

# Distributed Sensing

Distributed Intelligent Systems

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# What is this lab about?

- Energy efficiency in simulated static sensor networks
- Mobile sensor networks

# General Topics

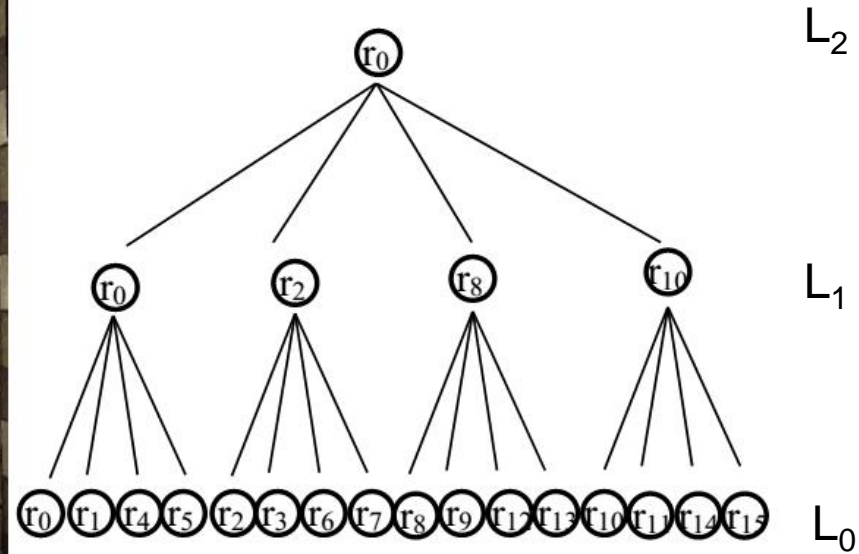


- Multiple basic case studies going through typical topics in distributed sensing:
  - performance evaluation
  - space-division scheduling
  - time-division scheduling
  - static vs. mobile sensor networks
  - controlled vs. uncontrolled mobility
- network of 16 robots
- sensing light field

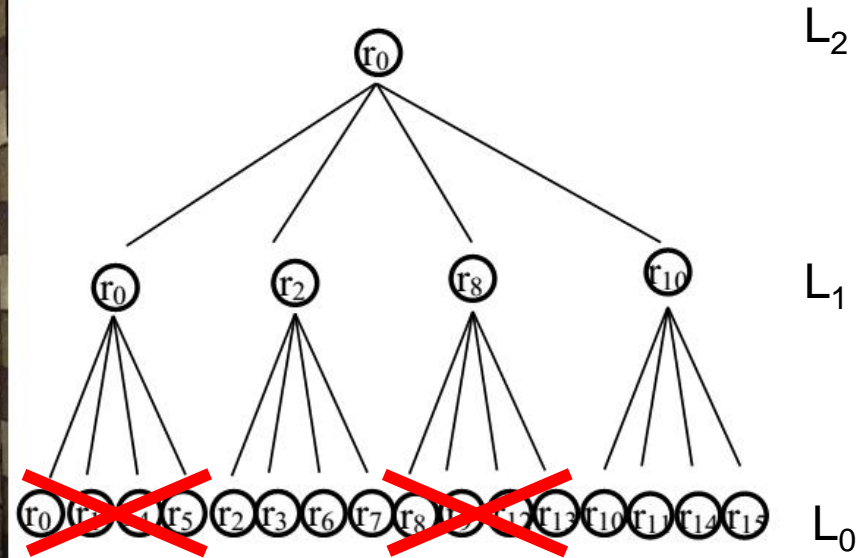
# General Performance Metric

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

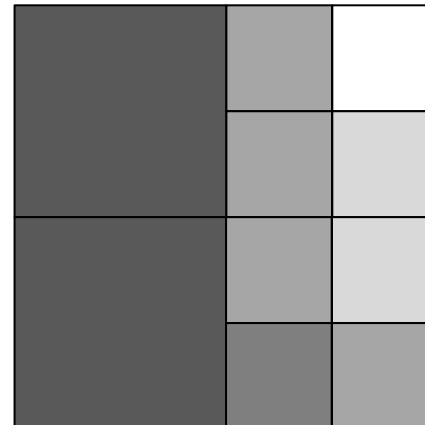
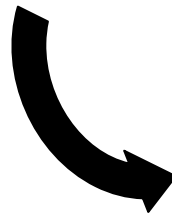
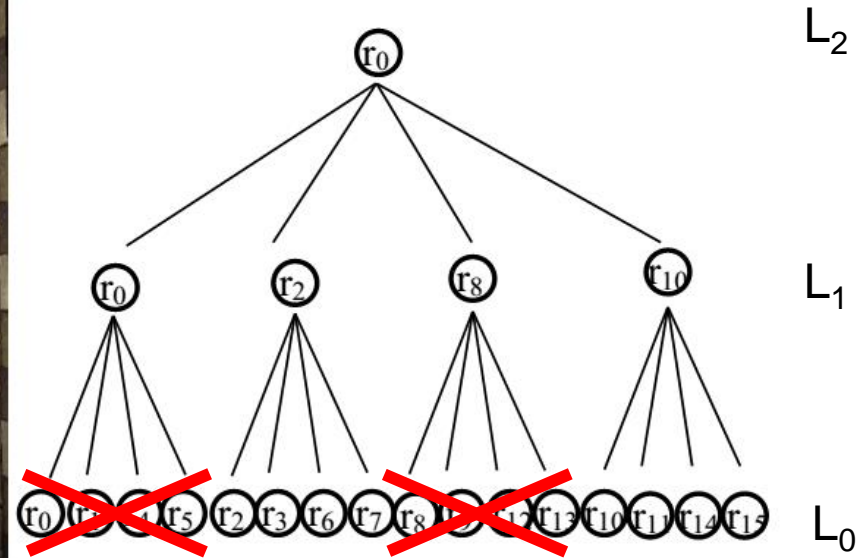
# Backcasting



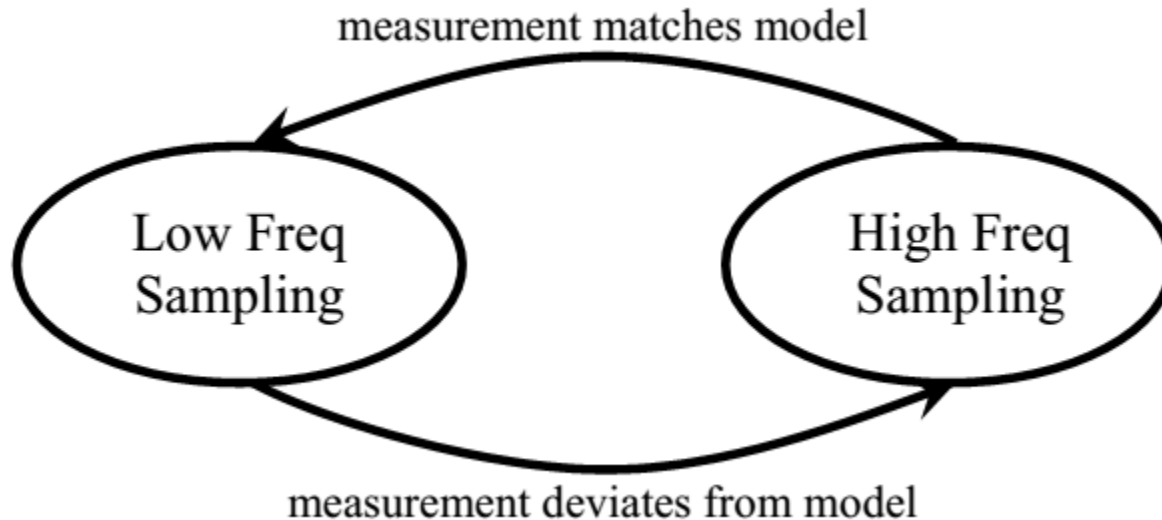
# Backcasting



# 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