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UNIVERSITÄT FREIBURG

Algorithms for Radio Networks

Mobility Models

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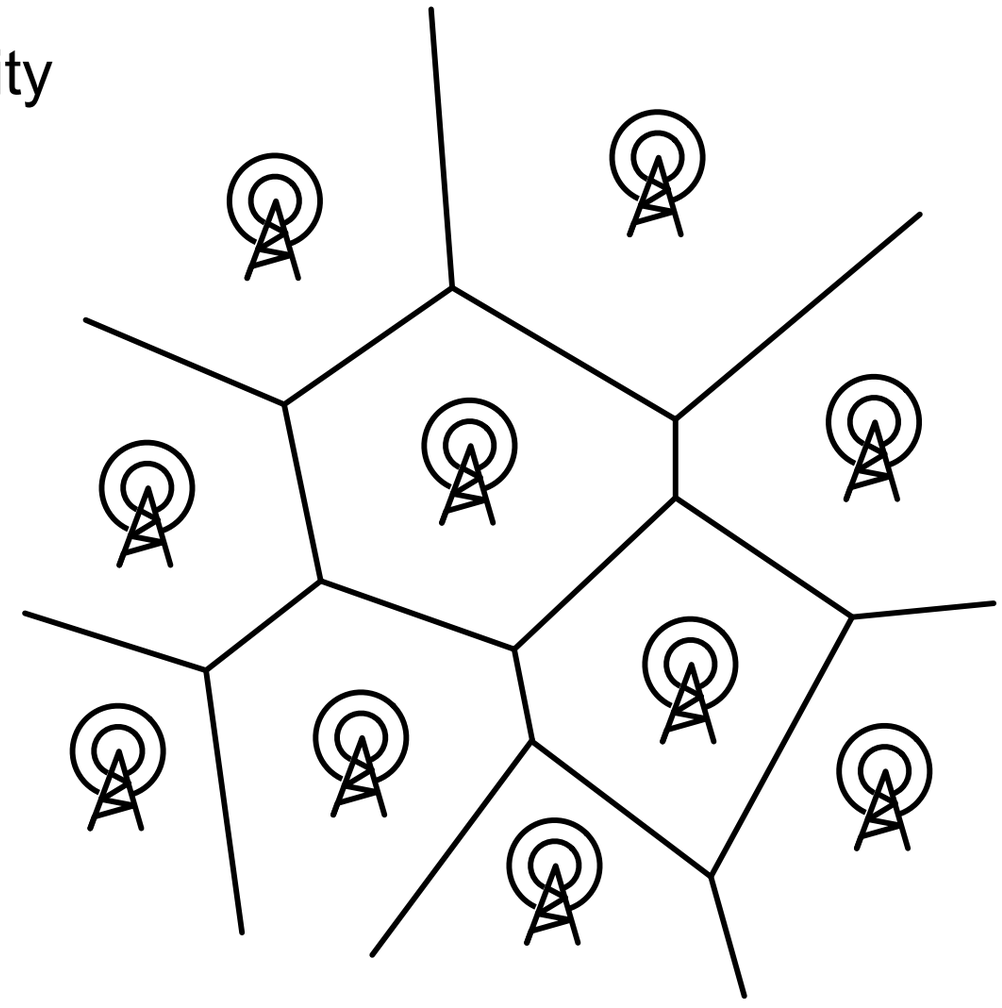
Mobility Parameters

- **Group behavior**
- **Limits**
  - Speed, acceleration, obstacles, streets
- **Dimensions**

  1, 1 1/2, 2, 2 1/2, 3
- **Predictability**
  - Simulation model
  - Completely erratic (adversary)
  - Biological, social inspired
  - Random process

Cellular Mobility Models

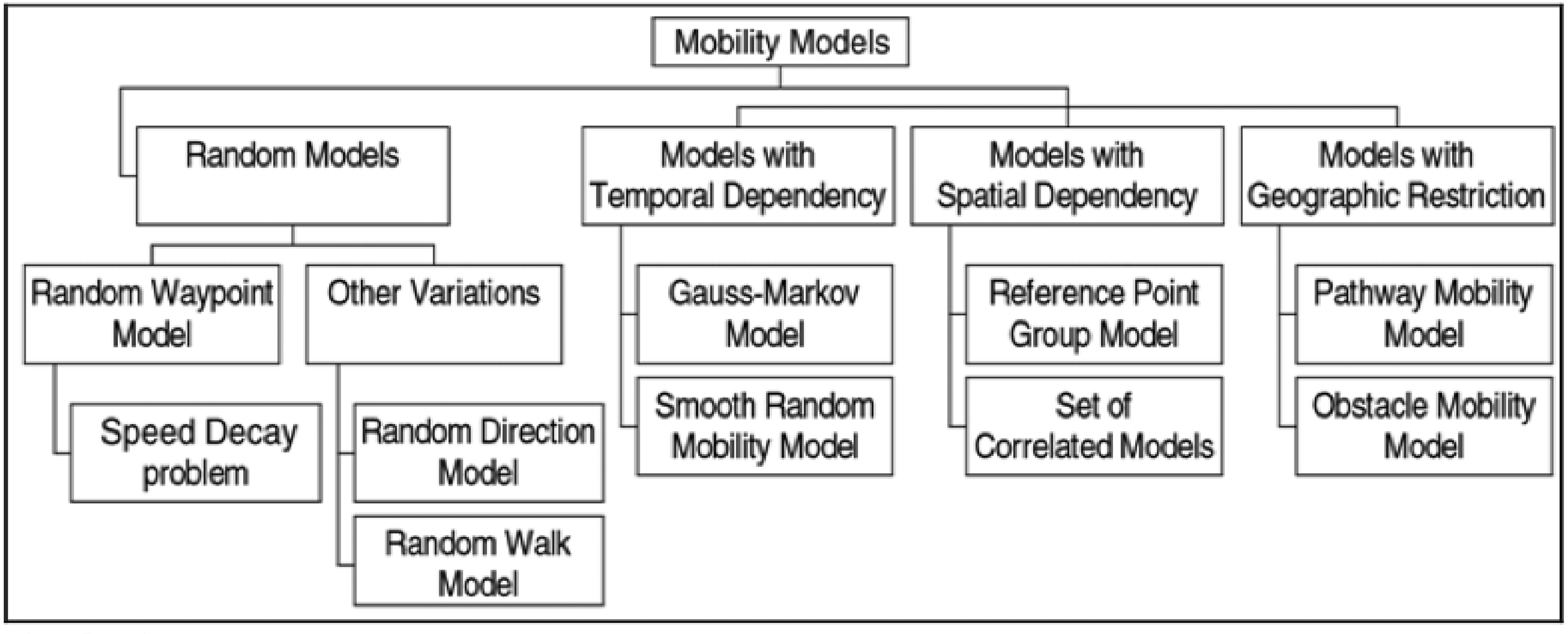
- **Describe changes only between cells**
  - Random Walk
  - A node remains in a cell with a given probability
    - same for change of cells
  - Memory-less Markov model
- **Traces**
  - Large data archive of user behavior
  - For simulation of handoff behavior
- **Fluid Flow**
  - Macroscopic view
  - Simulation model for liquids and gas
  - Good description for highways



Random Mobility Models

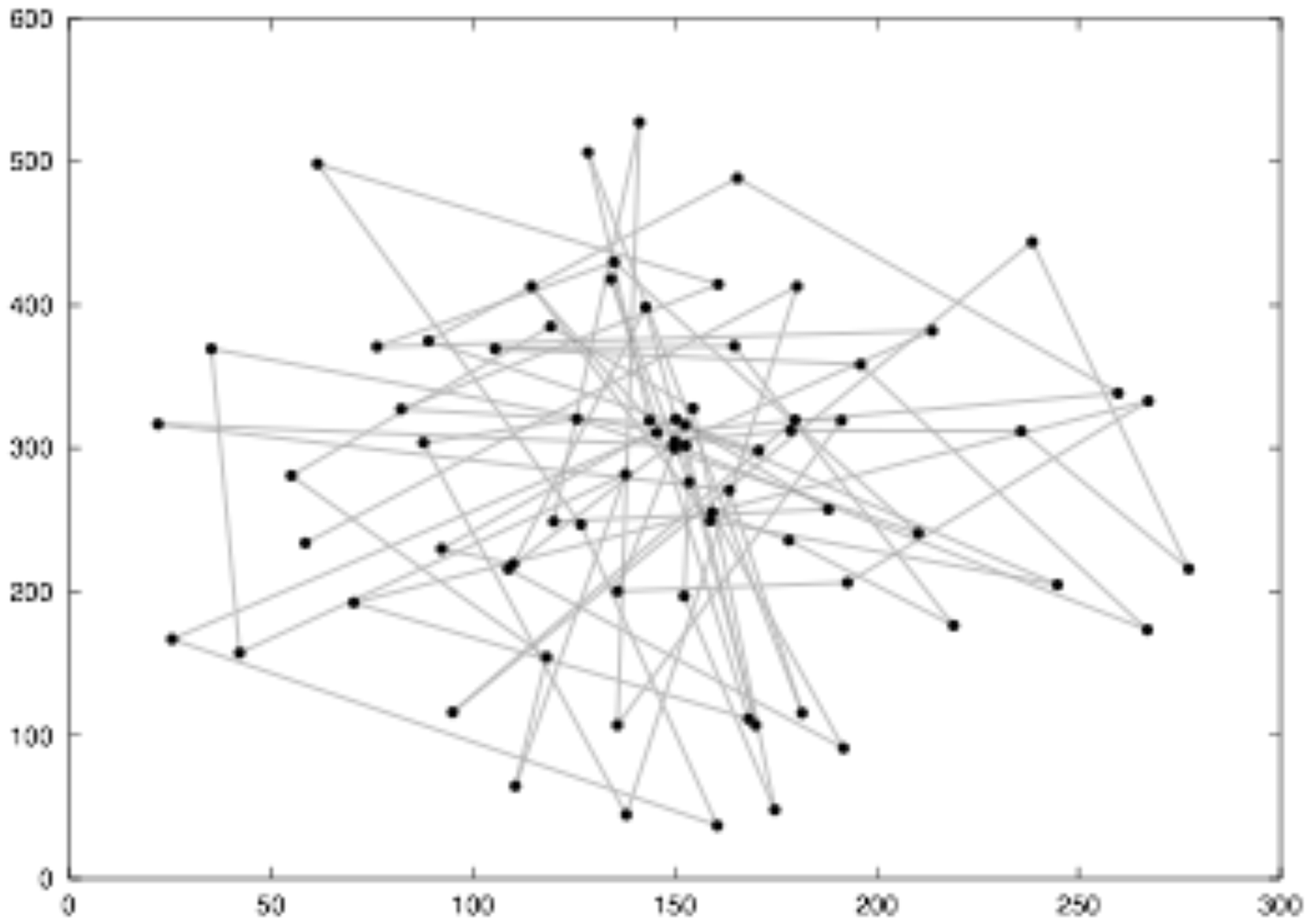
- **Random Walk**
- **Random Waypoint**
- **Random Direction**
- **Boundless Simulation Area**
- **Gauss-Markov**
- **Probabilistic Version of the Random Walk Mobility**
- **City Section Mobility Model**

[Bai, Helmy 2003]



Brownian Mobility Model

- **Brownsche Bewegung**
  - Speed and direction are chosen independently in each round

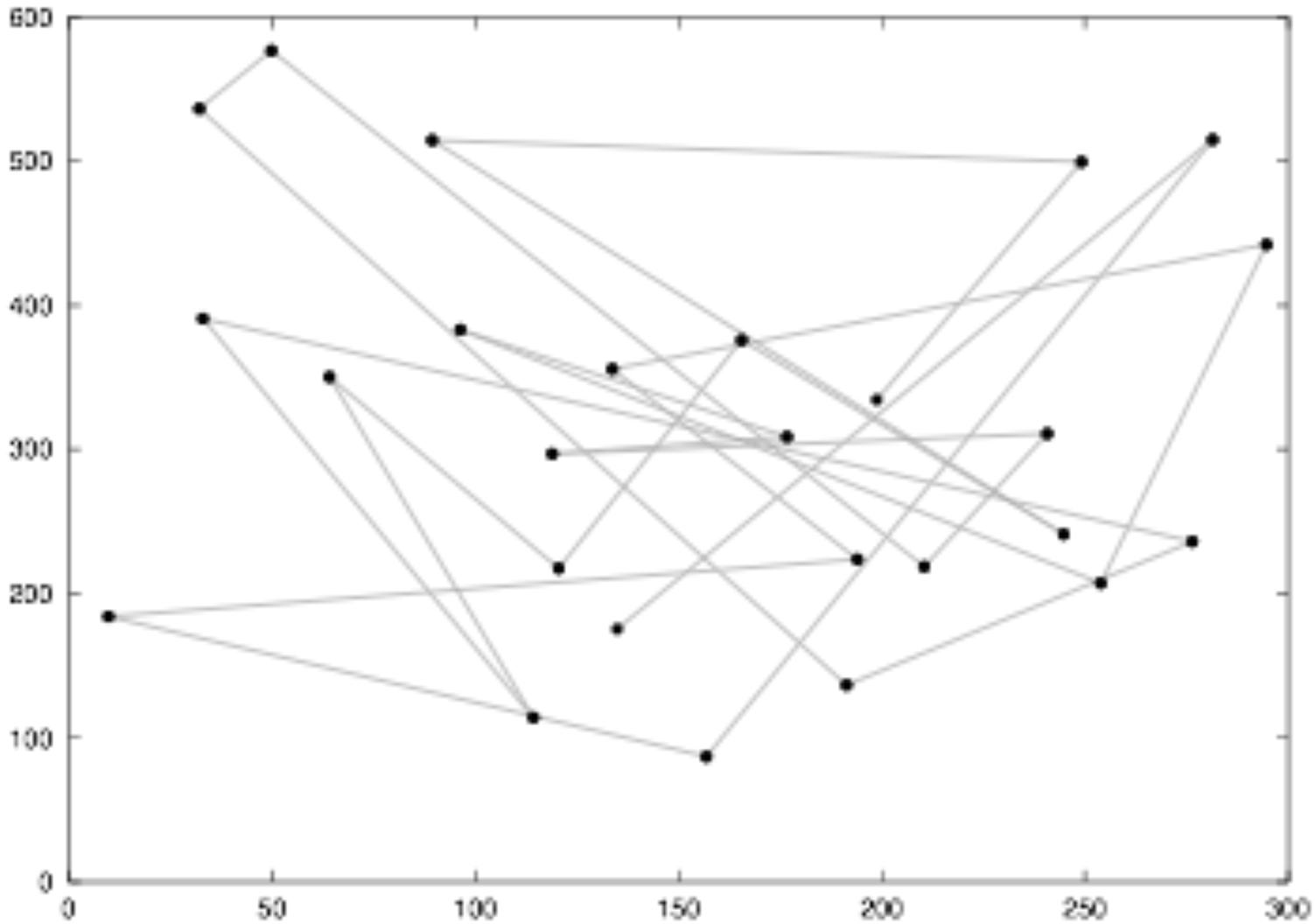


[Camp et al. 2002]

Random Waypoint Mobility Model

[Camp et al. 2002]

- Choose random target in rectangle
- Choose a random speed from an interval
- Move in a straight line to the target
- Pause for a given time
- Repeat for ever



Broch, J; Maltz DA, Johnson DB, Hu Y-C, and Jetcheva J (1998). "A performance comparison of multi-hop wireless ad hoc network routing protocols" in P*roceedings of the Fourth Annual ACM/IEEE International Conference on Mobile Computing and Networking (Mobicom98), ACM, October 1998*

Gauss-Markov Mobility Model

- **Flexible degree of randomness**
- **speed**
- **direction**

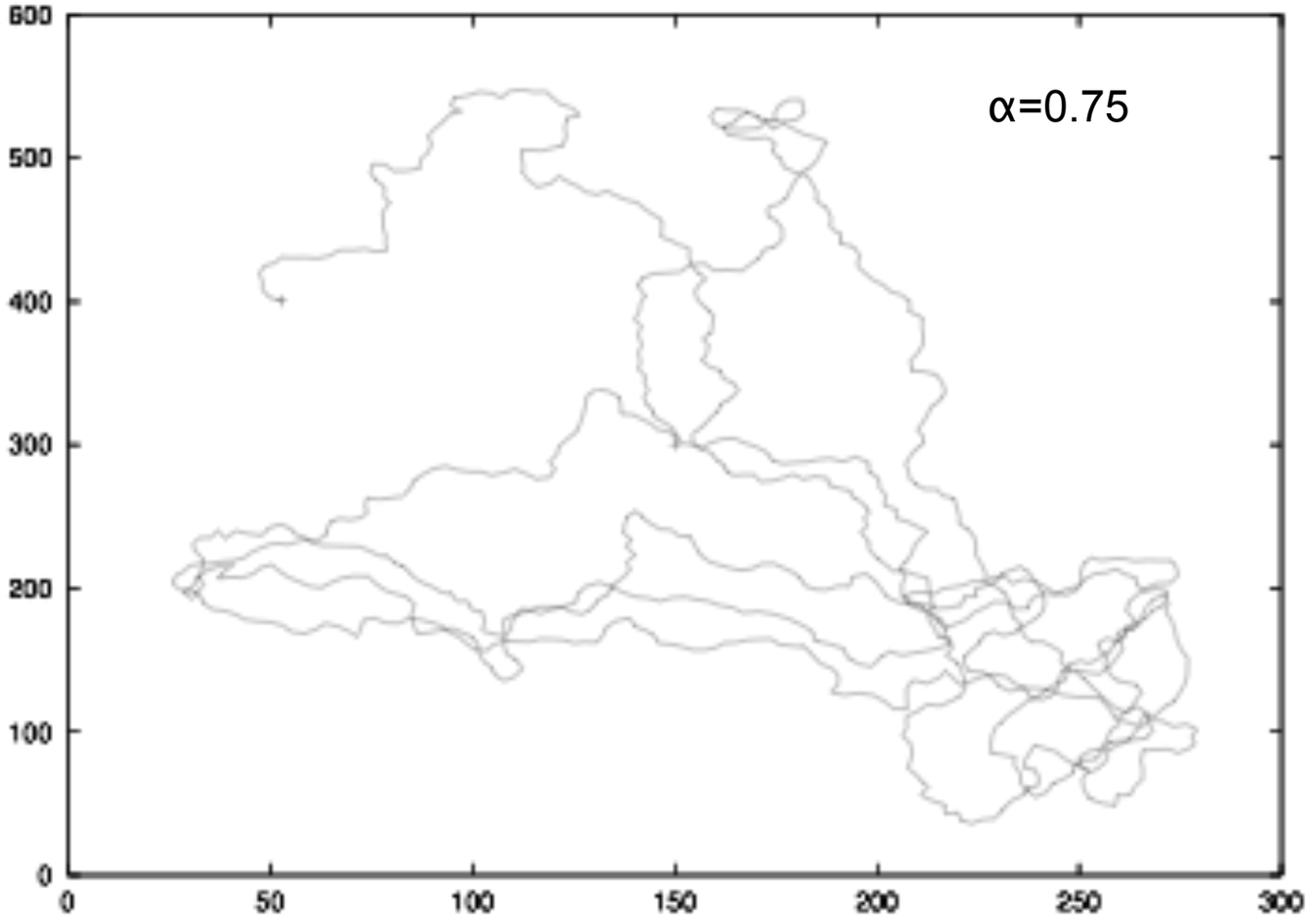
$$v_n = \alpha v_{n-1} + (1-\alpha)\overline{v} + \sqrt{1-\alpha^2} v_{X_{n-1}}$$

$$d_n = \alpha d_{n-1} + (1-\alpha)\overline{d} + \sqrt{1-\alpha^2} d_{X_{n-1}}$$

Tuning-Faktor

Mittelwert

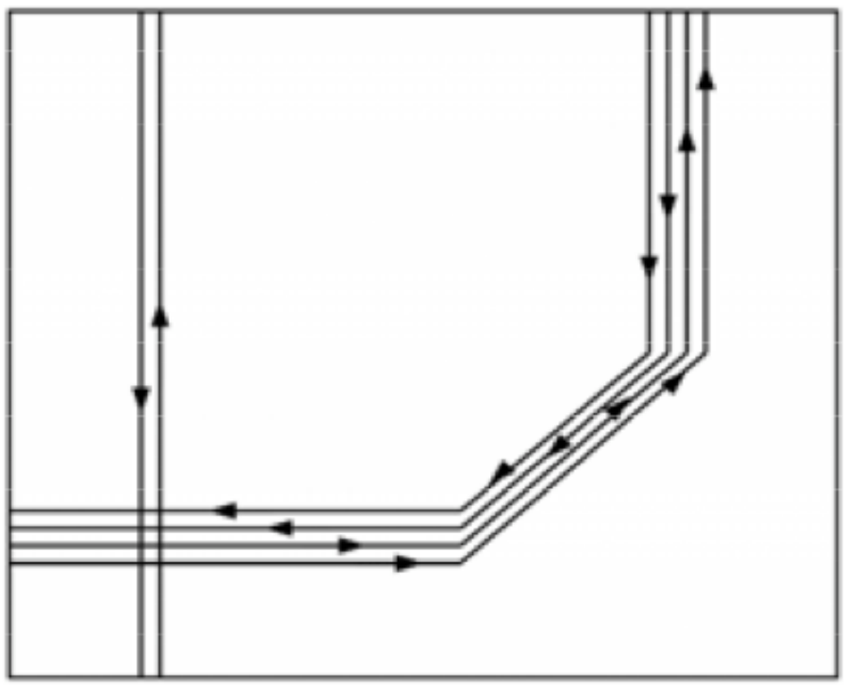
Zufällige normalverteilte Variablen



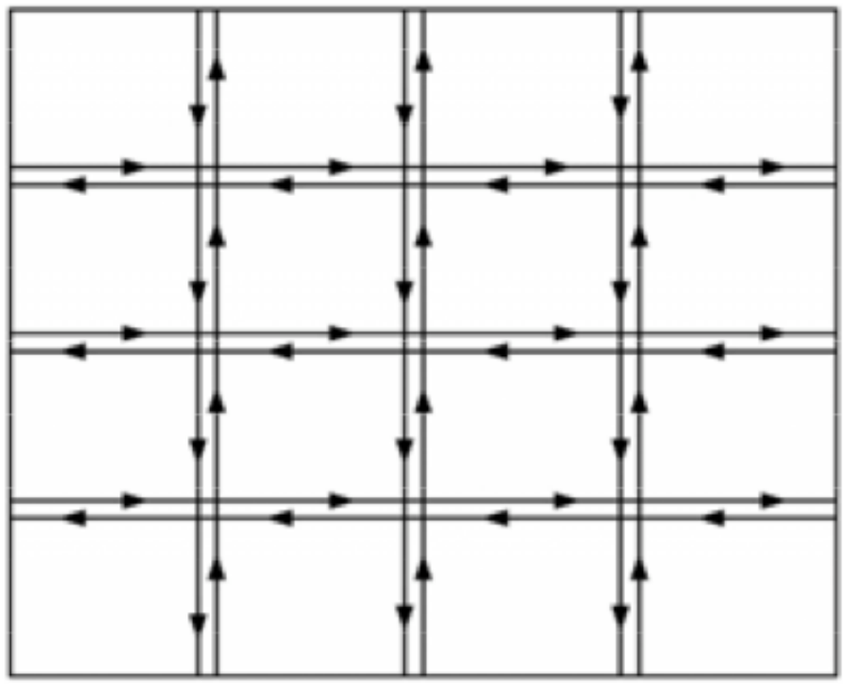
[Liang, Haas 1999]

City Section and Pathway

- **Mobility is restricted to roads**
- **Combined with other models such as motion**
  - random walk
  - random waypoint
  - archive

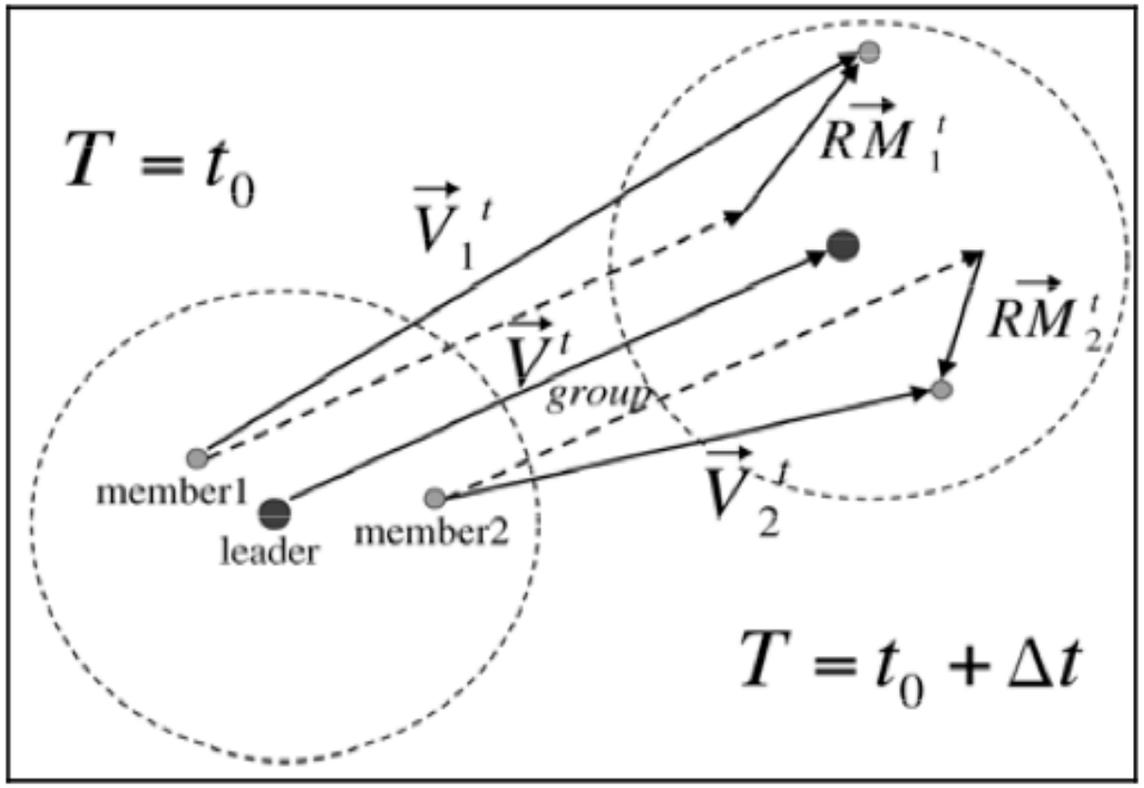


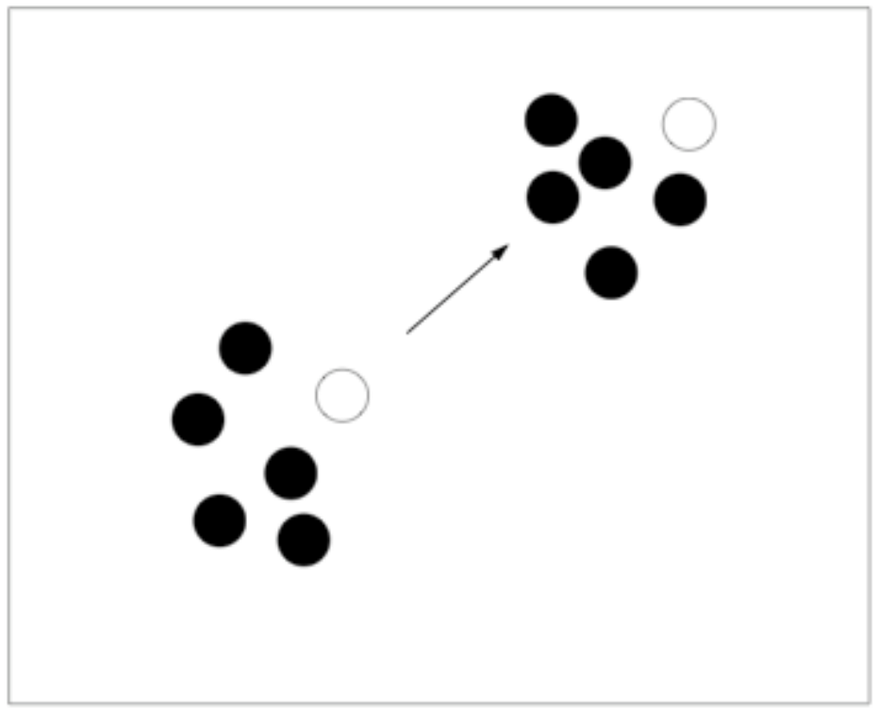
- **The path is based on the shortest path between start and finish**



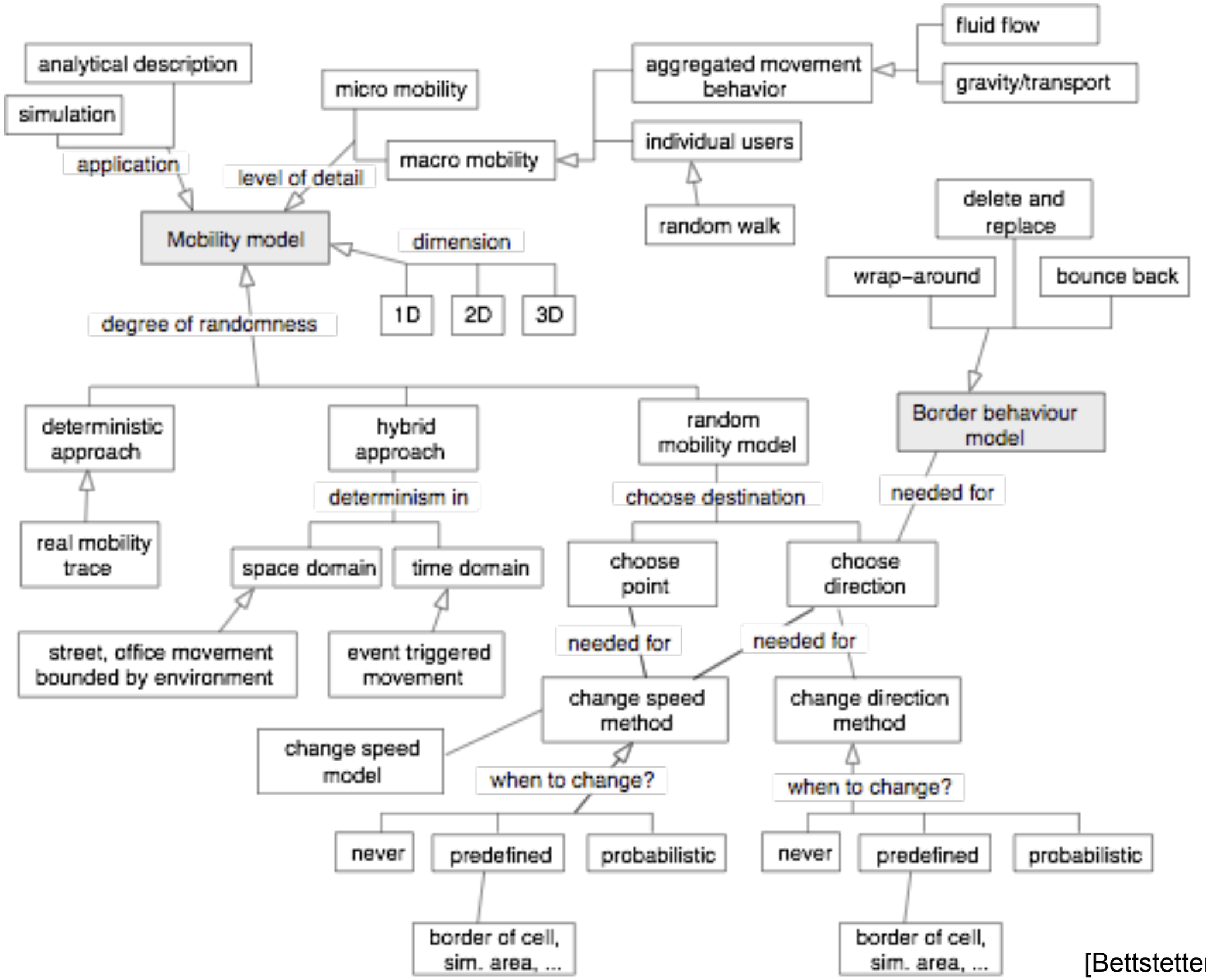
Group Mobility Models

- **Exponentially correlated random walk**
  - Mobility function with random variation generates group behavior
- **Reference Point Group**
  - Nomadic Community Mobility
    - Reference point of the results from focus group with offset
  - Pursue Mobility
    - Group follows a (possibly virtual) leader





Combined Models



[Bettstetter 2001]

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