

Going Beyond Nodal Aggregates

Saurabh Ganeriwal, Chih-Chieh Han, Mani Srivastava

Networked and Embedded Systems Lab (NESL) – <http://nesl.ee.ucla.edu>

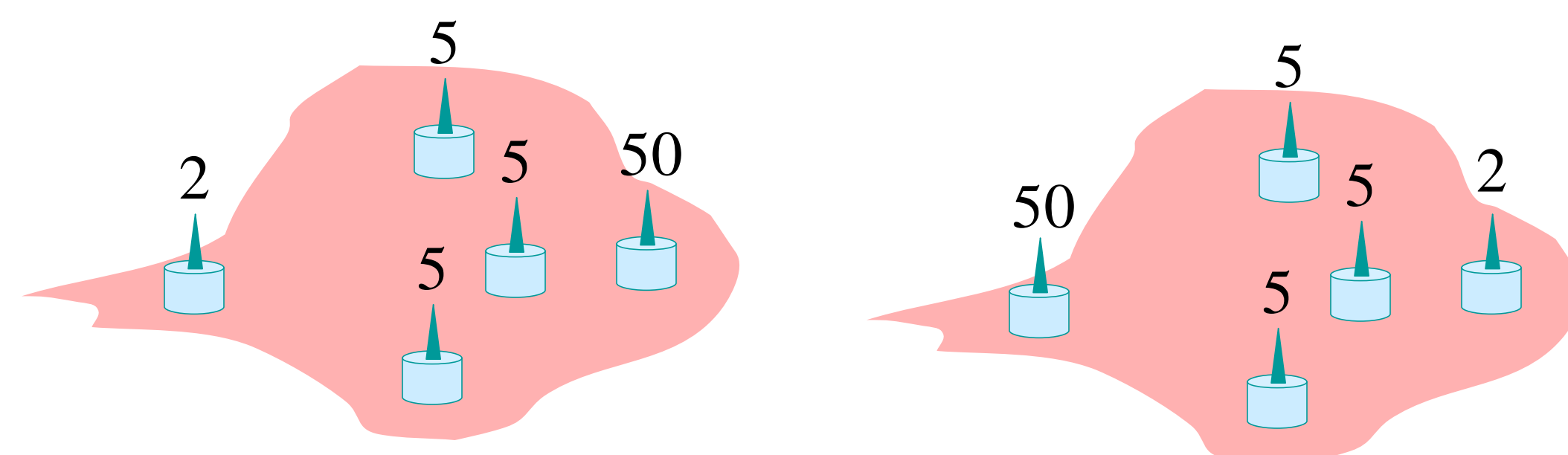
Introduction: Fallacy about Aggregation in Sensor Networks!

Aggregation in Sensor Network

- Strong coupling with the physical world!
- Underlying physical process is going to be mainly continuous.
 - Temperature, CO gas content, Precipitation, etc.
- Deployment is going to be random and generally unknown to the end user.
- Typical queries will be of the form
 - “Give me the average temperature in this *room*”
 - And not
 - “Give me the average temperature over the *nodes* N_1, N_2, \dots, N_k ”.

Nodal vs Spatial Aggregation

- Problem: Calculate the average reading over region R.
- Proposed solution of nodal aggregation : Calculate it over the discrete set of nodes lying in region R.
- Results in inaccurate answer.



- Deficiency: Missing notion of “*space*”.

Problem Description: Spatial Aggregation

What We Need?

- The value of the underlying process throughout region R.

What We Have?

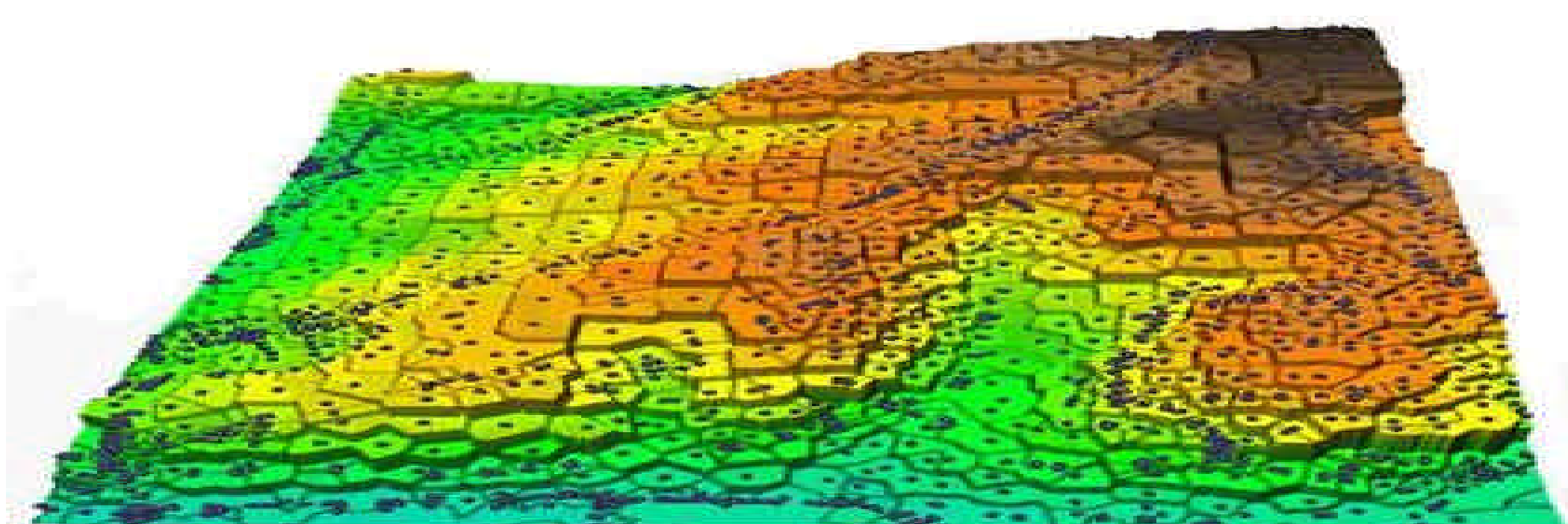
- A few samples of it in the form of sensor values
- Moreover they are *non uniform* in space.

What Can We Do?

- Use interpolation to estimate values at virtual nodes on a uniform grid.
- Use classical results of generating the process from non-uniform samples.
- *Fit a surface to existing available samples and calculate aggregate on that surface.*

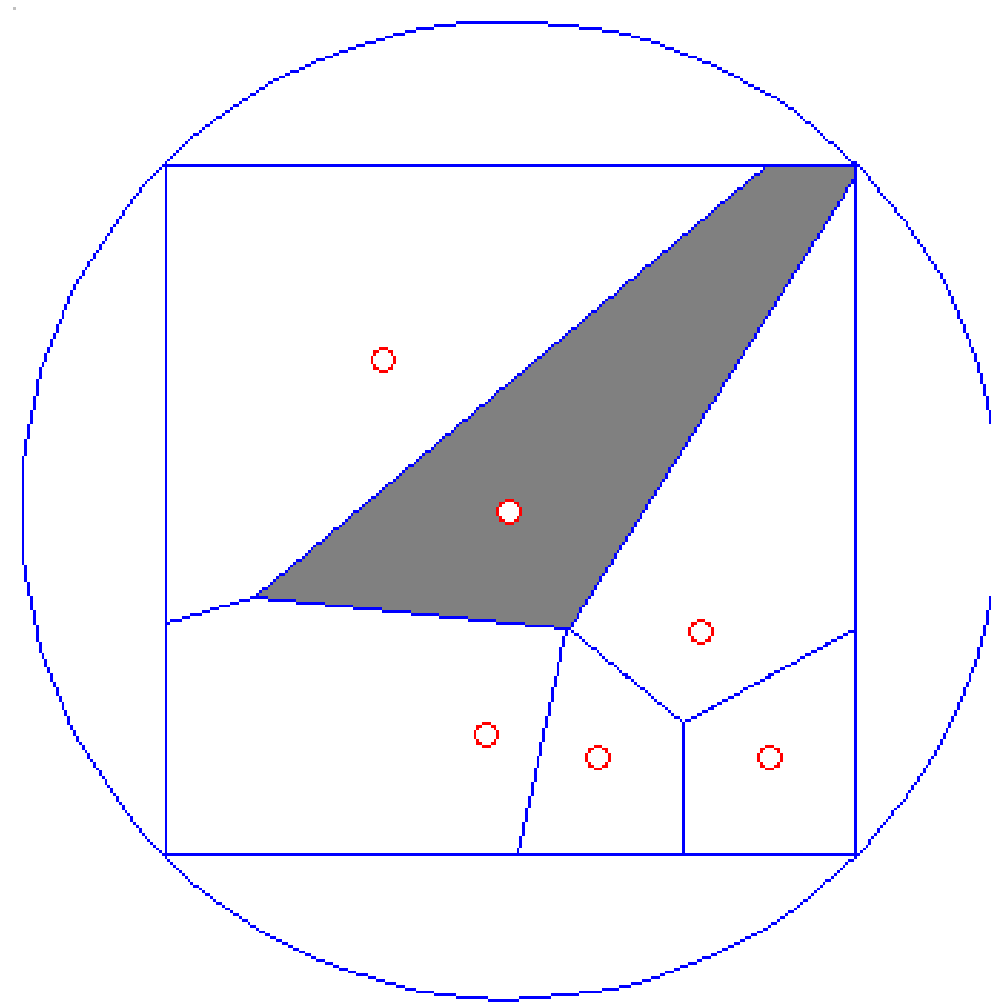
Proposed Solution: Voronoi Interpolated Aggregation Service (VIAS)

Weigh Readings by The Area of Voronoi Polygon



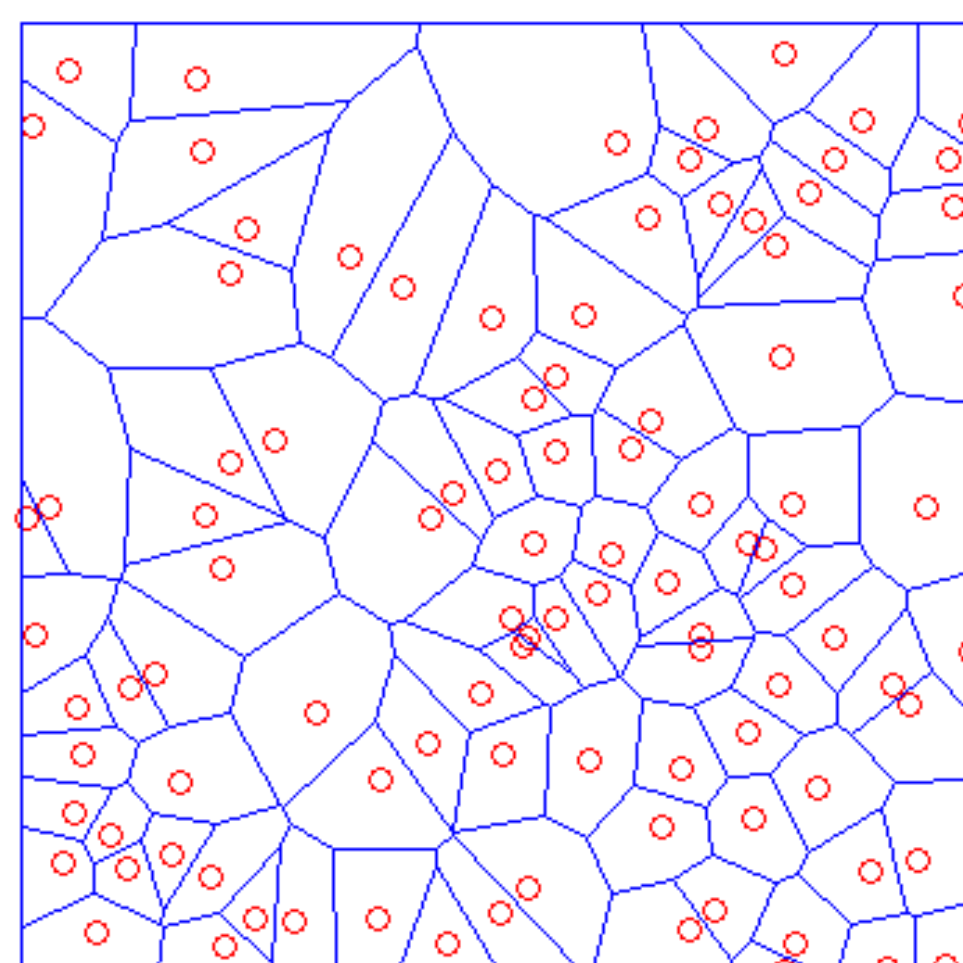
Localized Weighting Service (LWS)

- Each node construct Voronoi polygon over one-hop radio neighbor
- Polygon clipping on inscribed square
- Compute its Voronoi polygon area

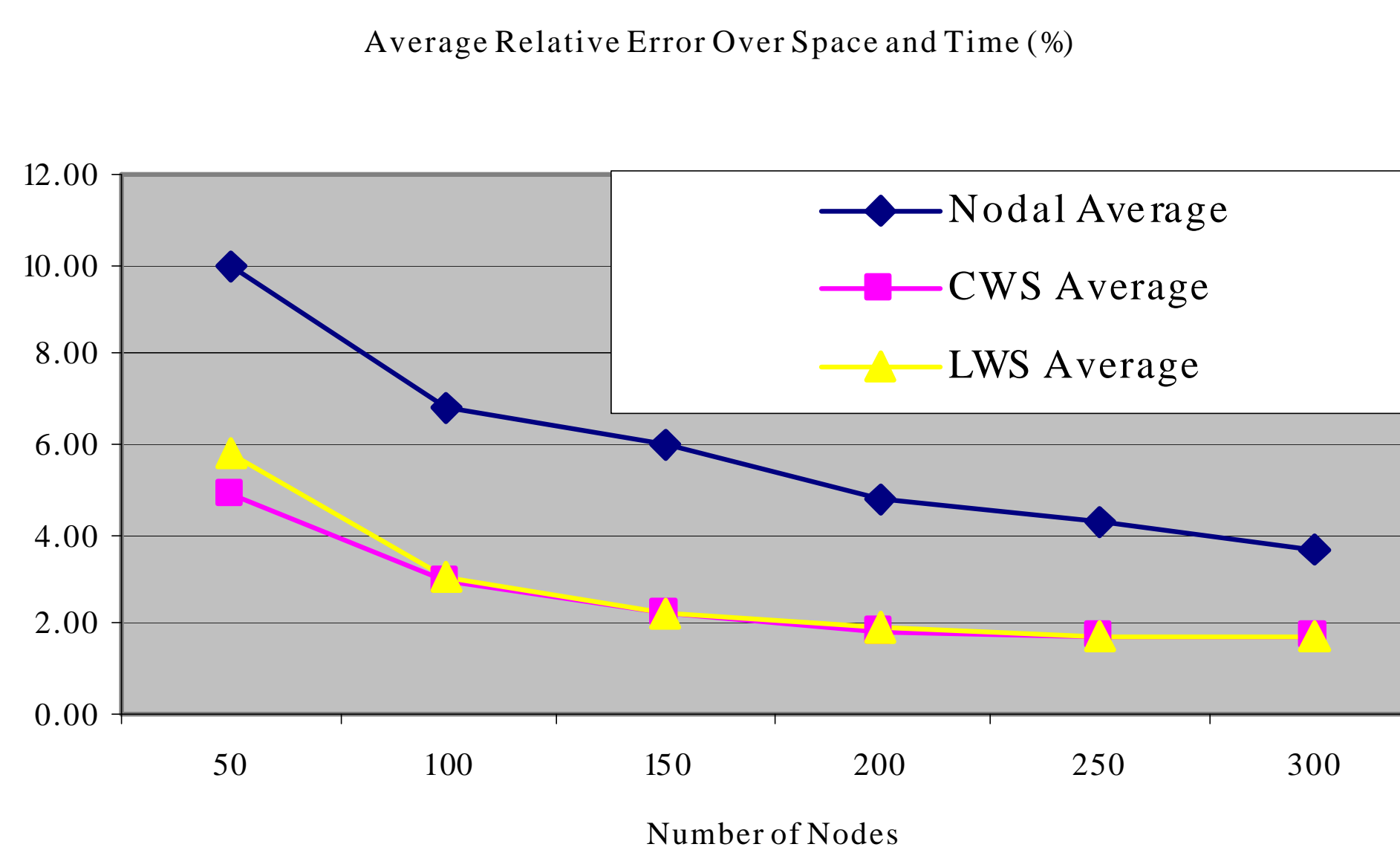


Centralized Weighting Service (CWS)

- Centralized node constructs Voronoi diagram over all nodes
- Polygon clipping on network boundary
- Compute each Voronoi polygon area



Simulation over Precipitation Data Set



Prototype Implementation on Berkeley Mote

