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# Supplementary Matrial

## 1. User Study

We conduct user studies in 5 different scenes to evaluate the performance of our approach. The first two scenes include the real data: *student003* and *zara01*. The rest three scenes are without real data: 100 agents walking in opposite directions on the road, 36 agents on the circle moving towards their opposing positions, 49 agents entering a narrow entrance.

We play two pre-recorded videos of agents' motion obtained from different approaches at the same time. The videos of different scenes are shuffled and placed on the left/right side of the screen. These two videos playing at the same time are called a comparison group. We invite 33 participants to complete the user studies. The participant is requested to give a score using a 7-point Likert scale referring to Heter-Sim [RXX*19], in which one means that the result presented on the left is closer to the real agent motion, 7 means that the result shown on the right is closer to the real agent motion, and 4 means no preference for either method. To present the user study results in the same score, we transfer the score for each method to a certain side when dealing with them.

For the scenes containing the real data, we set three comparison groups: the real data and our approach, the real data, and Heter-Sim, the real data and Power Law. When transferring the score, the real data is recognized as on the left side. Figure 1 and 2 show the result of the user studies in *students003* and *zara01*. Compared with Power Law [KSG14] and Heter-Sim [RXX*19], our approach get a higher score.

For the scenes without real data, we set two comparison groups for each scene: our approach and Heter-Sim, our approach, and Power Law. The results are shown in Figure 3, 4 and 5. When transferring the score, our approach is recognized as on the left side. In the scene of 100 agents walking in the opposite direction, the average score is above four, and most scores are within four and five, which indicates our method outperforms Heter-Sim and Power Law. In the scene of 36 agents on a circle moving towards their opposite positions, our approach performs better than Power Law [KSG14] and performs similarly with Heter-Sim [RXX*19]. In the scene of 49 agents entering the narrow entrance, our approach achieves better scores compared to Heter-Sim and outperforms Power Law. The user studies in these three scenes prove that our approach can generate realistic virtual agent motion following human recognition.

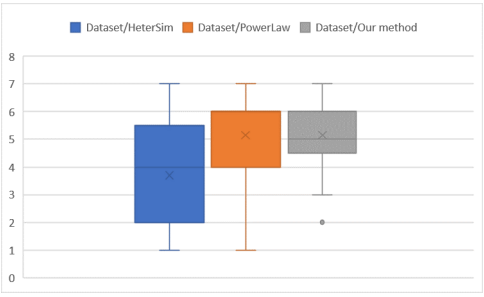


**Figure 1:** *Scores of user study on Students003*

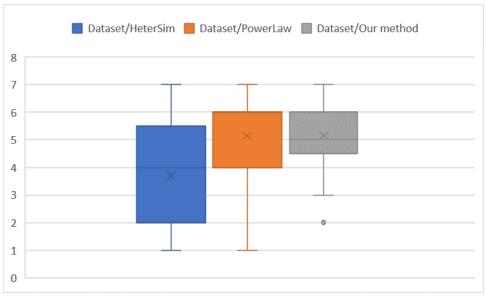


**Figure 2:** *Scores of user study on Zara01*

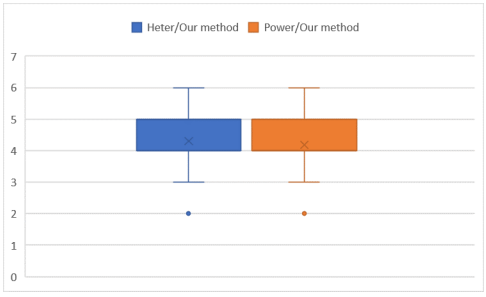


**Figure 3:** *Scores of user study in the virtual scene that 100 agents walk in the opposite direction*

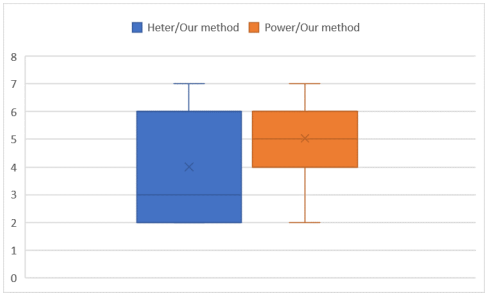


**Figure 4:** *Scores of user study in the virtual scene that 36 agents move towards their opposite positions*

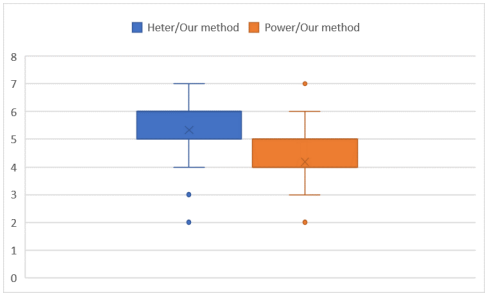


**Figure 5:** *Scores of user study in the virtual scene that 49 agents enter the narrow entrance*

## 2. Implementation

We show the flow chart of agent motion generation in Figure 6. First, we estimate the sequence of positions to predict the state features for virtual agents. Secondly, we match a suitable example for the agent based on the state features. Then we continuously use the personalized motion feature in examples and agent motion model to dynamically generate virtual agent motion at every frame. Last, we apply a deviation detection mechanism when using the example to ensure the matching example is suitable at the current time step.

Here we provide the value of all the parameters for better reproducibility. In the fusion agent motion model, we set pedestrian mass $m$ as 70 kilograms. The strength of goal driving force parameter $\zeta$ is 0.54. The strength of agents' interaction $k$ is 1. The threshold of the projected time of the potential future collision $\tau_0$ is 3 seconds. The perceived distance with other agents and obstacles of the agent is 10 meters. In the example construction process, the example duration $T$ is 4 seconds and the sampling interval is 0.4 seconds. The goal point is the position 2 seconds later. The density map is consisted of 6x6 grids and the edge of it is 8 meters. The variance of normal distribution $\sigma$ is 10000. In agent motion generation step, the weight $\mu$ of initial velocity $Sim_v$ is 0.1 and the deviation threshold of matching degree $d_l$ is 0.32.

## References

[KSG14] KARAMOUZAS I., SKINNER B., GUY S. J.: Universal power law governing pedestrian interactions. *Physical review letters 113*, 23 (2014), 238701. 1

[RXX*19] REN J., XIANG W., XIAO Y., YANG R., MANOCHA D., JIN X.: Heter-sim: Heterogeneous multi-agent systems simulation by interactive data-driven optimization. *IEEE transactions on visualization and computer graphics 27*, 3 (2019), 1953–1966. 1

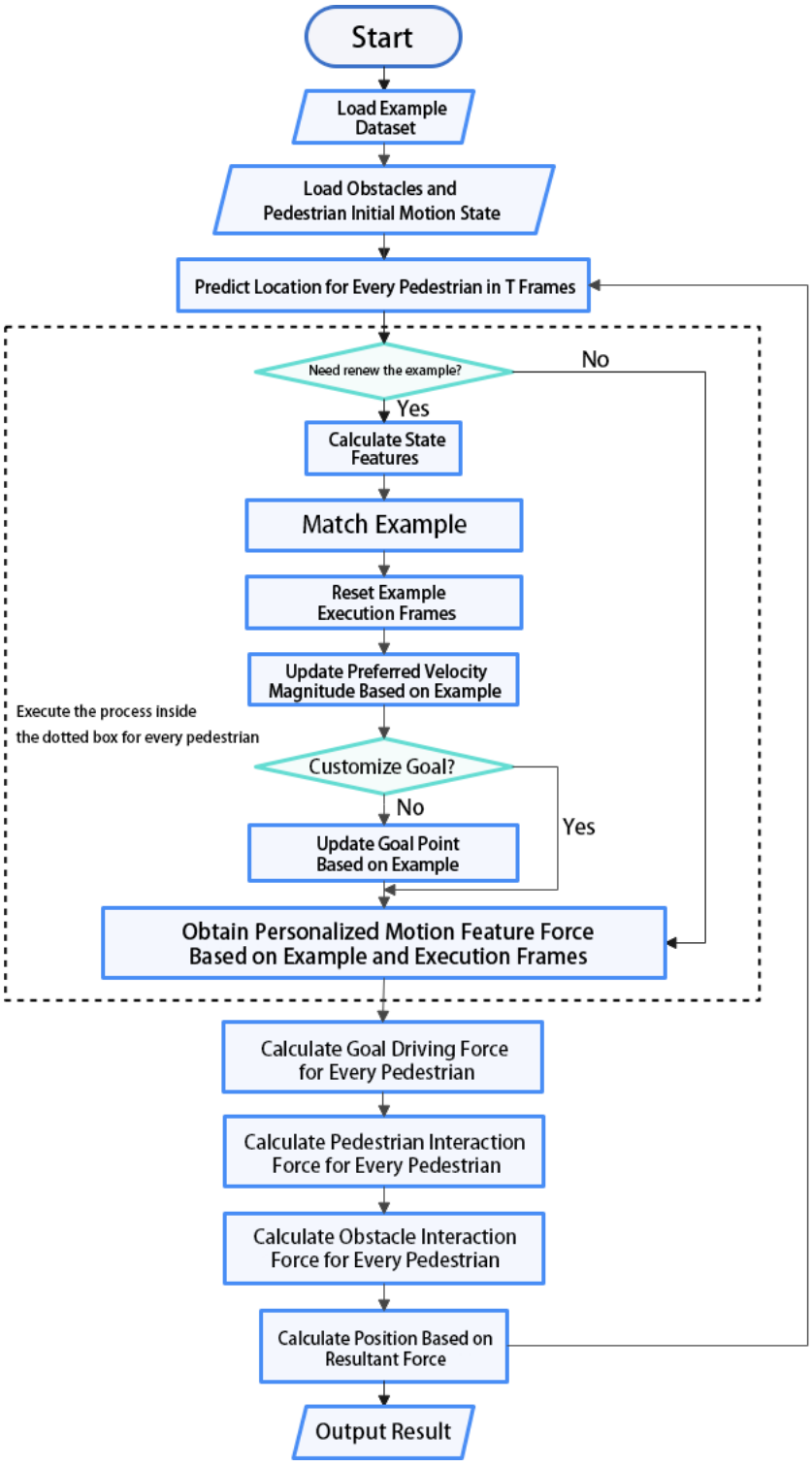


**Figure 6:** *Flow chart of agent motion generation*