A Mobility Model of Theme Park Visitors
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Abstract
We present a novel human mobility model for theme parks. In our model, the non-determinism of movement decisions of visitors is combined with deterministic behavior of attractions. The attractions are categorized as rides, restaurants, and live shows. The time spent at these attractions are computed using queuing-theoretic models. The realism of the model is evaluated through extensive simulations and compared with existing mobility models and the GPS traces of theme park visitors. The results show that our proposed model provides a better match to the real-world data (from CRAWDAD archive) compared to current state-of-the-art movement models.

Introduction
Recent advances in mobile devices enabled the increased popularity and usage of mobile applications. The realistic modeling of human movement has significant importance for the performance assessment of mobile wireless systems.

Motivation
- Mobility models drastically change performance results of networks
- Early models based on random walks are very coarse approximations
- Focusing on human walks due to limited vehicle use in theme parks

Outcomes of our model are useful for:
- Performance evaluation of mobile applications
- Theme park administration

Contributions
- A novel scenario-specific mobility model
- Representing the social behavior of gathering in attractions, spending time in queues, and the least-action principle
- The best statistical match to the GPS traces amongst the tested synthetic models

Fractal points and clusters
- Self-similar fractal points and least action trip planning satisfy fundamental statistical features of human walks.
- The areas with high densities represent the popular places.

Attractions
Attractions are represented by queuing models. The types and the weights of the queues are based on the previous work on theme park design.

<table>
<thead>
<tr>
<th>Attraction</th>
<th>Queue model</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main rides (RD)</td>
<td>M/D/n</td>
<td>17%</td>
</tr>
<tr>
<td>Medium-size rides (M-RD)</td>
<td>M/D/n</td>
<td>56%</td>
</tr>
<tr>
<td>Restaurants (RT)</td>
<td>M/M/1</td>
<td>17%</td>
</tr>
<tr>
<td>Live shows (LS)</td>
<td>M/M/n</td>
<td>10%</td>
</tr>
</tbody>
</table>

Landmark
A landmark is a place where there are multiple static queues, static noise points, and mobile nodes.

Visitor Model
- Visitors pre-plan their visit by deciding hangout times and the set of attractions to be visited.
- The modified LATP algorithm decides the next destinations and minimizes the travel distances.

Theme Park with Landmarks
The mobility model can be easily applied to model a complete theme park scenario. By separating landmarks as vertices and adding weighted non-directional edges, we can generalize the mobility from a landmark to the whole theme park.

Simulation Results

References