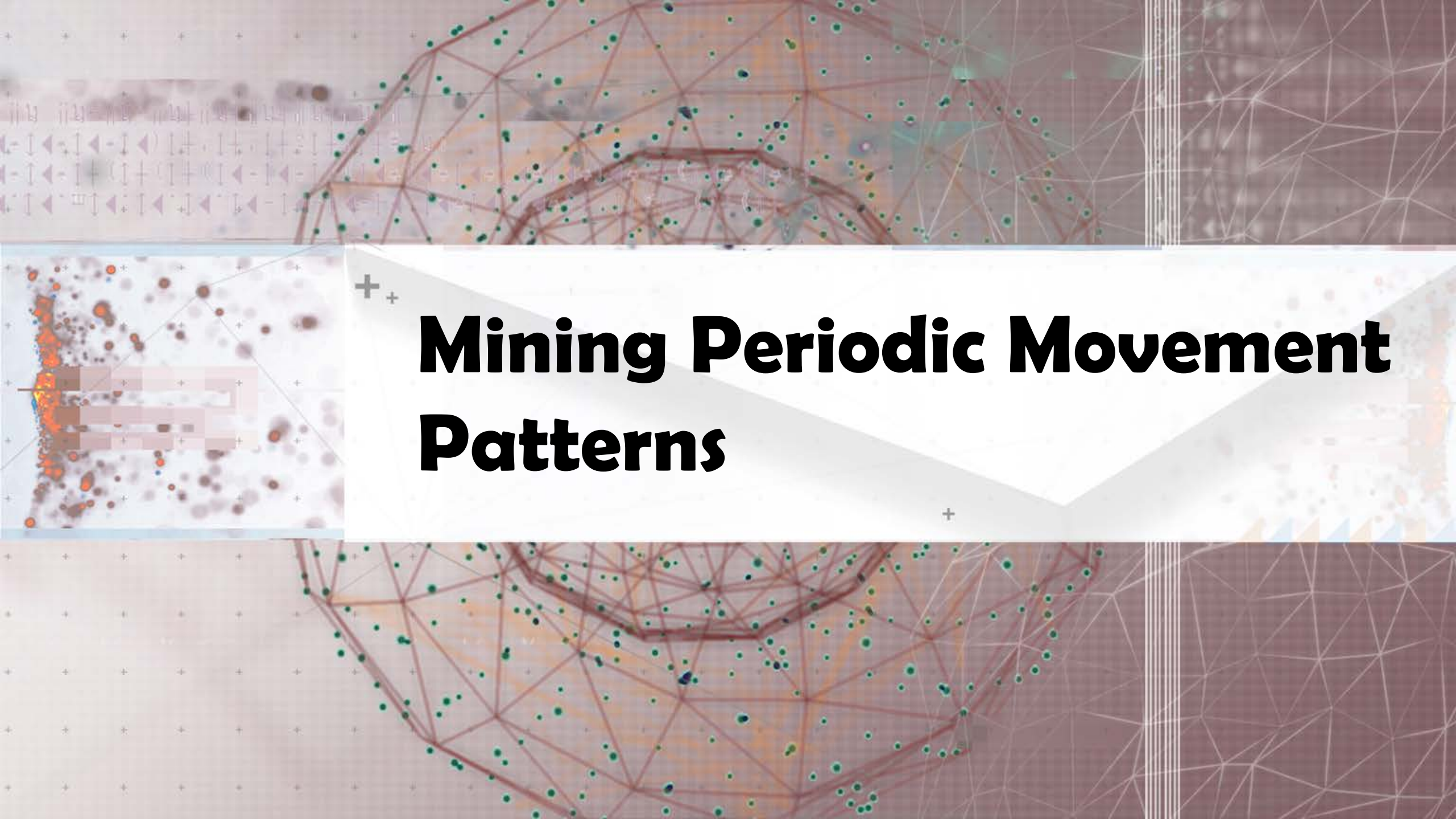
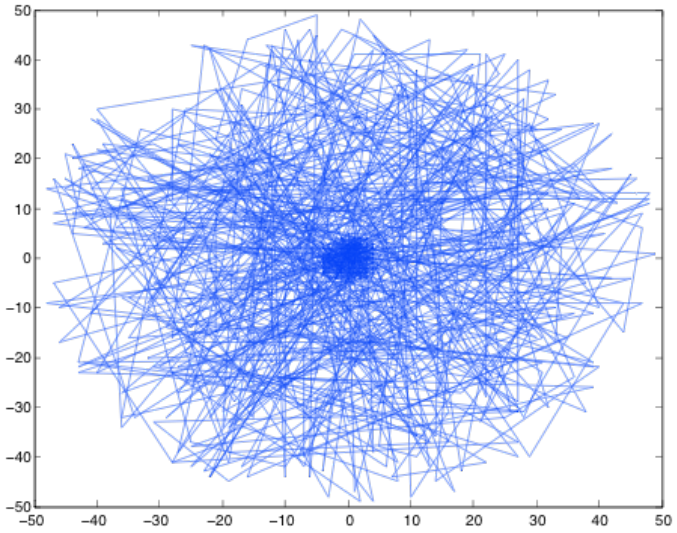
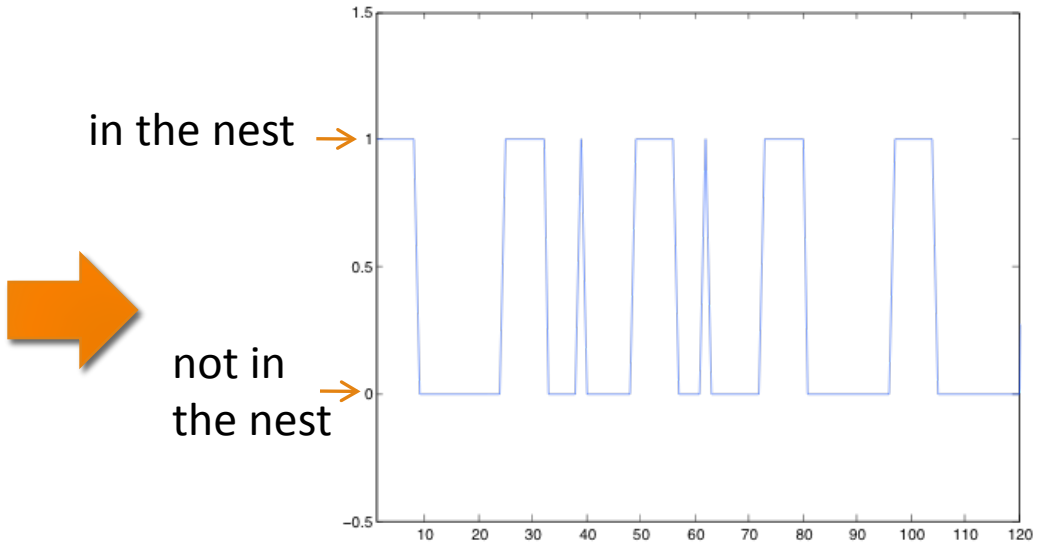


Mining Periodic Movement Patterns

Pattern Discovery in Sparse Movement Data: Finding Good Reference Points

- **Pattern discovery in sparse data** (e.g., find bird flying patterns)
  - Periodicity shows up in some reference "spots" (or "cluster centers")
  - Reference spots can be detected using **density-based method**
  - Periods are detected for each reference spot using **Fourier Transform** and **auto-correlation**

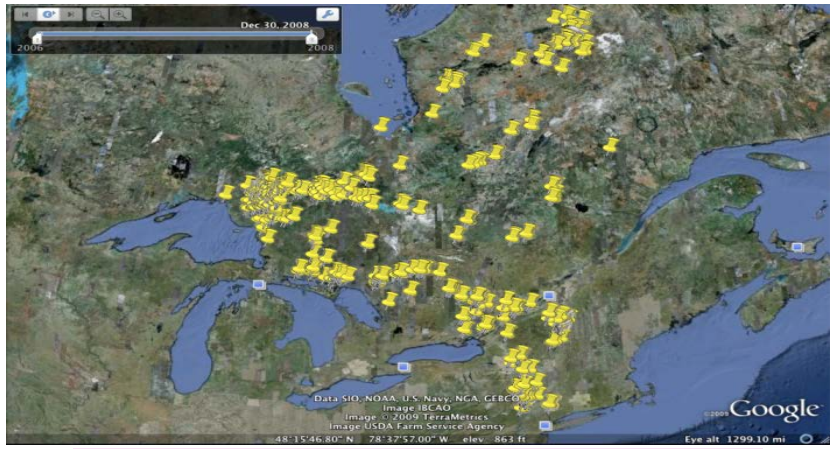




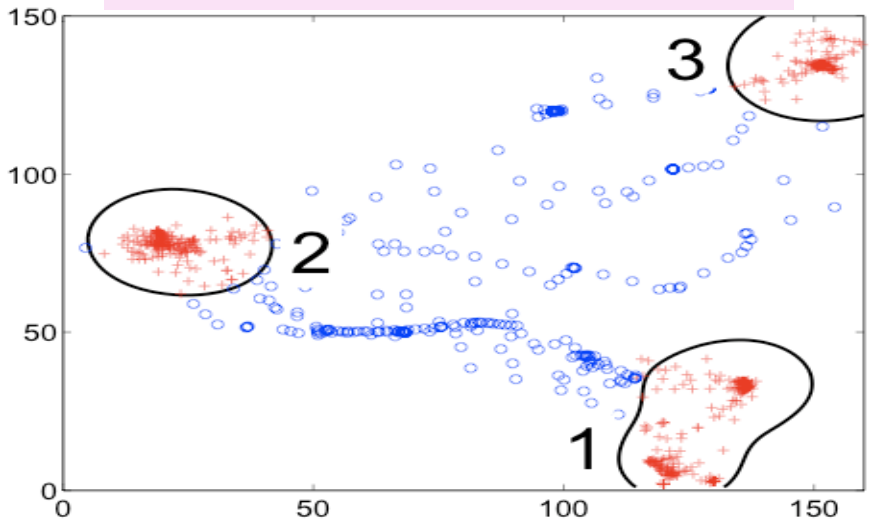
Finding bird flying patterns?
Bird Nest is a good reference point

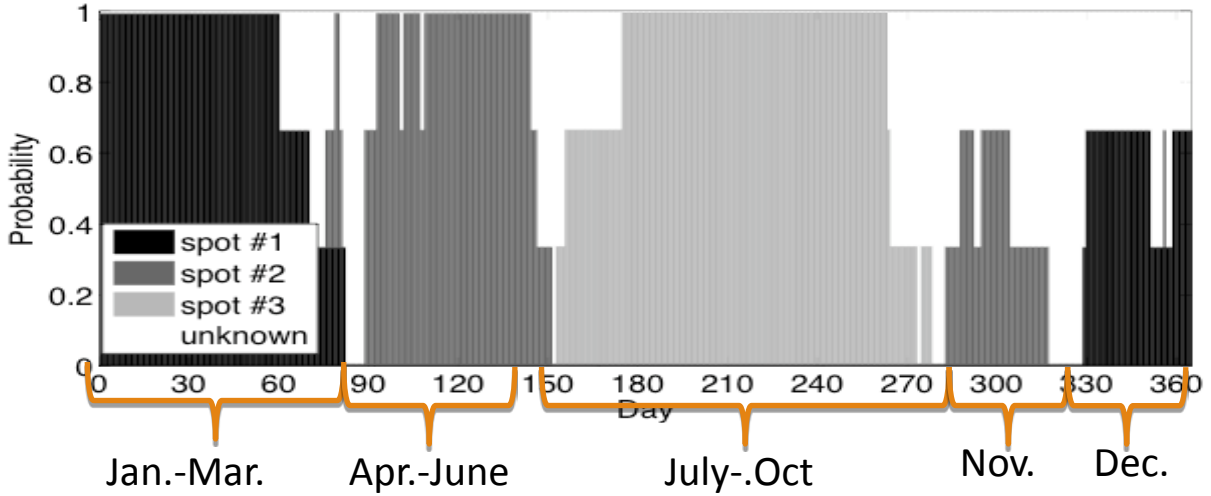
Period is more obvious in this binary sequence!

Example: Mining Periodic Patterns with Sparse Data



3-yr Bird migration data: very sparse



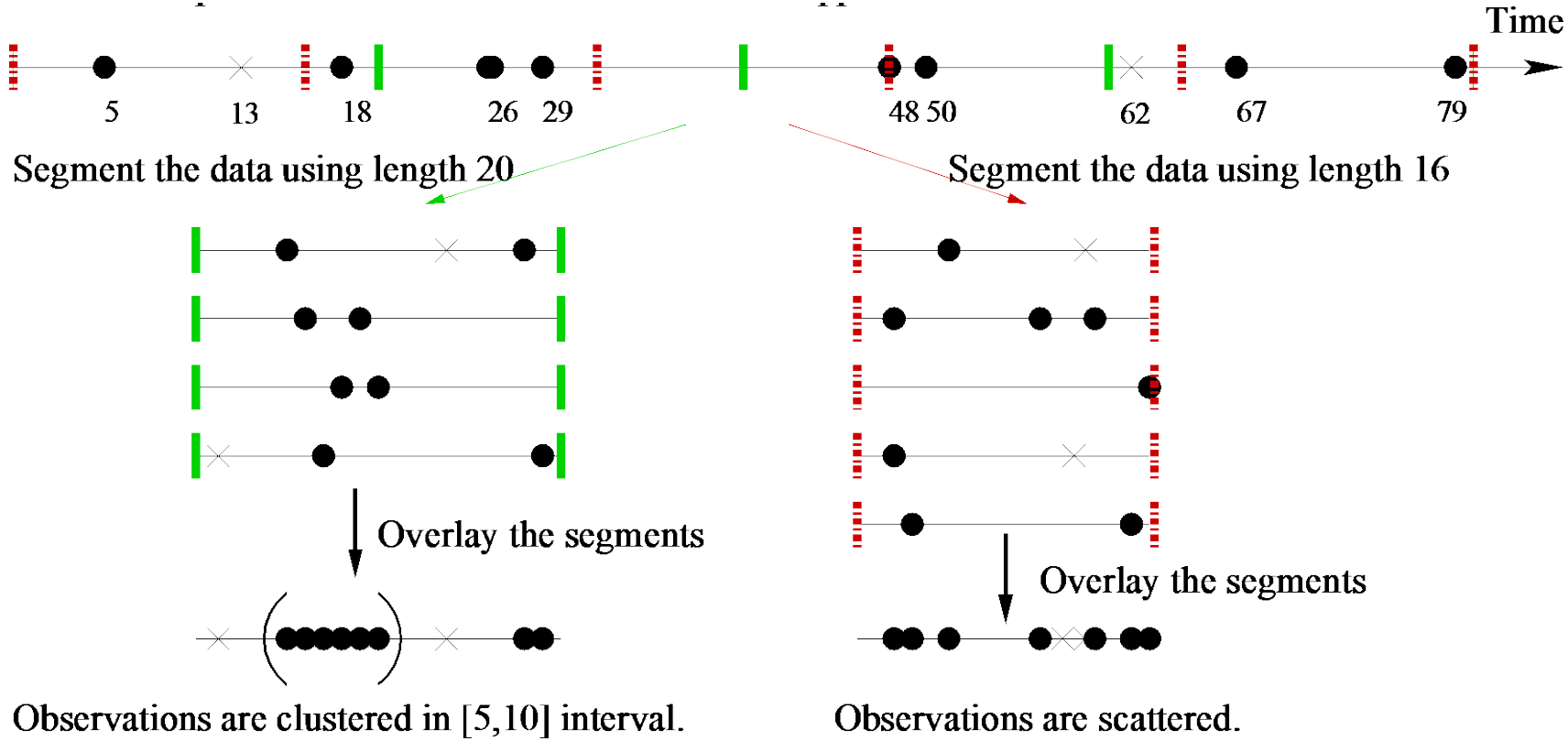


- **Detecting periods**: Cluster data to find reference "points" and then detect multiple interleaved periods by Fourier Transform and auto-correlation
- **Summarizing periodic patterns:** By clustering and pattern discovery

Z. Li, et al.: Mining Periodic Behaviors for Moving Objects. KDD'10

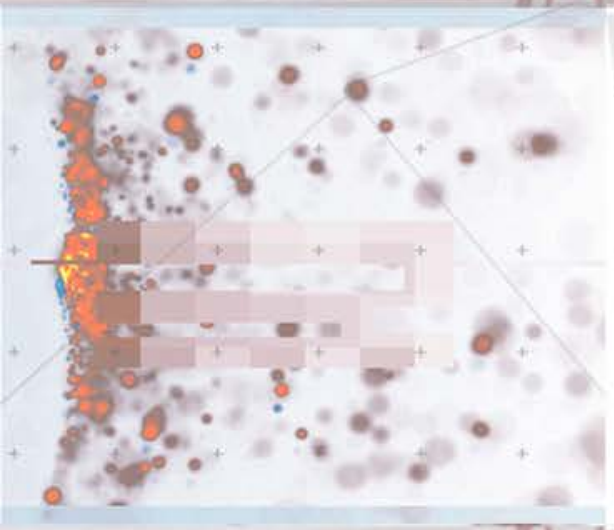
Periodicity Detection in Sparse Data

- Time-related data can be scattered and sparse, e.g., phone calls at a location



- Projecting on the true period, it shows a highly skewed (clustered) distribution
- Effective method can be developed based on this observation

Z. Li, et al., ePeriodicity: Mining Event Periodicity from Incomplete Observations. IEEE TKDE, 2015



Summary

Summary: Mining Spatiotemporal and Trajectory Patterns

- Mining Spatial Associations
- Mining Spatial Colocation Patterns
- Mining and Aggregating Patterns over Multiple Trajectories
- Mining Semantics-Rich Movement Patterns
- Mining Periodic Movement Patterns

Recommended Readings

- F. Giannotti, M. Nanni, F. Pinelli, D. Pedreschi: Trajectory Pattern Mining. KDD'07
- Y. Huang, S. Shekhar, H. Xiong: Discovering colocation patterns from spatial data sets: A general approach. IEEE Trans. on Knowledge & Data Eng., 16(12), 2004
- Y. Huang, J. Pei, H. Xiong: Mining Co-Location Patterns with Rare Events from Spatial Data Sets. GeoInformatica 10(3): 239-260, 2006
- K. Koperski, J. Han: Discovery of Spatial Association Rules in Geographic Information Databases. SSD'95
- J.-G. Lee, J. Han, and K.-Y. Whang: Trajectory Clustering: A Partition-and-Group Framework, SIGMOD'07
- Z. Li, B. Ding, J. Han, R. Kays: Swarm: Mining Relaxed Temporal Moving Object Clusters. VLDB'10
- Z. Li, B. Ding, J. Han, R. Kays, P. Nye: Mining Periodic Behaviors for Moving Objects. KDD'10
- Z. Li, J. Wang and J. Han, ePeriodicity: Mining Event Periodicity from Incomplete Observations. IEEE TKDE, 27(5): 1219-1232, 2015
- C. Zhang, J. Han, L. Shou, J. Lu, and T. La Porta: Splitter: Mining Fine Grained Sequential Patterns in Semantic Trajectories. VLDB'14