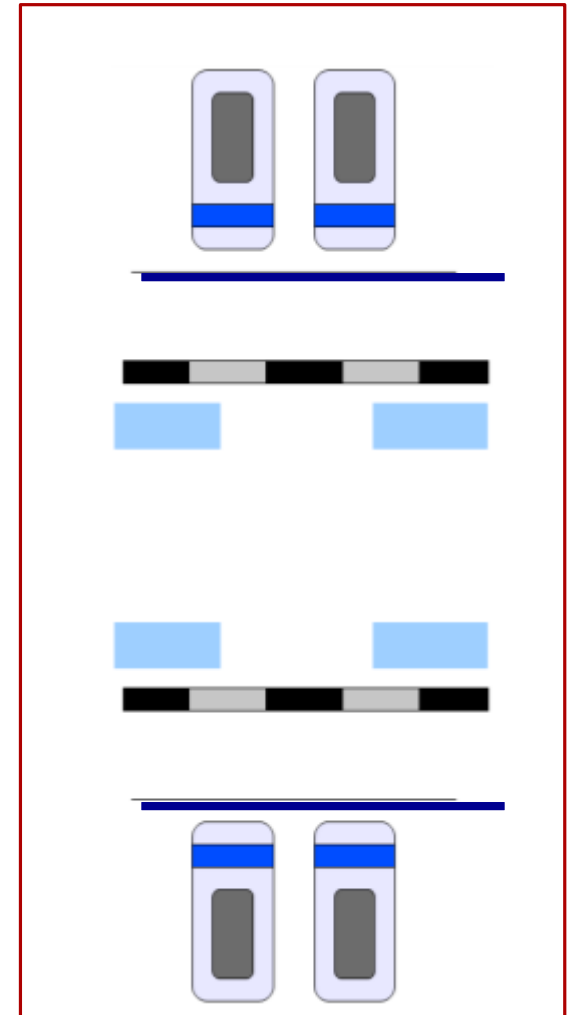
1



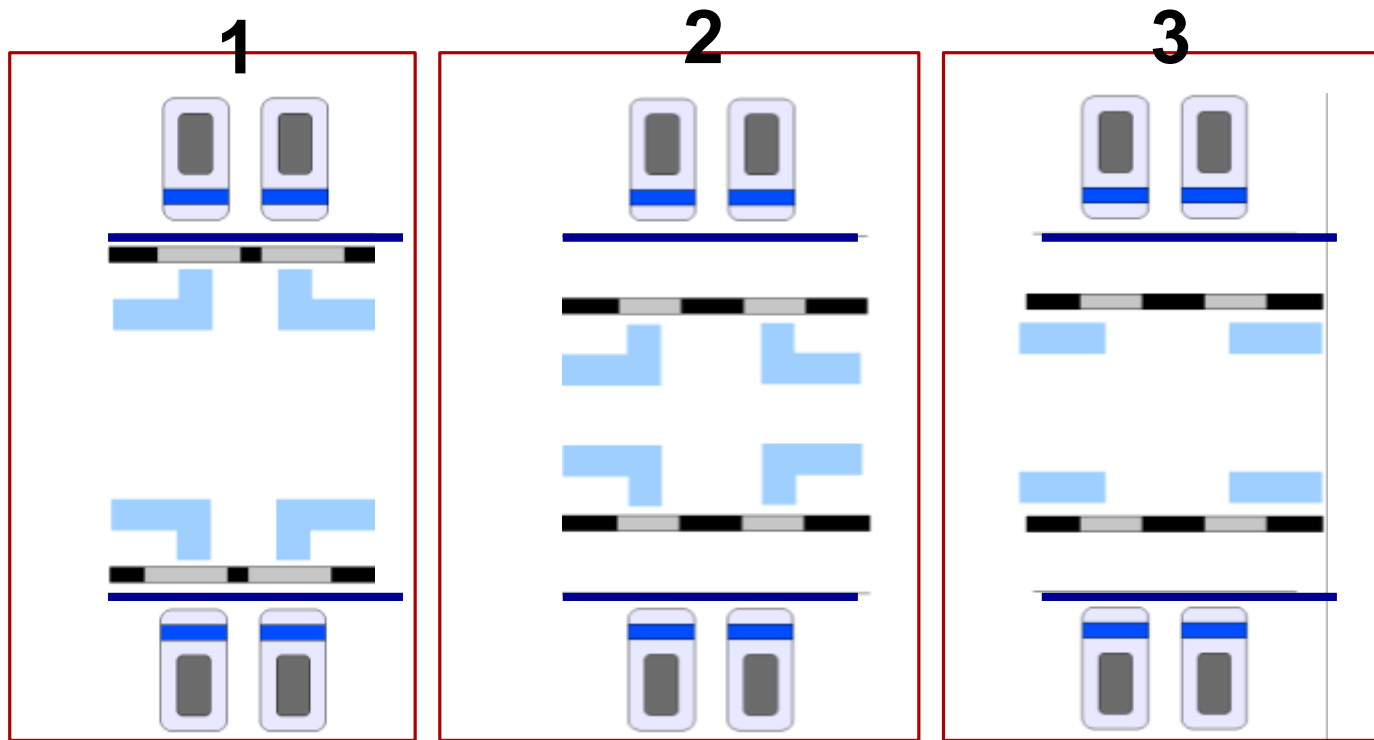
2



3



Results



	Alight + Board (sec.)	Disappear (sec.)
Pattern 1	52	77
Pattern 2	56	87
Pattern 3	57	77

Conclusions

- We have developed a passenger flow simulator on a Shinkansen platform based on multi-agent model
- Not only a passenger but its baggage is expressed as an agent
- Queues on the platform can be analyzed
- We have applied the simulator
 - Shape of alignment areas
 - Platform screen gates
 - Platform screen gates + Shape of alignment areas