Application of Sensor Network for Supporting Fire Fighters
Patrick Y. H. Cheung and Nick Maxemchuk
COMET Group, Columbia University, New York

Project Goal
- Support fire-fighters in the rescue mission by providing real-time information, like fire size, spreading speed, chemical concentration, etc., collected from the fire scene.

Telescopic Data Compression Scheme
- To save transmission power and prolong network lifetime, we propose a compression scheme that removes redundancy in sensor data based on sampling theory. Advantages include:
  - Compression ratio close to the theoretic optimum value.
  - Allow users to get a crude overall signal profile efficiently and then “zoom into” particular regions of interest.
  - Local interpolation filters out data noise.

Step 1A: Formation of Sample Points
The many randomly spaced sensor readings are compressed to a fewer number of uniform sample points.

Step 1B: Calculating Sample Points
Possible interpolation algorithms:
- Nearest neighbor
- Inverse distance weighting
- Linear triangular
- Cubic Hermite triangular
- Interpolated uniformly spaced sample
- Reconstructed signal

Step 2: Collecting Sample Points
Different Resolutions in Different Areas
A higher uniform sampling density is applied to the area of interest.

Fire Scene Temperature Distribution Reconstructed from Uniform Samples of Varying Densities

Technical Challenges of Deploying Smart-Dust Type of Sensor Networks
- Large number of randomly spaced sensors
- Severe energy constraint
- Limited computational power
- Data “funneled” to a small number of sinks
- Compression algorithm must be distributed

Data from sensors is “funneled” to a collection point

Compression Performance Based on an Ideal Bandlimited Signal

Further information is available by email to patrick@ee.columbia.edu.