Multi-Robot Task Allocation

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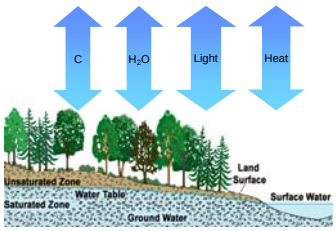
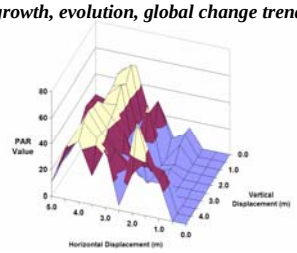
NIMS: http://www.cens.ucla.edu/portal/nims.html

Introduction: Multi-Robot Task Allocation for Spatiotemporal Monitoring

We are interested in:

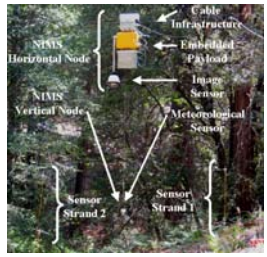
- Monitoring ***spatiotemporal*** phenomena in Atmosphere, Water, Soil, and Ecosystems
- Long-term unattended data acquisition
- Monitoring Photosynthetically Active Radiation (PAR)
- The characterization of solar radiation spatiotemporal patterns important for: ***growth, evolution, global change trends***

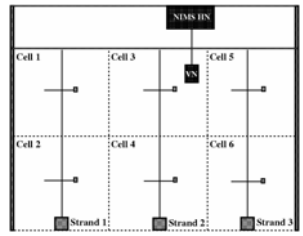




Our System:

- Networked Infomechanical System (NIMS) architecture that combines *both static and mobile* sensor nodes
- Static sensor nodes are positioned in the volume surrounding a transect in which the mobile node operates





Proposed Solution: Task allocation in Networked Info-Mechanical System

NIMS-TA Algorithm

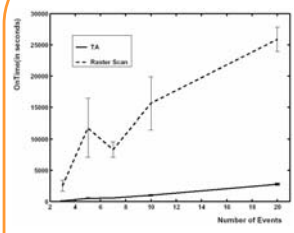
Static Node:

1) **Task generation**: If node's sensor reading is above a threshold a *task* is created and a notification message is broadcasted
2) **Task management**: maintain T_a and T_{na}

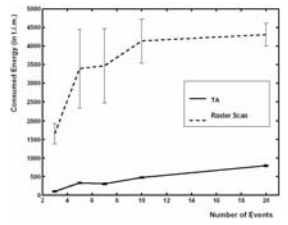
Mobile Node:

1) All incoming new tasks are sorted according to the criterion ***C*** (time of arrival) and stored in T_a
2) Robots exchange utilities (based on distance) of performing tasks in T_a
3) The task of highest priority is extracted from T_a and assigned to the most fit robot (with highest utility)
4) Based on the task information the robot computes a goal point (projection) and a corresponding cell C_k
5) Navigate to the goal point, perform sampling
6) After robot completes its last task it notifies Sensor Network

Experiment 1: NIMS-TA vs. Raster Scan

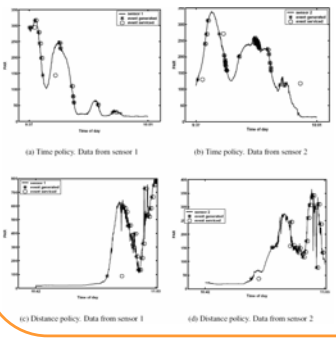


Comparison of event OnTime between TA and Raster Scan. Number of events varies between 3 and 20.

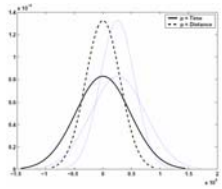


Comparison of energy consumption in units of time-in-motion (t.i.m.) between TA and Raster Scan. Number of events varies between 3 and 20.

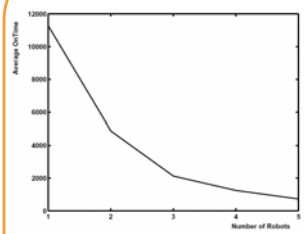
Experiment 2: Experiments at James Reserve



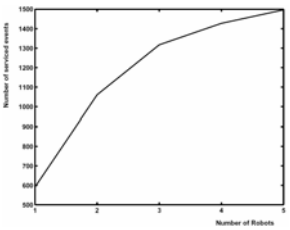
- Single robot experiments (one NIMS node)
- Time policy: tasks with smaller time stamp get priority
- Distance policy: tasks closer to the robot get priority



Experiment 3: Multi-Robot Task Allocation



Average OnTime as a function of the number of robots



The number of serviced events as a function of the number of robots

Future Work: A Closed-loop Modeling System

- Analyze the data gathered by the proposed task allocation system
- Construct a model of the studied phenomenon
- Improve the performance of the TA system with domain knowledge obtained from the model
- In turn, improve the model