



CENTER FOR EMBEDDED NETWORKED SENSING

IMAGEin Ecology

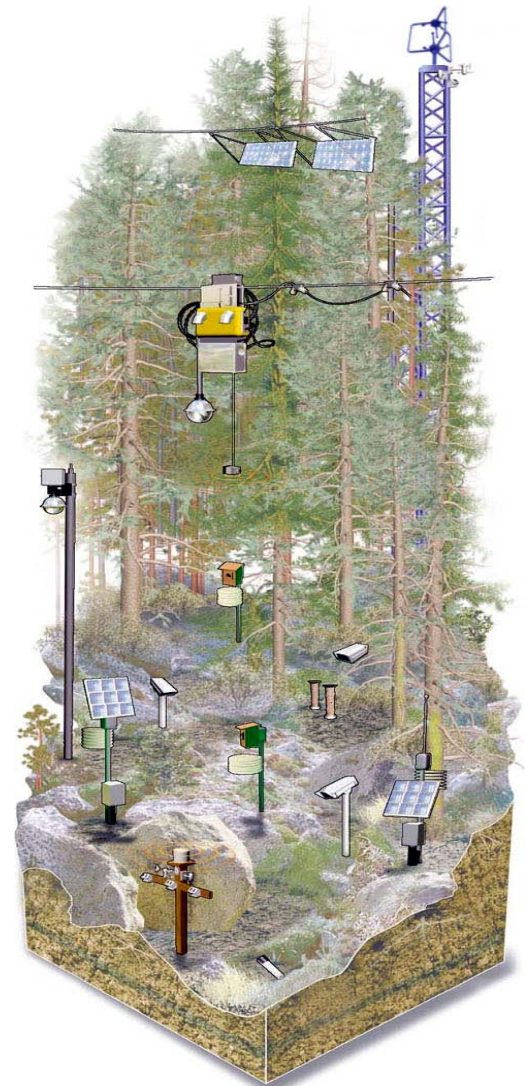
Presenters: Josh Hyman, Teresa Ko

Shaun Ahmadian, Mike Allen, Sharon Coe, Deborah Estrin, Brian Fulkerson, Eric Graham, Michael Hamilton, Mark Hansen, John Hicks, Mohammad Rahimi, Stefano Soatto, Eric Yuen, Alan Yuille,

UCLA CENS, Vision Lab

- There are questions we can't (easily) answer with traditional sensors
 - What are the CO₂ relations of a plant in the field?
 - Is the flowering and leafing events of different species synchronized with pollinators and herbivores?
 - When do the different stages of the avian breeding cycle occur and what types of behaviors do birds exhibit in these stages?

- Indirect sampling of actual phenomena of interest
 - Color → CO₂
 - Timing of flowering → synchrony of pollinators
 - Egg Count → breeding stage





Overcoming limitations of general vision approaches

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Category Recognition Goal:

Distinguish between many categories, including an “everything else”.

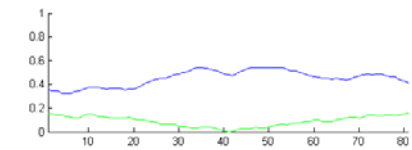
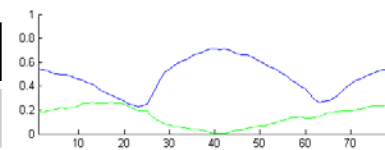
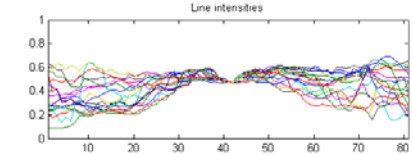
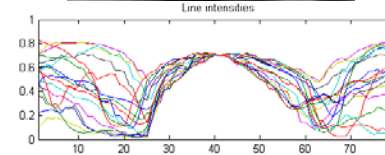
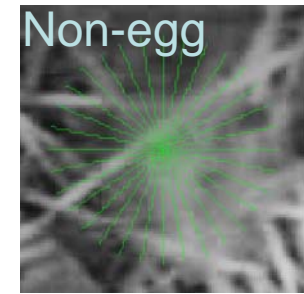
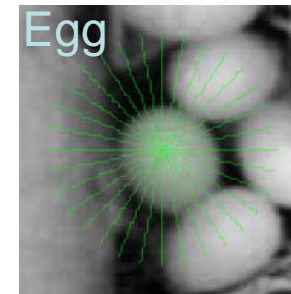
Application Goal:

Distinguish between a few categories, knowing the data collected will only contain those categories on a constrained system.

	SIFT Descriptor		Profile Intensity	
	Precision	Recall	Precision	Recall
1000+ images	80.61%	53.50%	96.72%	84.14%

Our Approach

- Find an relationship from the problem space into feature/model pairs
- Allow the application to determine the parameters
- Systemically integrate domain knowledge



Generalizable? :

Detecting flowers in meadows



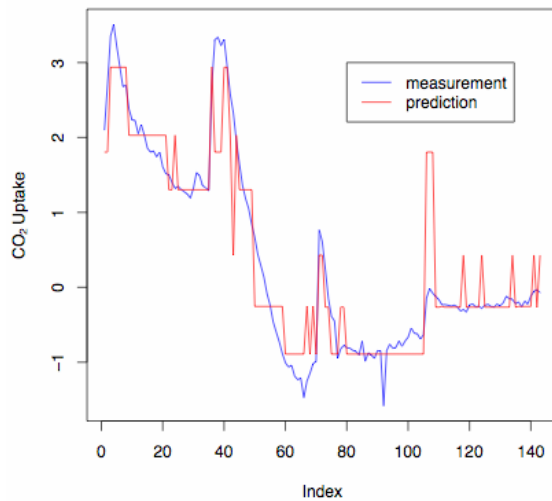
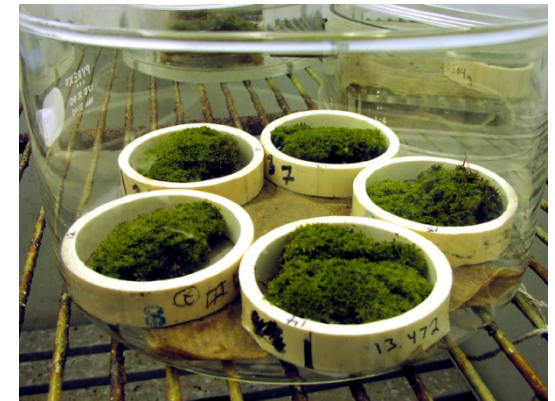
Doing what humans can't do

Application Goal:

Determine CO₂ uptake of a drought-tolerant moss in the field.

Using Domain Knowledge:

There is a known correlation between moss color and CO₂ uptake. However, requires a human observer in the field at all times.



Building a model:

1. Extract color based image features
2. Build a regression based model of CO₂ data collected in a laboratory.



Eventually, apply to historical data from existing experiments in the field.



Imagers and interactive sensing

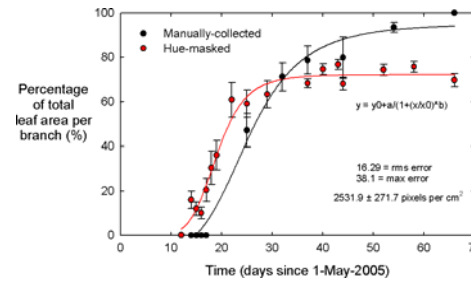
Area of interest



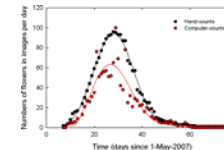
Interactive visualization & image processing



Image Capture



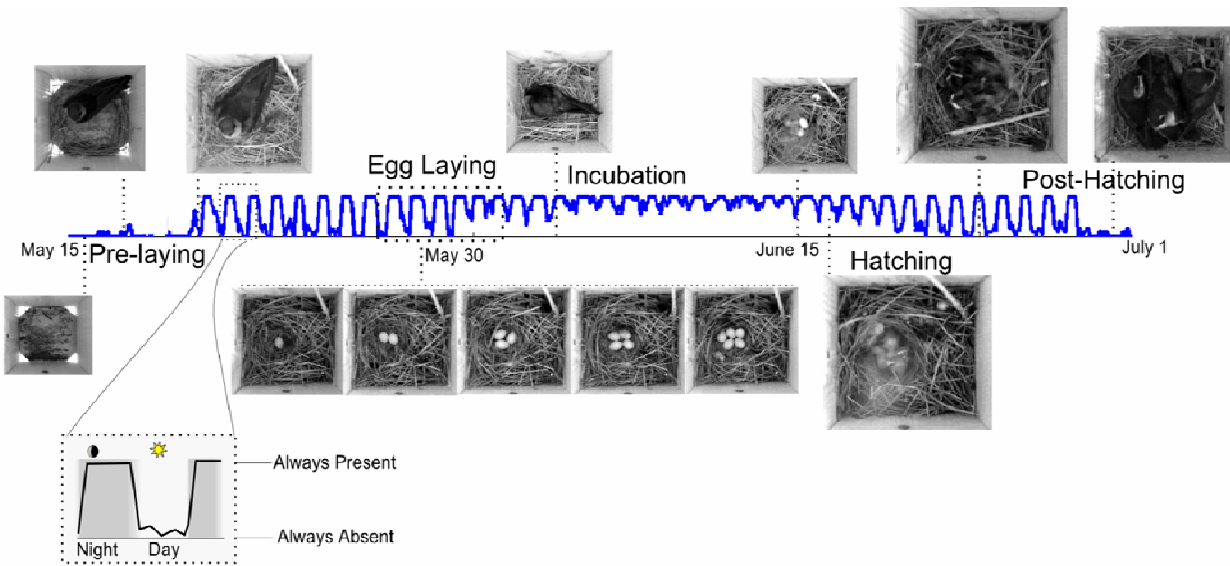
Scientific results





Developing the system

End Goal: Snapshot of nesting cycles.



Characteristics

- Dense Spatial Sampling
- Remote Locations
- Automated Processing

Approach

- Low-power image sensor and radio
- Adaptive Sampling
- Partition computation across a hierarchy of heterogeneous processors

