Information Content in Motion

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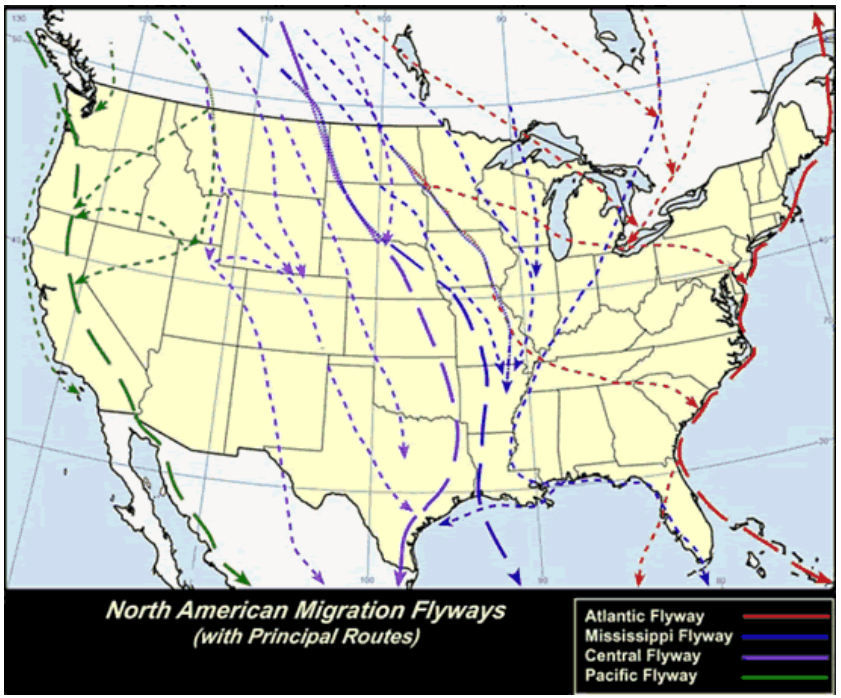
Questions

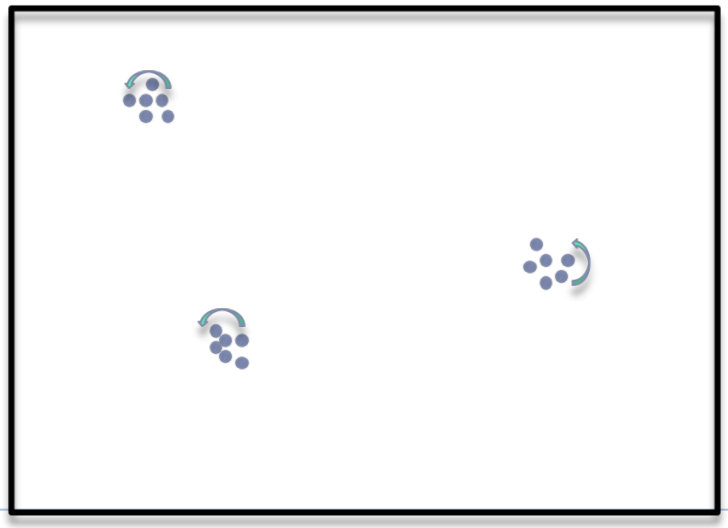
- What are good definitions for the information content of motion?
- How can we identify patterns in motion?
- How can we create algorithms and efficiency analyses that are dependent on the information content of motion?

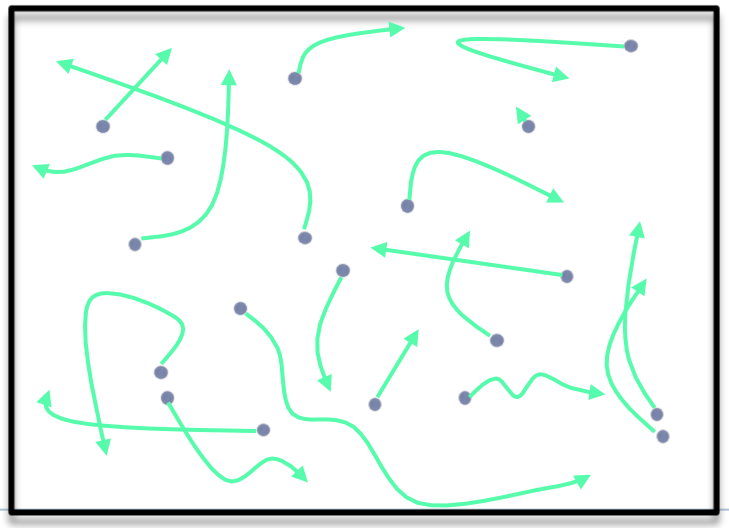
Motivation


North American Migration Flyways
(with Principal Routes)
Atlantic Flyway
Mississippi Flyway
Central Flyway
Pacific Flyway

Motivation

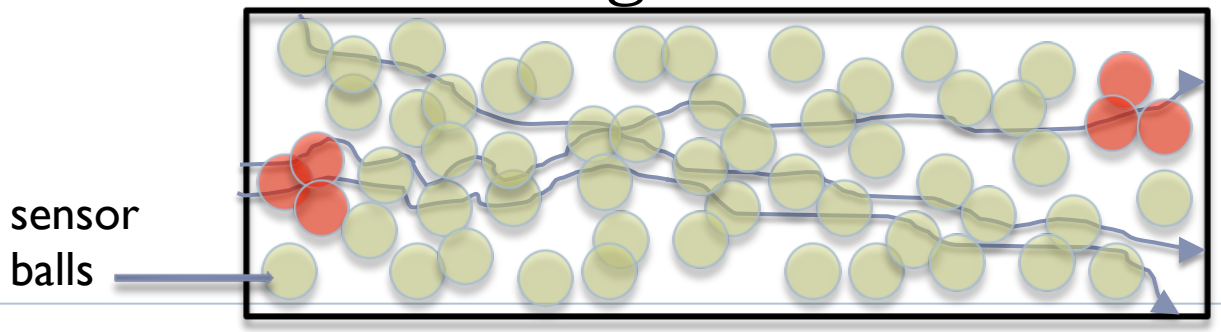
- Develop a framework for kinetic data from sensors
  - No advance object motion knowledge
  - No restrictions on object motion
  - Reasonable assumptions of what a sensor can know
  - Efficiency analysis that is motion sensitive





Our Framework

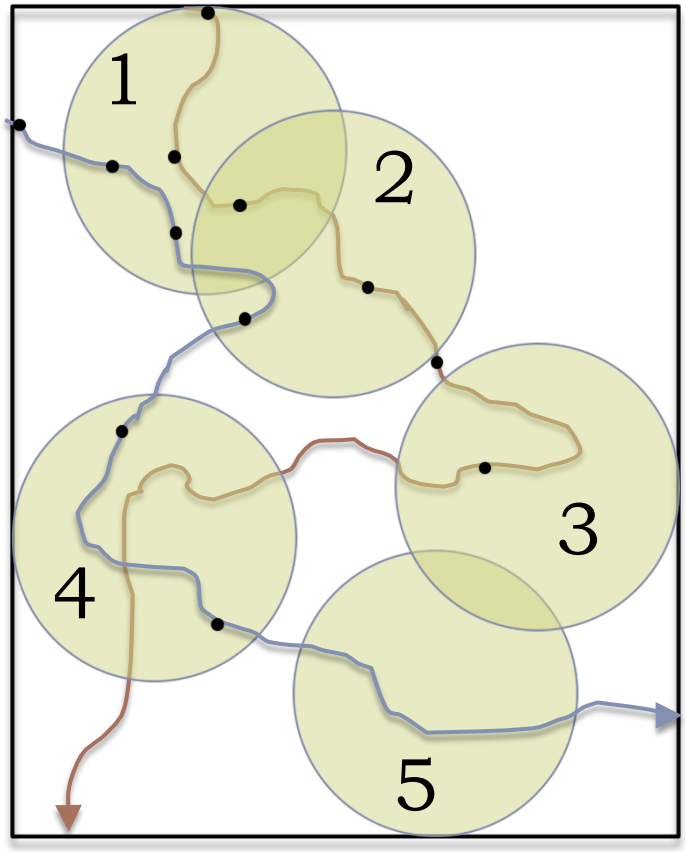
- Detection region around each sensor (stationary sensors)
- Point motion unrestricted
- No advance knowledge about motion
- Each sensor reports the count of points within its region at each synchronized time step
- *k*-local: Sensor outputs statistically only dependent on *k* nearest neighbors



Sorelle A. Friedler and David M. Mount. Compressing kinetic data from sensor networks. AlgoSensors 2009.

Data Collection

Data based on underlying geometric motion

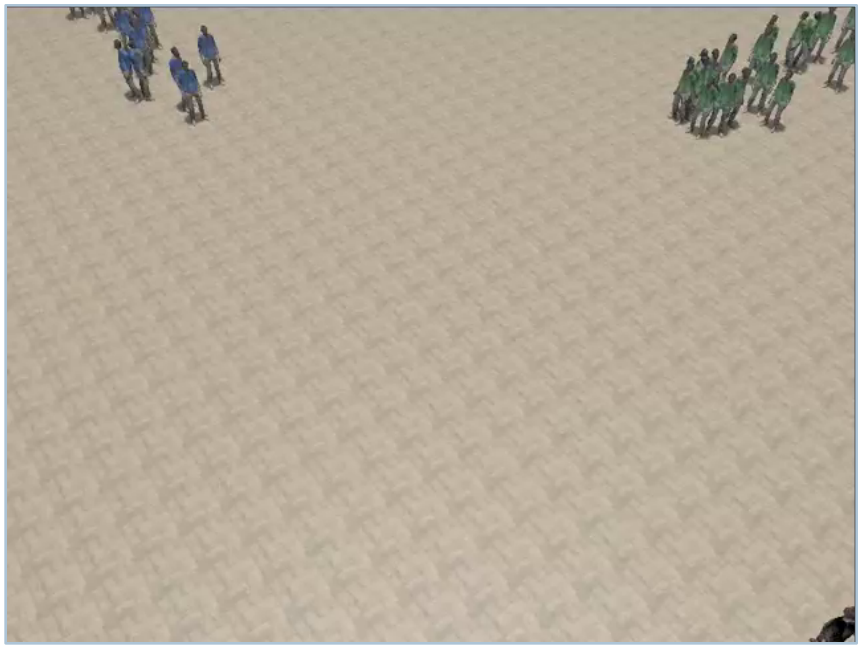


Sensor data streams

x_1	x_2	x_3	x_4	x_5
1	0	0	0	0
2	0	0	0	0
2	1	0	0	0
0	2	0	0	0
0	0	0	1	0
0	0	1	1	0

time

Spatio-temporal k-Center Problem



simulation by the UNC collision avoidance team

- $\mathbf{X} = \{X_1, \ldots, X_S\}$
- $X_i = X_{i1},\ldots,X_{ij}, \ldots, X_{iT}$
- Assign counts to k clusters $C_{ij1}, \ldots, C_{ijk}$ such that for all sensors and times i,j
  - $\Sigma_\ell C_{ij\ell} = X_{ij}$
- Minimize the maximum $H_\tau(\mathbf{X})$ over all $C_\ell = \{C_{ij\ell}\}_j$

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