Crowds

- Arun C Sundaram

Fitting Behaviors to Pedestrian Simulations

Alon Lerner1, Eitan Fitusi1, Yiorgos Chrysanthou2 and Daniel Cohen-Or1

SCA 2009

Agenda

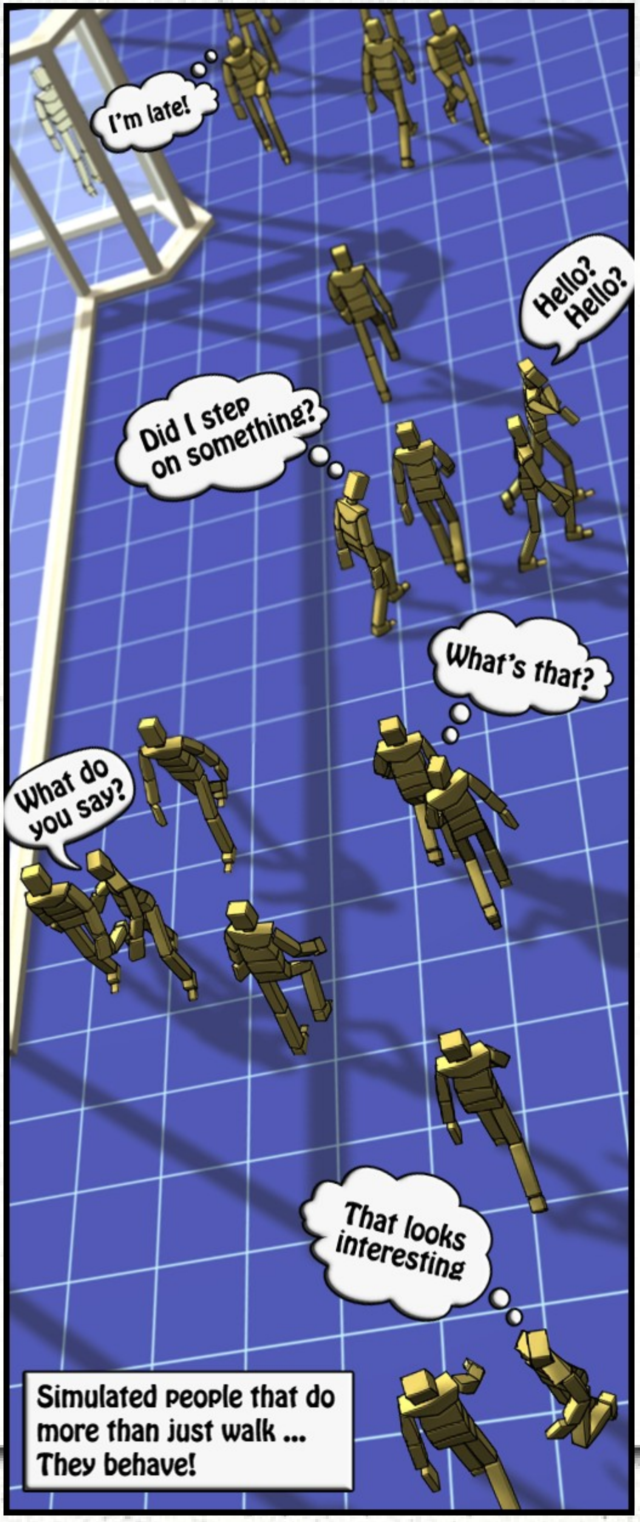
- Problem
- Contributions
- How ?
- Evaluation

Problem to Address

Usually, crowd simulation techniques focus on generating realistic crowds at the trajectory level. They direct people along believable, collision free paths

- However, people do more than just walk

- Should the agents perform such actions at inappropriate times, it may seem odd

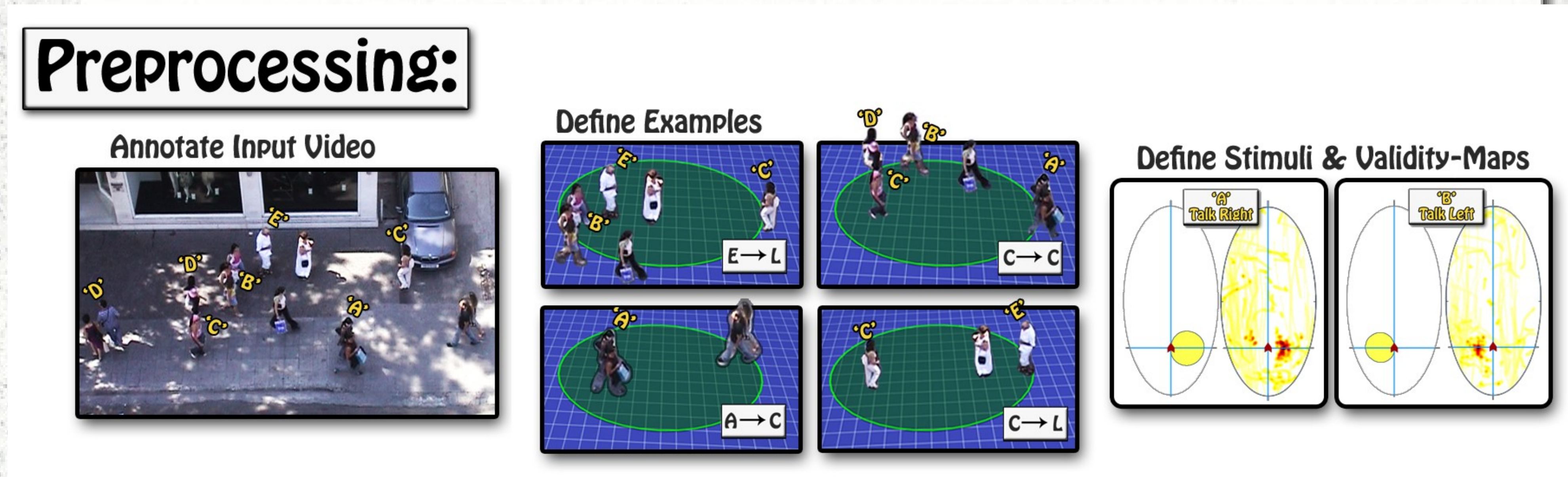


Fitted Actions

- Look around (left/right)
- Talk to someone (left/right)
- Talk on the phone
- Point (left/right)
- Check the time
- Comb Hair
- Look back
- Look down

Overview of solution

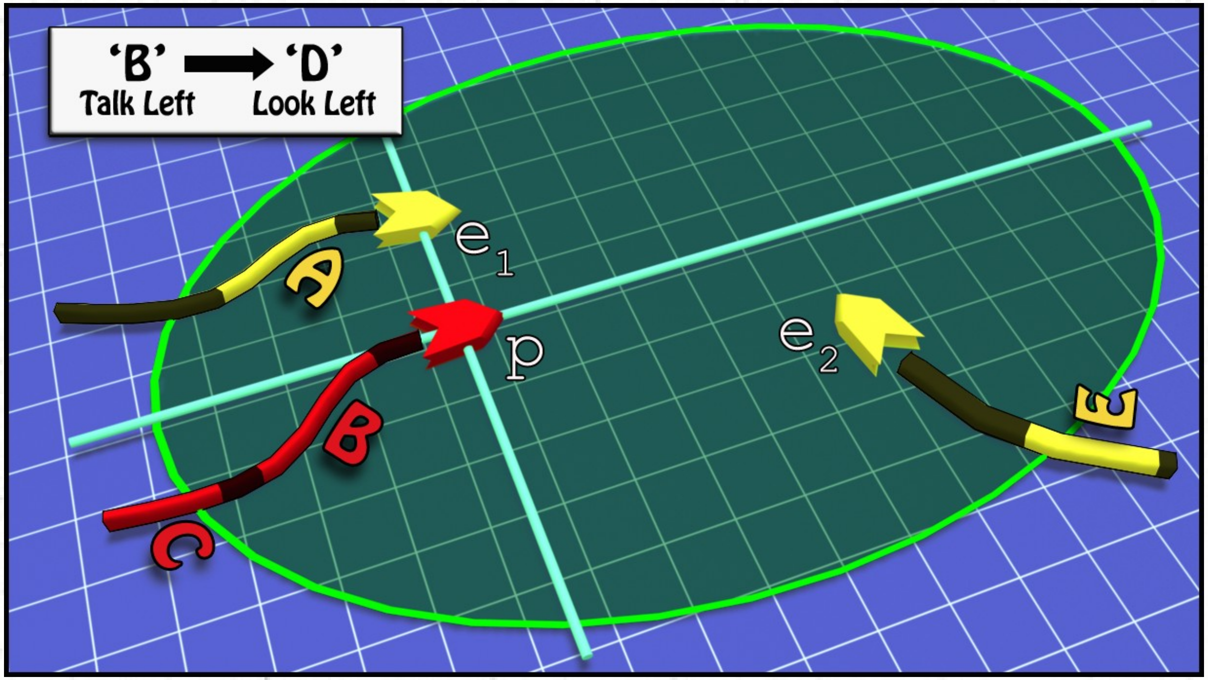
- A data-driven approach for fitting behaviors to simulated pedestrian crowds
- Annotates agent trajectories, generated by any crowd simulator, with action-tags.
- Example Based (from real videos)
- Stimuli and Validity maps



Manual Annotation

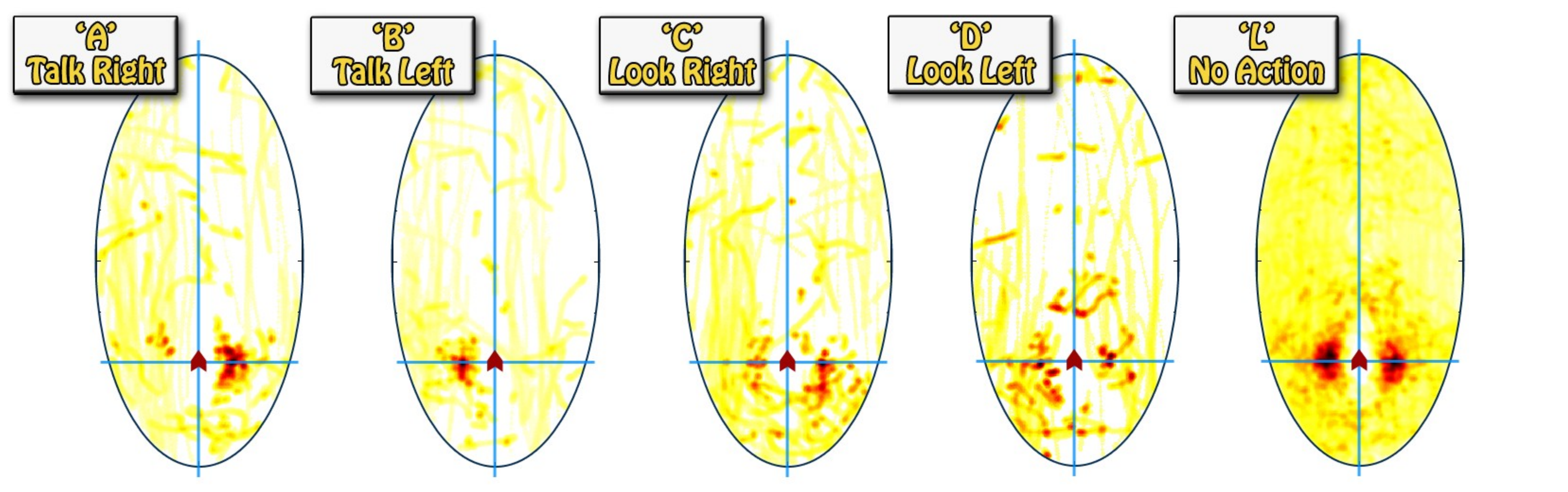
“The stimuli surrounding a person at a certain time motivates an action to be performed shortly after“

Example configuration



Examples are generated from every frame along the trajectory of each person that appears in the input video.

Stimuli map



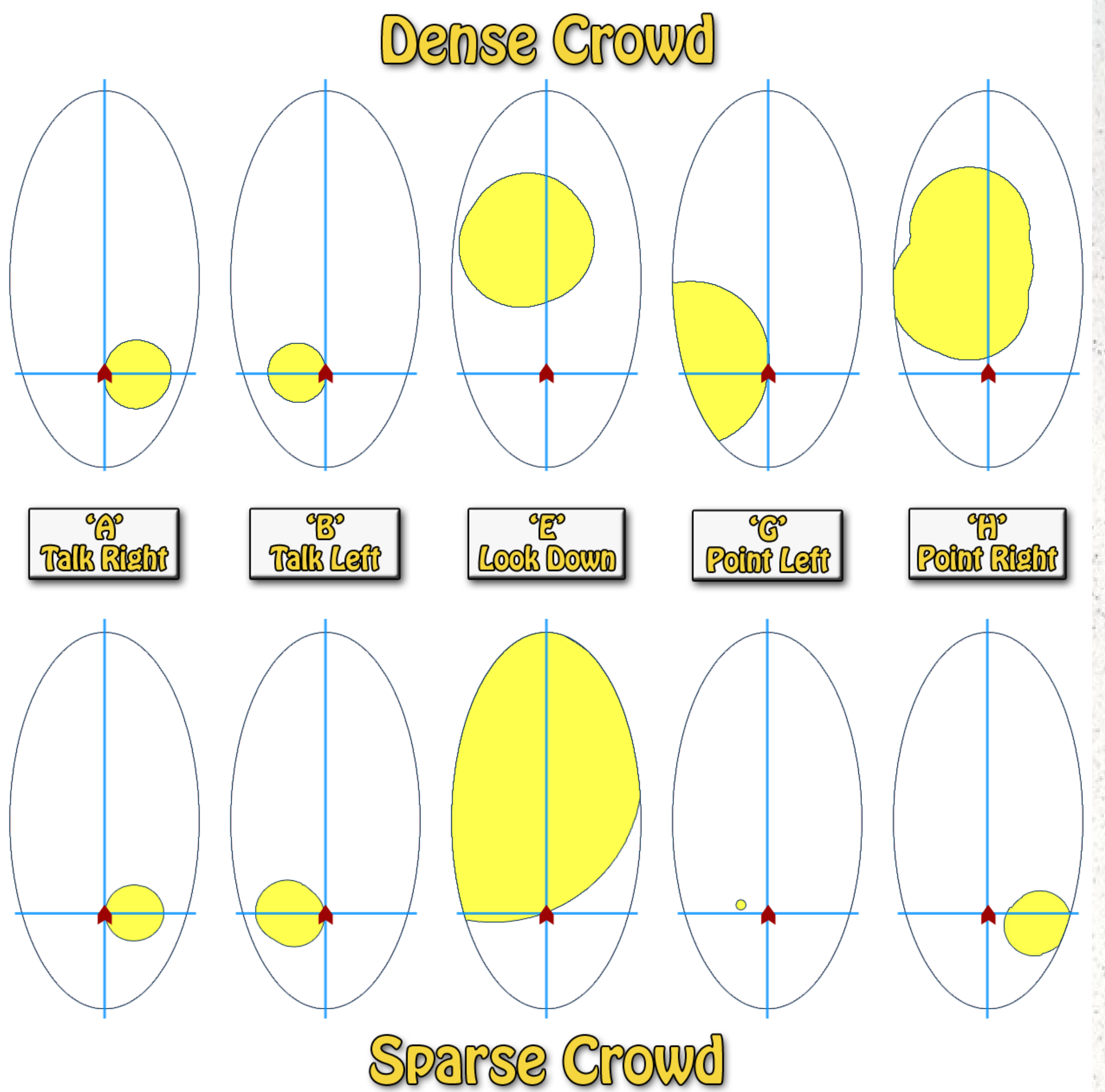
Density based influence functions (Depending on the action, some stimuli might be more important than others)

Acts influence function for a given action

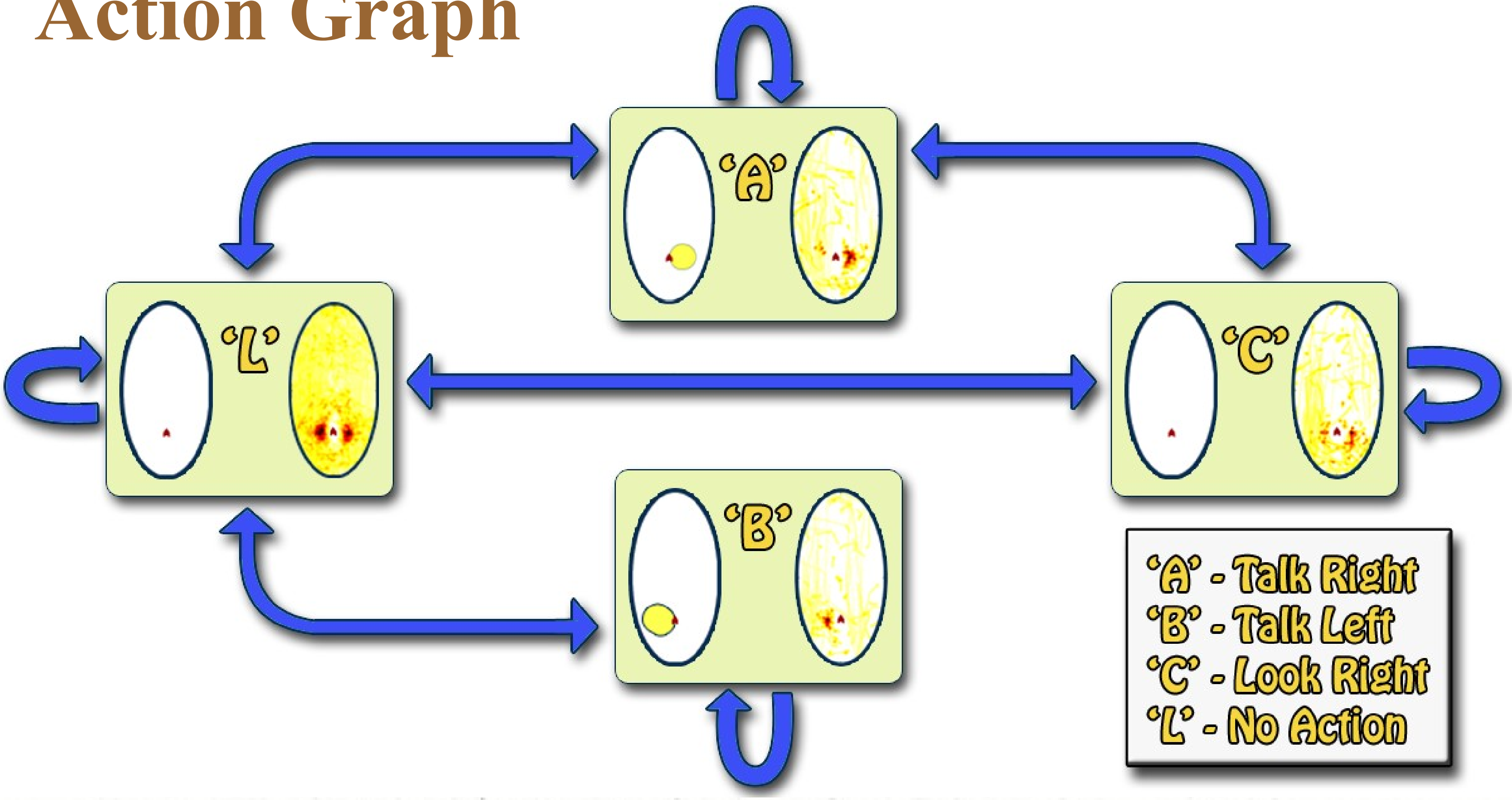
Evaluation of the similarity between a stimuli configuration of a simulated agent and the configuration stored in an example.

Validity map

Impose constraints over the stimuli required for performing an action, as observed in the input video

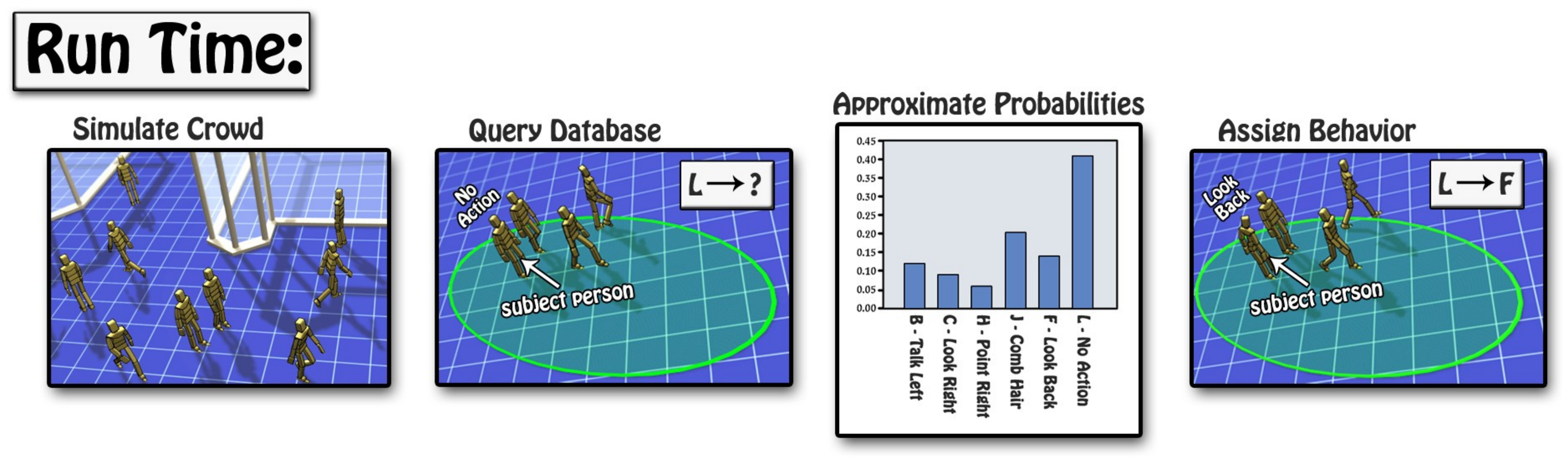


Action Graph



Probabilistic finite automata that provides a convenient means for fitting action-tags to simulated agents

Nodes represent actions and directed edges observed transitions between actions



- Check validity
- Assign probabilities based on examples

"The probability of an action is determined according to the number of examples collected and their degree of similarity to the agents stimuli."

Assign the Action Tag

Points of Influence

Similarity Function

$$Sim(Q,E) = w_p S(q_p, e_p) + \sum_{q_i \in Q} w_i \max_{e_j \in E} \{S(q_i, e_j)\}$$

$$S(q_i, e_j) = \sum_t c_t S_t(q_i, e_j)$$

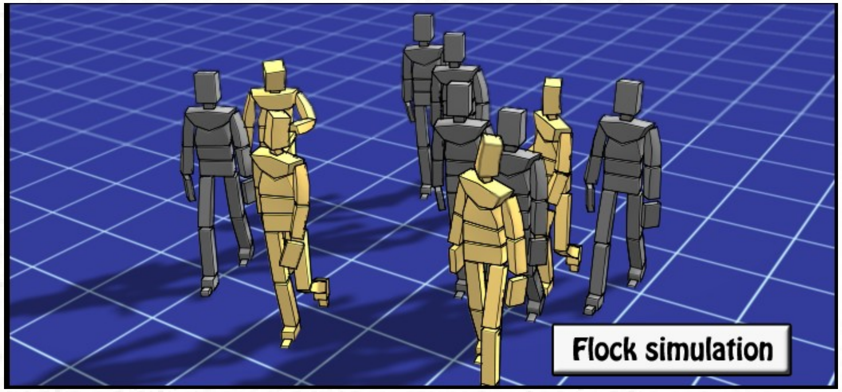
$$S_t(q_i, e_j) = 1 - \alpha dP(q_i, e_j) - \beta dB(q_i, e_j)$$

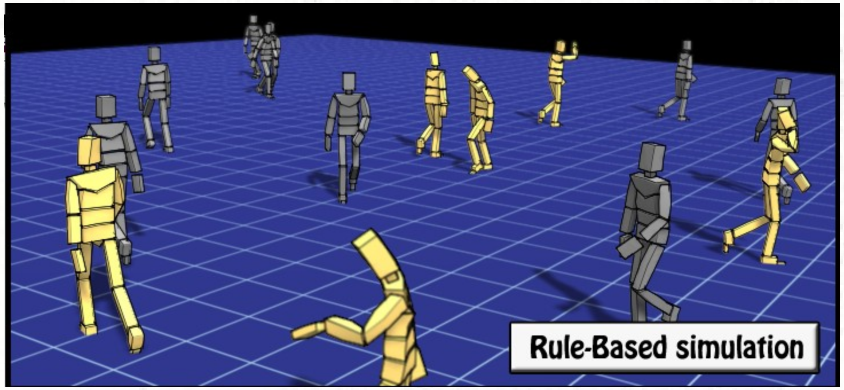
$$dP(q_i, e_j) = \begin{cases} 0 & dist(q_i, e_j) < r_{\min} \\ \left(\frac{dist(q_i, e_j) - r_{\min}}{r_{\max} - r_{\min}}\right)^2 & r_{\min} < dist(q_i, e_j) < r_{\max} \\ 1 & r_{\max} < dist(q_i, e_j) \end{cases}$$

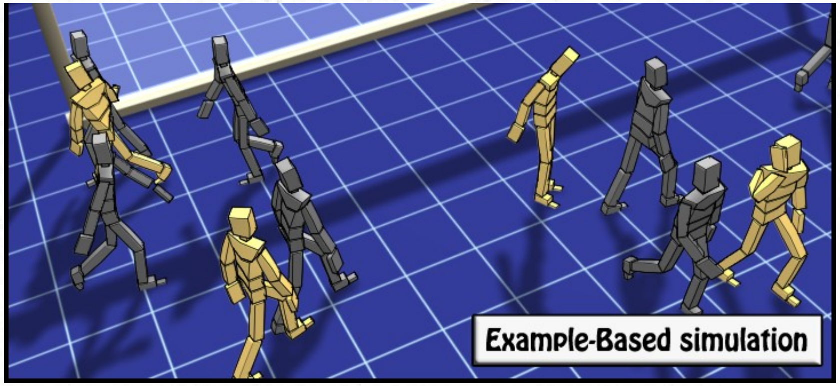
Ct – relative weight of time t along the trajectory
dB(qi,ej) - (topological distance in the graph between the action-tags of qi and e j at time t)/(maximal topological distance in the graph)

Evaluation

Input Video :
five minutes long
captured unaware pedestrians walking in front of a department store







Extra Functionality

Scaling the weight of no-action

Action Type	Weight of the no-action node				
	0	1	10	40	100
Talk right	60	46	68	38	12
Talk left	51	60	53	33	9
Look right	121	122	83	31	21
Look left	69	97	77	43	19
Look down	11	16	25	9	7
Look back	69	82	59	30	9
Point left	0	0	0	0	0
Point right	7	8	5	2	3
Talk on cellular	156	70	51	14	17
Comb hair	80	72	59	26	12
Look at watch	18	52	50	19	15
Total	642	625	530	245	124

Scaling the weight of an arbitrary node in the graph, which affects the frequency of a specific action.

Thank You