



CENTER FOR EMBEDDED NETWORKED SENSING

Designing Data Driven Systems for Real-world Applications

CENS Annual Research Review

Matthew Mayernik and

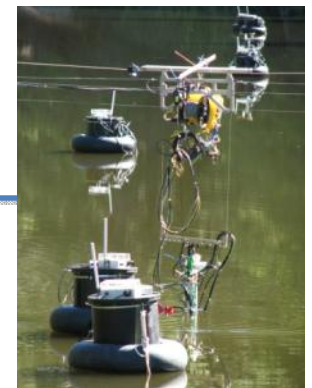
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CENS Data Collection

- CENS collects data for scientific and technological applications through real-world deployments
- Deployments take place in numerous locations in California and around the world
 - San Joaquin River basin
 - Aquatic
 - San Jacinto James Reserve
 - Aquatic & terrestrial
 - La Selva Biological Station (Costa Rica)
 - Terrestrial
 - Among others
- Data from these deployments are spatially and temporally distributed
 - Important both for short term and long term research



Sensors used on CENS Platforms

- Aquatic: (e.g. NIMS, NAMOS)
 - Hydrolab MS or DS series (temp, pH, SpCond, DO, chlorophyll-a, rhodamine, among others)
 - MBARI ISUS (nitrate)
 - SonTek Argonaut (ENU flow velocity, compass)
 - Fluorometer (chlorophyll-a)
 - Among others
- Terrestrial: (e.g. NIMS, AMARRS)
 - Atmospheric (air temp, RH, wind speed)
 - Solar radiation (PAR, pyronometer, pyrgeometer)
 - Imagers
 - Among others



Environmental Sensing Challenges

- Sensor placement
 - Mobile sensors (1,...,m)
 - Fixed sensors (1,...,n)
- Data aggregation
 - Variable rate data collection
 - Filtering redundancies
- Efficiency
 - Utilization of time
 - Mobile system use
 - Path planning
 - Sampling location



NIMS Data Collection Process

Networked InfoMechanical Systems (NIMS)

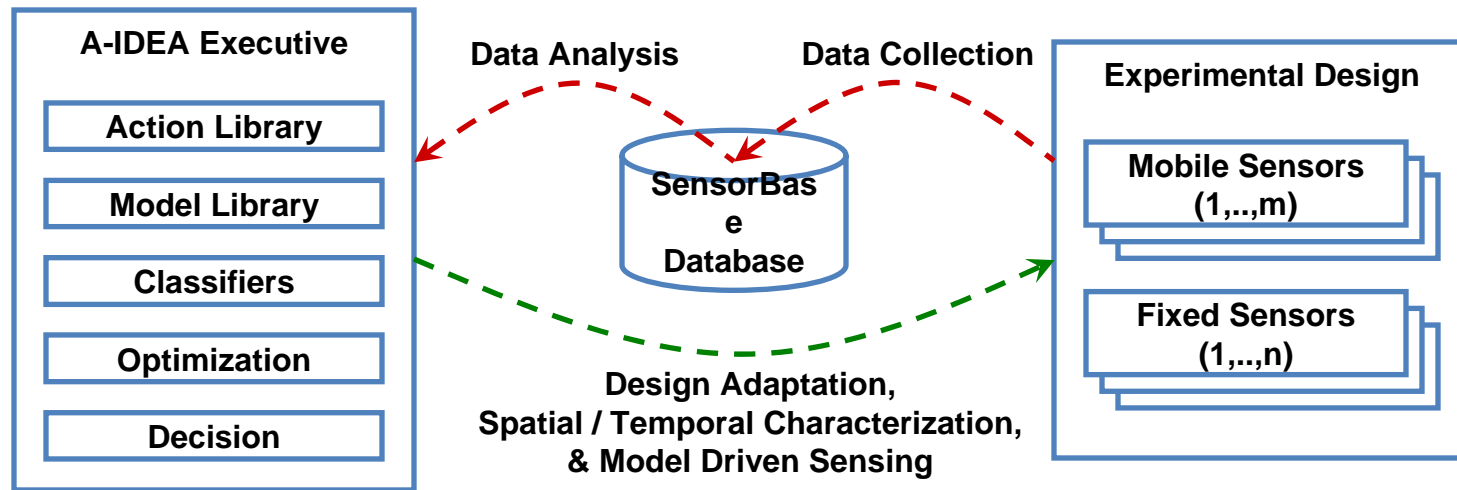
- NIMS-RD
 - Aquatic and terrestrial environments
 - 2-D vertical cross-section
 - Setup ~ 2-5 hr
 - Minimal intrusion
 - Real-time data (festooning)

- NIMS-AQ
 - Aquatic environments
 - 3-D volume
 - Setup ~ 1 hr
 - 15-20 cm pontoon draft
 - Real-time data (wireless)



Autonomous IDEA

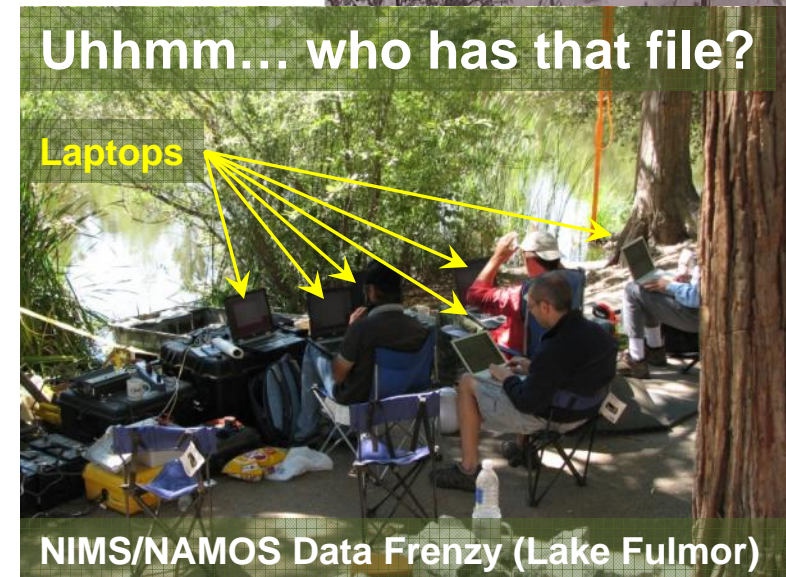
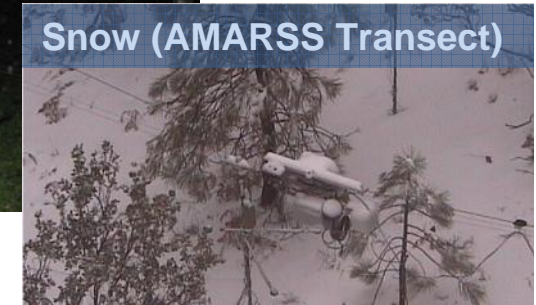
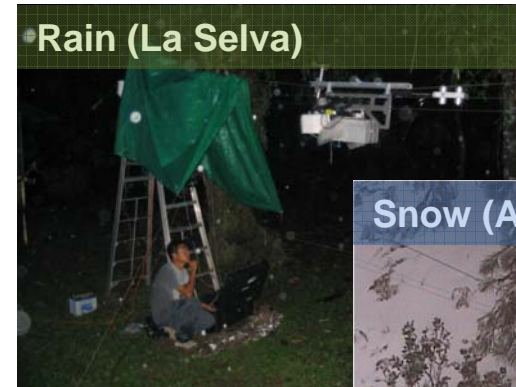
Iterative experimental Design for Environmental Applications (IDEA)



- An approach for characterizing an unknown environment under the constraints of rapidly evolving phenomena.
- In-field adaptation in the experiment design
 - Capture phenomena dynamics exploiting observations from prior models, iteratively executed experiments and the behavior of the underlying control processes (if known).

Context of Data Collection

- With data coming from real-world deployments, the context of data collection is important
- Data collection decisions are often based on the state of instruments and field conditions
- Deployment information varies between CENS research groups and is stored in many locations
- Not easy to find
 - Takes some effort to find out who has gone where to take what data



CENS Deployment Center (CENSDC)

- A Web-based repository for CENS deployment information
 - Centralized planning and researching of deployment activities
 - Structured and searchable deployment metadata to facilitate knowledge discovery
- A cross-linkable source of contextual information for CENS data, including:
 - Dates
 - Locations
 - People
 - Equipment Used
 - Data Collection Procedures



Equipment:			
Acoustic ENSBox Batteries	🔍	10, 0, Bring	
CF Media Reader	🔍	1, 0, Bring	
Electrical tape	🔍	1, 0, Bring	
External hard drive (500GB)	🔍	1, 0, Bring	
Flagging tape	🔍	1, 0, Bring	25 foot lengths

Task
1: TRANSECT SETUP - The following are the steps involved in setting up a NIMS-RD transect
2: Set up anchoring ladder, attach spool wheel to top
3: Attach tie-downs to anchor points and string up static cable
4: Attach end pieces and NIMS motor to static cable
5: String up ver, hor, calib cables

Putting It All Together



- CENSDC serves as the central repository for pre-deployment planning and requirements
- Deployment objectives and timelines are clear as everyone has the same information
- Post deployment analysis, conclusions and lessons learned are updated on CENSDC for future use

Institutional Memory

- CENS researchers have extensive field experience
 - But, research personnel changes regularly due to graduation and people moving on to other projects
- The CENSDC as a training tool for new researchers
 - Post-deployment notes
 - Problems encountered and solved
 - Suggestions for future deployments

