ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

Disal

Distributed Sensing

Distributed Intelligent Systems

5.12.2018

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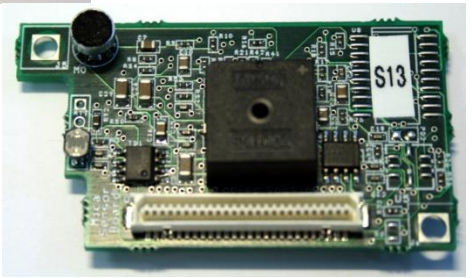
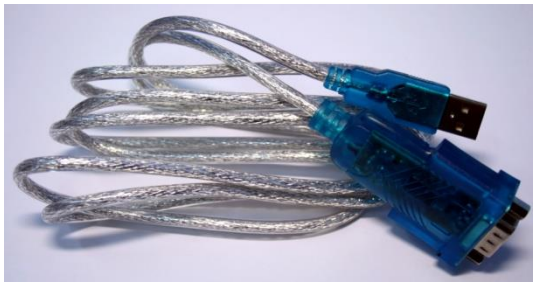
What this lab is about

- Part 1
  - Introduction to the MICAz a Wireless Sensor Network (WSN) node
  - Measuring light signals with MICAz and an external sensor board
- Part 2
  - Multiple basic case studies going through typical topics in distributed sensing in Webots

Part1: Hardware

- Each group of two students will receive
  - 1 MICAz
  - 1 programmer
  - 1 sensor board
  - 1 USB-to-serial cable





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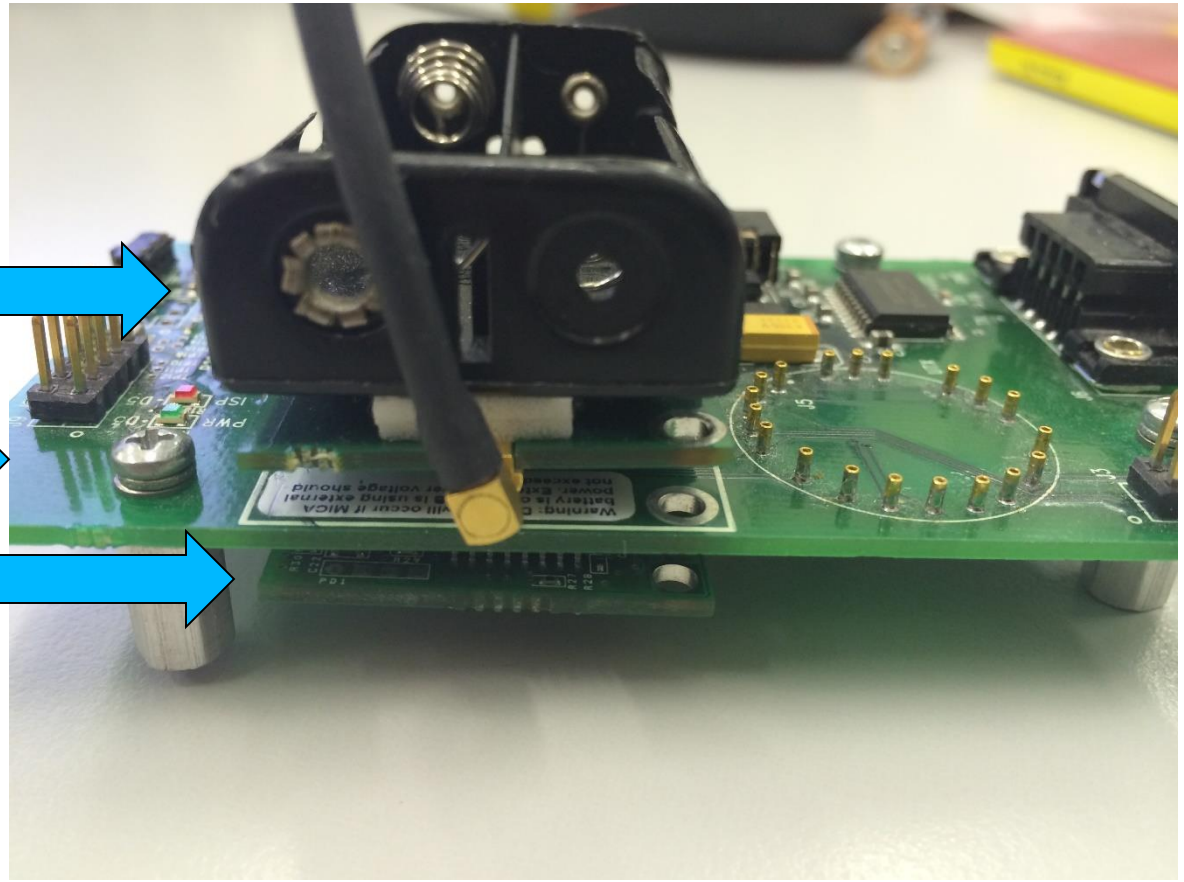
Part1: Connection Overview MICAz

MICAz

Programmer

Sensor board

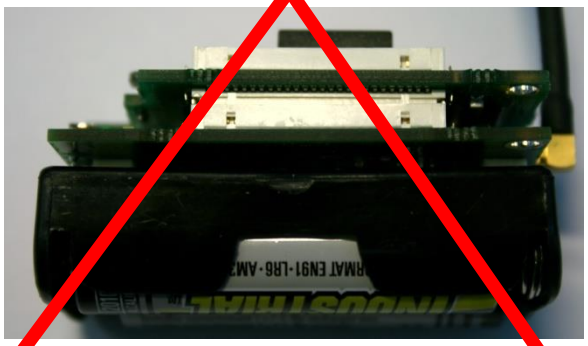


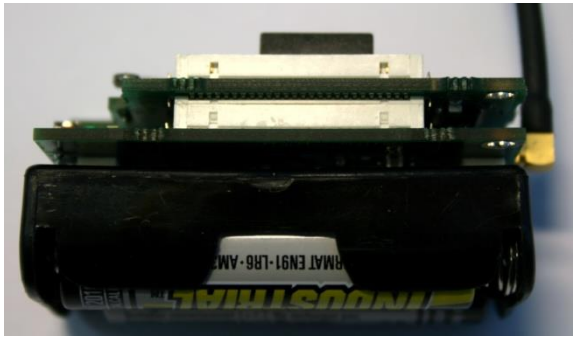
Part1: MICAz connector

Make sure you connect the programmer and senor board properly

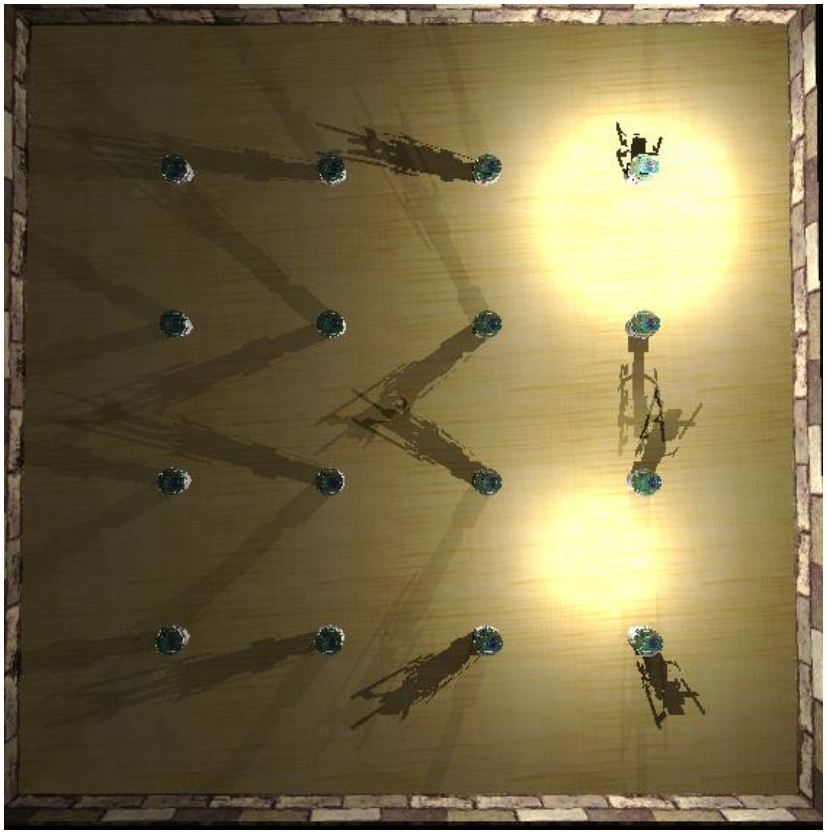
Programmer

Sensor board





Part 2



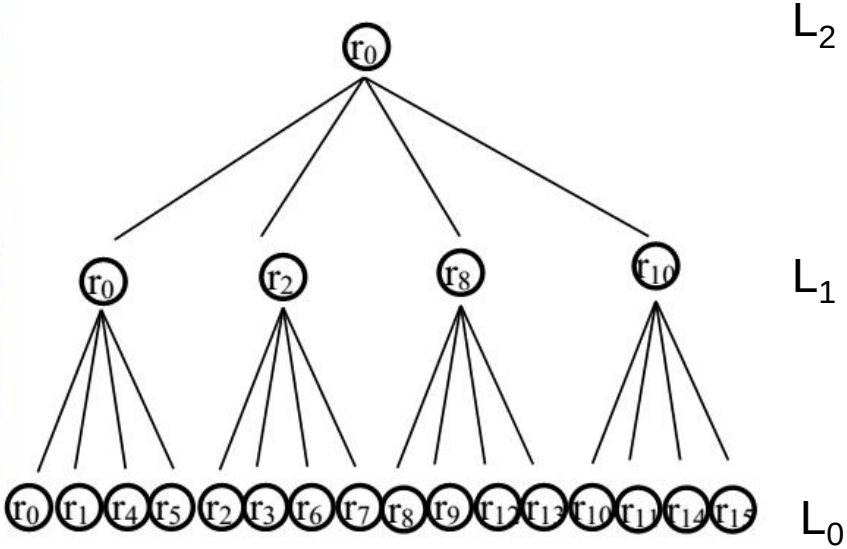
- Multiple basic case studies going through typical topics in distributed sensing:
  - performance evaluation
  - space-division scheduling
  - time-division scheduling
  - static vs. mobile sensor networks
  - controlled vs. uncontrolled mobility

- network of 16 robots
- sensing light field

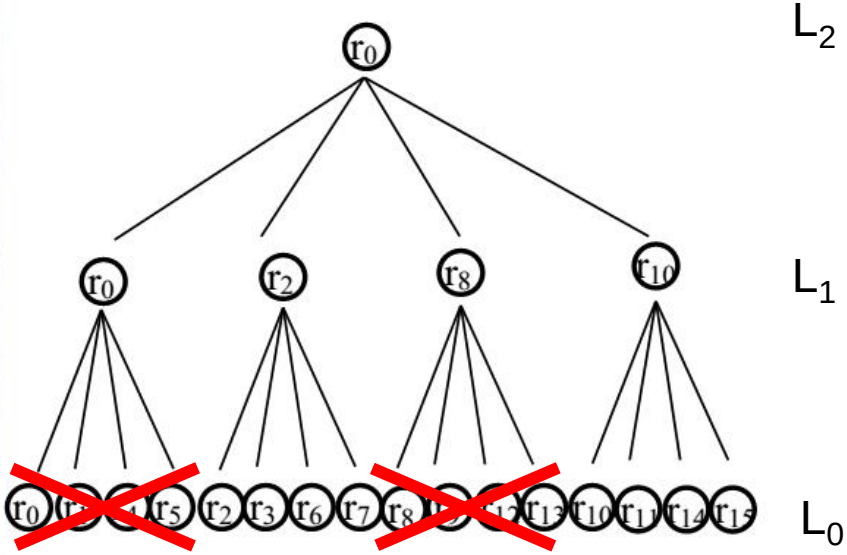
General Performance Metric

$$M_C(\alpha,\beta,\gamma,\delta) = \alpha \cdot \underbrace{\left(1 - \frac{1}{\varphi_{max} - \varphi_{min}} \cdot \sqrt{\frac{\sum_{n=1}^{N}\left(\hat{\varphi}_n(x,y,t) - \varphi_n(x,y,t)\right)^2}{N}}\right)}_{\text{Estimation error}} + \beta \cdot \underbrace{\left(1 - \frac{\sum_{k=1}^{K} S_k}{K \cdot T \cdot F_s / L_s}\right)}_{\text{Measurement cost}} + \gamma \cdot \underbrace{\left(1 - \frac{\sum_{k=1}^{K} P_k}{K \cdot T \cdot F_m}\right)}_{\text{Communication cost}} + \delta \cdot \underbrace{\left(1 - \frac{\sum_{k=1}^{K} V_k}{K \cdot T \cdot v_{max}}\right)}_{\text{Mobility cost}}$$

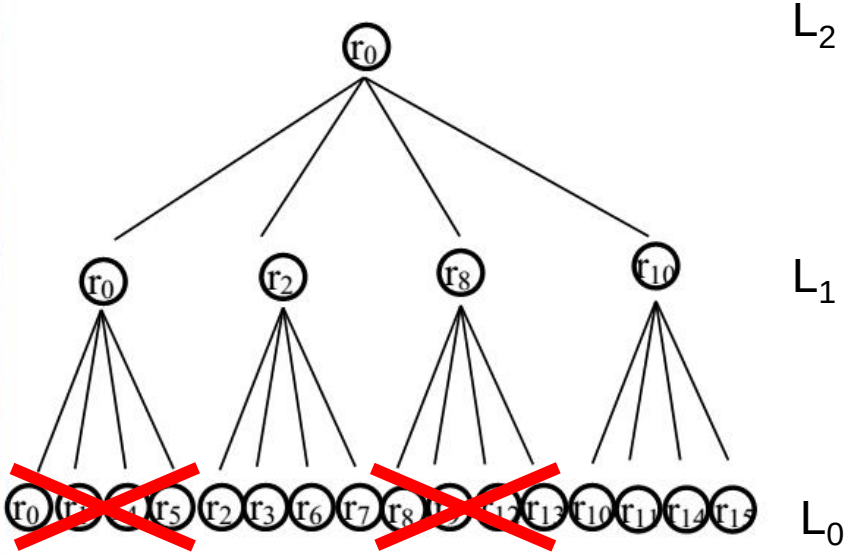
Backcasting

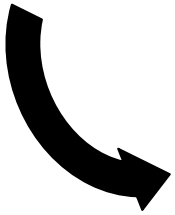


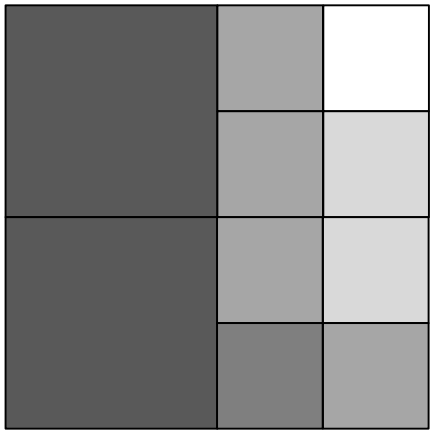
Backcasting



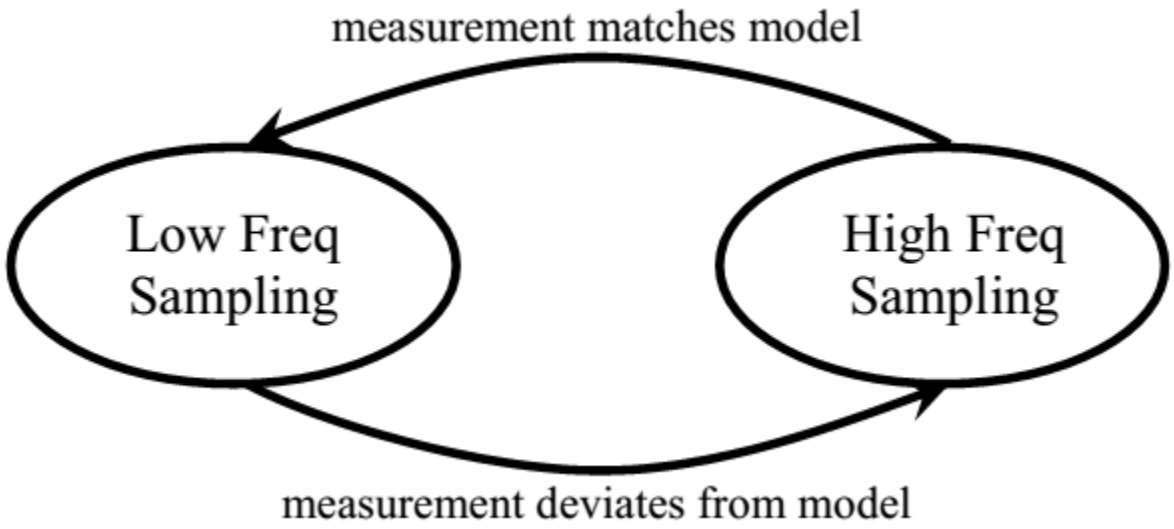
Backcasting







Time Adaptive Sampling



Assumption: linear model of sensed process $\hat{x}_t = \alpha \cdot x_{t-1} + \beta$

Controlled vs. Uncontrolled Mobility

- Random walk
  - varying field dynamics
- Guided mobility
  - local communication
  - personal/neighborhood best (highest observed gradient)
  - inertia & randomness
  - *Hint*: Similar to lab 4, there is a function for how to navigate a differential wheel robot towards a goal position