e-FARMS: a two-way road from small farms into the networked world

http://www.lis.ic.unicamp.br/projects/efarms
Satellite sensors

Ground sensor network

TWO WAY ROAD

Cooperative COOXUPE

Hardware

UNICAMP PUC-Campinas

Farmers Produce

Images

Maps

Reports

UNICAMP PUC-Campinas
GOALS – Science & Technology

• Sensor-based agricultural data management
  ⇒ MODELS, METHODS, ALGORITHMS
  ⇒ MANAGEMENT, INTEGRATION, ANALYSIS, VISUALIZATION

• Wireless data communications in rural areas
  ⇒ INFRASTRUCTURE, PERFORMANCE
GOALS – Social Impact

• Decision support in agriculture
  ⇒ MODELS + SOFTWARE TOOLS

• Wireless data communications in rural areas
  ⇒ LOW COST SOLUTIONS
Project members

- Four computer scientists
  - Databases, image processing, networks, interoperability
- Three agro-scientists
  - Remote sensing, precision farming, soil management
- One (very) large coffee cooperative
  - 12,000 farms
  - Three states
Results – Science & Technology

• Technology (networks and prototypes)
  – Communications infra

• Research
  – Models for yield forecasting
    • MSc & PhD research (Paper drafts)
  – Image processing
    • Satellite image segmentation using GP (2 papers)
  – Databases
    • Time series mining (1 journal paper submitted)
    • Content annotation (1 journal paper + 1 PhD workshop)
RESULTS
PUBLICATIONS


Results - Networks
From sensors to Internet

Phase 1
– Laboratory experiments

Phase 2
– Temperature sensor to base (antena at 5,8GHz, stability tests)

Phase 3
– Sensor -> base -> “farm” -> Internet

Phase 4 (ongoing)
– Extend to 3 “farms”, 3 sensor types
Phase 1 – Lab Tests
Phase 2 - Antenae
Temperature in LIS
Last temperature sensor reading in LIS was: 25.89 Celsius at 2008-09-19 17:20:23-03:00
Phase 4 – 3 “farms” in 2009

Moisture network

Cooperative

Radiation, temperature
Results – Models, Images, DB
Ariranha

NDVI Medio vs Tempo

Cálculo de NDVI

Documentação

WebMaps

O que é o Webmaps
Equipe
Apoio

Cadastros

Cultura
Região
Propriedade
Talhão

Produtos

NDVI
Pluviometria
Temperatura
NDVI time series, Araraquara, 1999/2000

Rain
Temperature
Radiation

Roots and buds (1)
Growth (2)
Maturation (3)

Productivity ? (IBGE)

NDVI

0,2
0,3
0,4
0,5
0,6
0,7
0,8

jul
ago
set
out
nov
dez
jan
fev
mar
abr
mai
jun
jul
ago
set
NDVI Models

Sugar cane

Urban area

Annual culture
NDVI

Models

Image Processing

Series Mining

Sugar cane

Urban area

Annual culture
NDVI

Models

Image Processing

Series Mining

Sugar cane

Urban area

Annual culture

Annotations
Classification of image regions

Identification of coffee
Series mining – co-evolution

Temperature

Rainfall

Temporal warp

Estimate joint future behavior?

Search for joint patterns?
Annotations – semi-automatic generation
Meet the Real world challenges
Corn – 15 and 27 days after planting

Conventional system

Direct planting
Research challenges
Directions

• In the domain (agricultural sciences)

• In CS (databases, networks, image processing, software engineering)

• A combination of both
Challenges in the domain

• **MODELS**
  – How to describe crop behavior
  – How to describe physical, husbandry environment

• **DATA**
  – Which data to collect, and how

• **DECISION SUPPORT**
  – How to influence future
  – How to interpret and adapt models
Challenges in CS

- Data heterogeneity
  - Spatio-temporal scales, sampling, devices, purposes, collection methods
- Image processing
  - Classification, segmentation
- Retrieval mechanisms
  - Mining, provenance
- Sensor network management - QoS
Challenges in CS + domain

- Domain requirements -> new algorithms
- Model management
- Decision support
- Requirements eliciting
- Testing
Summing up

Technological results
Networks
Prototypes

Scientific results
1 short paper
2 full papers
1 journal paper
1 submitted journal

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