Introduction and Motivations

Every day thousands of people travel from their home to their working place and the same way back in the evening. A big part of these people do this by train, including the members of our group. In traffic peak hours, train stations get crowded with people waiting for their train. Naturally, no one wants to travel a long distance without having a seat. Commuters cluster near the entrances of a train and most of them are polite and let people inside leave the train before entering. However, there are some individuals which don't want to wait and start pushing into the train before everyone has left. Their actions often result in a jam in the entrance area of the train causing the process of getting all people to where they want to take much more time as if when they waited outside of the train. Since each member of our group has to deal with such situations mostly every day, we want to investigate how the level of aggression affects the time needed to let people leave and enter a train until it is ready to continue cruise. We try to simulate a rush hour situation for both the entrance area of an ICN and an IC with different levels of aggression. The higher the aggression of an individual, the higher the chance it tries to enter the train too soon. Also the aggression influences on how often a person tries to take over another person. All these parameters are united in the social force model, which we will use in our simulation.

Fundamental Questions

Is the social force model suitable for situations described in the introduction or should we apply changes to make it more reliable? Example: Do people wait in corners before attempting a second push into the seat direction? Does the model fail in very small rooms like an entrance area of a train? Can the model in our case result in a social deadlock, where no person can make any further move and the situation is stuck?

Can we design areas that pushy persons can use to evade deadlocks?

Expected Results

By experience we can tell that pushy persons increase the amount of time depending on how many people try to push at the same time. This means one pushy person alone won't make that much of a difference in an Intercity entrance area whereas five pushy persons in the same entrance area can cause a big jam. In Intercity tilting trains the situation is even worse since there is not as much space available for evasion maneuvers as in a normal two-floored Intercity train. We expect our model to reflect these experiences.

Also we expect situations without pushy persons or with a strategy to resolve faster then situations with pushy and aggressive persons.

Research Methods

We base our work on the “Airplane Evacuation Simulation” by Philipp Heer and Lukas Bühler.

Like them, we will use continuous modeling by implementing the social force model with a defined time step **dt**. A situation is resolved when every involved passenger reached its target area. As long as the situation is not resolved, the time step is increased and used to compare different situations.

Description of the model

Our goal was to implement an easy model of the entrance area of a train in which the jamming situations could be simulated. Reworked plans of entrance areas can be imported into Matlab. These plans can be used to generate the simulation environment. Different elements on a map are identified by colors. Unlike in the airplane evacuation situations, we do not have the same target areas for every person on the map. Target and starting areas can overlap. To solve this problem, extra layers can be imported into Matlab. Each layer represents one group of passengers with their start and target areas marked on the layer. Given this file structure, we get our main map with walls and special areas and an arbitrary number of group layers identifying the start and end areas for each group.

Given this input, Matlab will first generate the shortest path from any point to designated exit zones for each layer. Out of these results, Matlab generates a vector field for each layer in the space of the train entrance area. Every passenger then follows the path given by these vector fields to the next exit.

The main simulation is then performed with an implementation of the social force model as described in [1].

Passengers tend to follow the shortest path to their exit. They will not, however, always be able to follow the shortest path due to several factors affecting their direction. First, people can not walk through walls. This will be implemented introducing a physical force radiant from the walls. Also, passengers can not walk through each other unless they are ghosts, which we didn't take into account in this sheet. To prevent a situation where one passenger walks through another passenger, we introduce a second force pushing people away from each other. Finally there is the social force which reflects social interactions and, in our case, the behavior of a passenger according to its aggression level.

Implementation

The simulation can be split into two parts. The first part initializes all variables and resources needed for the computation which is done in the second part. The first phase is packed into a file named “Setup.m” and is a Matlab script which can be run without any arguments passed to it. When the setup script has finished executing, the simulation is ready for the second phase which is represented in a file named “Simulation.m”. This file again is a script. It will, however, abort execution when you didn't run the setup script.