

# INFO-H-414 - Swarm Intelligence

## Swarm Robotics - Chain Formation Strategy



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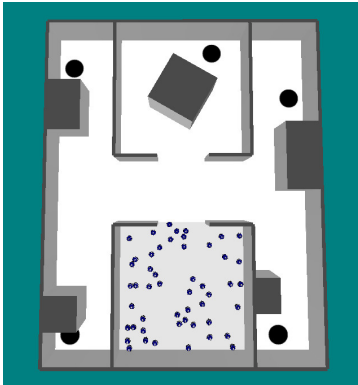
Introduction

Controller

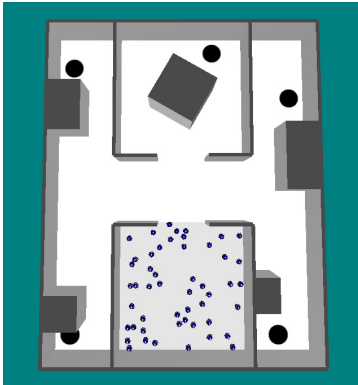
Results

Conclusions

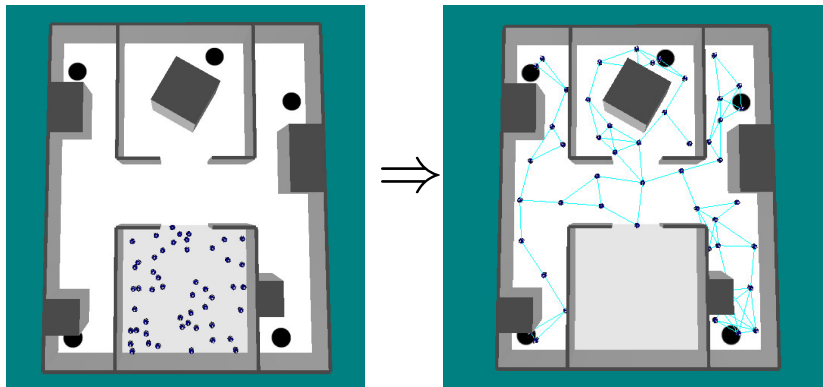
# Introduction



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# What does the method use?



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## Sensors

- Proximity sensors
- Distance scanner
- Range and Bearing
- Ground sensors

## Actuators

- Wheels
- Range and Bearing

- *Sense, Think, Act* paradigm
- Potential-fields approach [HMS02]

# Chain example

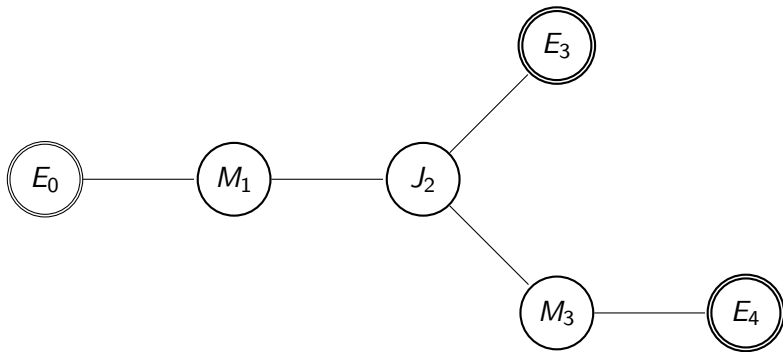


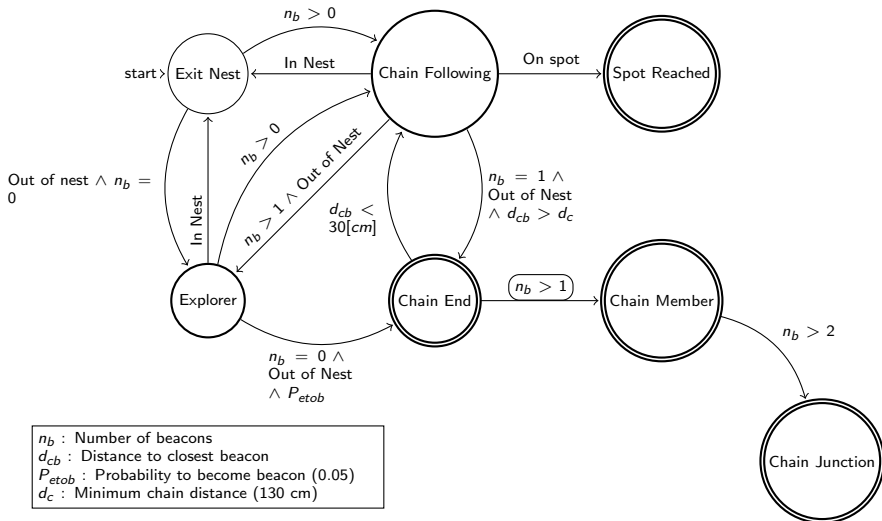
Figure: Chain example with nodes labeling and id

# Rules

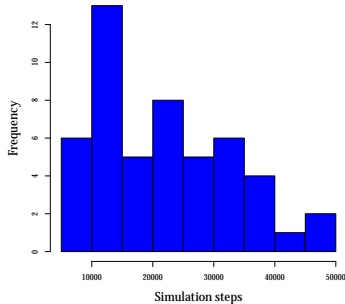
1. Chain beginning rule
2. Chain attaching rule
3. *Chain end* to *Chain member* transition
4. *Chain member* to *Chain junction* transition
5. Chain identifier computation



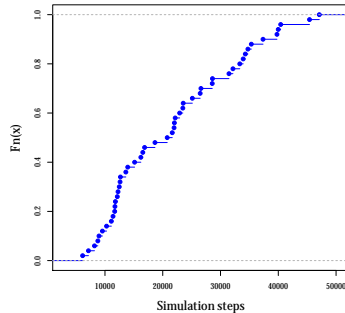
# Probabilistic FSM



# Robots in chain



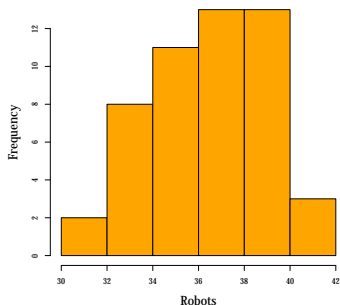
(a)



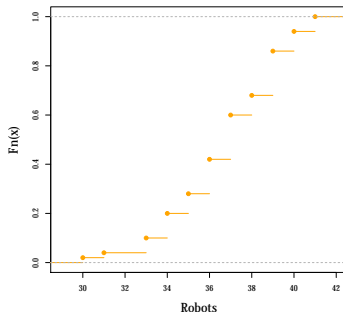
(b)

**Figure:** Observed distribution of the number of robots in chain over 50 trials displayed as histogram (a) and empirical cumulative density function (b)

# Completion time



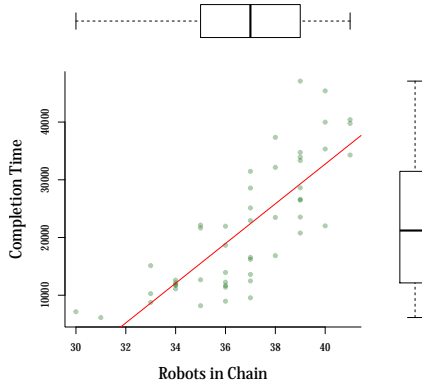
(a)



(b)

**Figure:** Observed distribution of the experiments' completion times over 50 trials displayed as histogram (a) and empirical cumulative density function (b)

# Correlation



**Figure:** Scatterplot of the experiments' completion times versus the number of robots in chain on 50 trials.  $r = 0.7934599$

# Conclusions

- Simple method:
  - Random walk
  - Limited communication
- Here, simplicity entails:
  - Lack of placement optimality
  - High results variability
- The width of the communication range impacts on:
  - Completion time
  - Number of robots in chain
- Relevant impact of the structure of the environment on the method's performance.


# Questions ?



## References (1)



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POLYTECHNIQUE  
DE BRUXELLES

-  Andrew Howard, Maja J Matarić, and Gaurav S Sukhatme.  
Mobile sensor network deployment using potential fields: A  
distributed, scalable solution to the area coverage problem.  
*In Distributed Autonomous Robotic Systems 5*, pages 299–308.  
Springer, 2002.