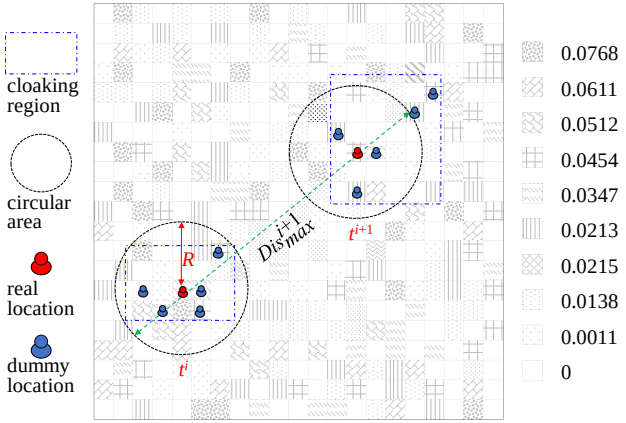
DPPS: A novel dual privacy-preserving scheme for enhancing query privacy in continuous location-based services

Long LI, Jianbo HUANG, Liang CHANG, Jian WENG, Jia CHEN, Jingjing LI

Frontiers of Computer Science, DOI: 10.1007/s11704-022-2155-9

Problems & Ideas

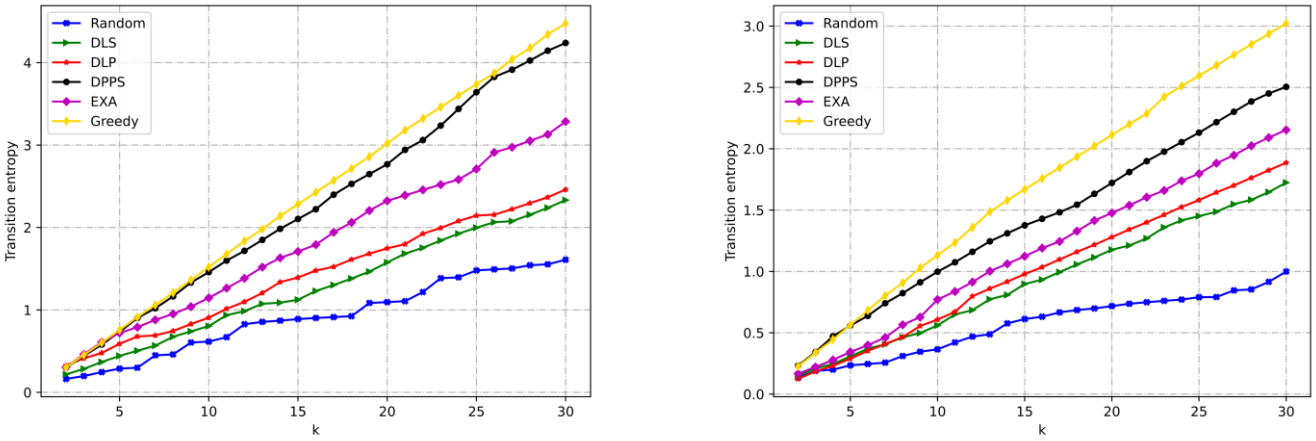
- Problems of location-based services (LBSs):
  - Location queries can be used to infer users' sensitive private information
  - An adversary can infer real locations from the correlations between consecutive locations in a continuous LBS.
- Ideas: First, a correlation model is proposed based on a hidden Markov model (HMM) to simulate users' mobility and the adversary's prediction probability. Second, an advanced k-anonymity algorithm is proposed to construct cloaking regions.



At t^i, three dummy locations are generated close to the real location, which makes it easy for the adversary to identify the real location. Furthermore, one of the dummy locations selected at t^{i+1} is not in the query range and exceeds the maximum distance Dis_{max}^{i+1}, so the adversary can directly identify it as a fake location based on the correlation between the two location sets.

Main Contributions

- Contributions:
  - 1) By simultaneously considering the anonymity of a single location and the correlations between consecutive locations, DPPS is proposed to achieve dual protection of location privacy.
  - 2) To effectively capture the side information hidden in the correlation between consecutive locations, a hidden Markov model (HMM) is used to simulate these correlations in accordance with the user's mobility.
  - 3) To provide query probability anonymity, an advanced k-anonymity algorithm (AKA) is proposed to construct cloaking regions.



The performance of DPPS is second only to that of the greedy algorithm and significantly better than that of the other algorithms. This phenomenon can be attributed to the fact that the DPPS algorithm additionally considers the distribution of the dummy locations, resulting in a slight decrease in the transition entropy performance.