"How to share the network resources (wireless bandwidth) to maximize the effectiveness of sensor-enabled applications (missions)?"

- WSN environments with significant bandwidth constraints
- Heterogeneous missions utilizing multiple types of sensors.

**Challenges**

**Mission-oriented Sensor Networks**
- Different sensors have different relative importance
- Importance of one sensor changes dynamically based on data quality from other sensors.
- Different sensors have different relative importance
- Need for differentiated or prioritized congestion control.

**Wireless Sensor Networks**
- Channel capacity is not fixed
- Exploit broadcast capabilities at the link layer
- Contention among transmissions can change

**Dynamic environment**
- Missions come and go at different times
- Topology changes frequently (node mobility, wireless link variability, sensor activation)
- Contention among transmissions can change

**Networked Sensor Interfaces**
- Sensor contributes to multiple missions
- Multicast flows
- Different missions need different amount of data from the same sensor.

**Broad Approach**

**Network Utility Maximization (NUM)**
A Distributed, Utility-Based Formulation of Resource Sharing

1. Each mission has a "utility": $U_m(x_1, x_2, ..., x_n)$
   - A measure of how "happy" the mission is
   - A function of source rates from all its sensors
2. Allocate WSN resources (network interface bandwidth of nodes) to maximize cumulative utility.
3. Congestion control is formulated as a utility maximization problem

**Our Objective:**
"Rate/Congestion Control for Network Utility Maximization"

**Our Analysis Framework**

**WSN-NUM Protocol**

**Protocol-level Simulation**

We simulated this protocol on 802.11b based network and studied network utility, delays, losses, overheads. Results show that our framework can provide (i) very good resource sharing and (ii) fast adaptation to changes in missions or sensor topology.

**Future Work and Publications**

Future work includes:
- Extension of utility functions to consider alternative additional metrics (latency, loss) or non-concave behavior
- Joint optimization of rates with wireless interface transmission power, since transmission power is a scarce resource that directly affects link bandwidth and contention regions.