Slide 1

Tokyo Institute of Technology

Persistent Coverage Control

10-12324
Koudai Sugimoto

Tokyo Institute of Technology · Fujita Laboratory

Slide 2

Movie: TeamViewer

Tokyo Institute of Technology

Human-Controlled Coverage

Tokyo Institute of Technology · Fujita Laboratory · 2

Slide 3

How to use TeamViewer

Tokyo Institute of Technology
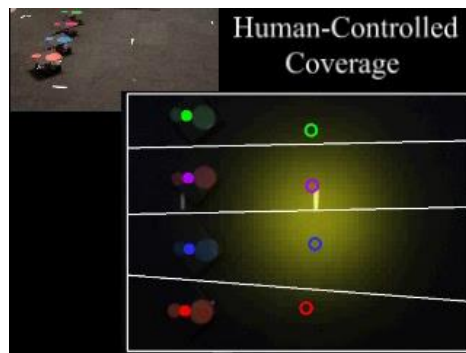
1. Start TeamViewer on PC and iPad
2. Input ID and tap "remote control" on iPad
3. Input password on iPad

・Connect to nearest Wi-Fi to secure satisfactory communication.
・Even if correct ID is automatically input, you should input it again.
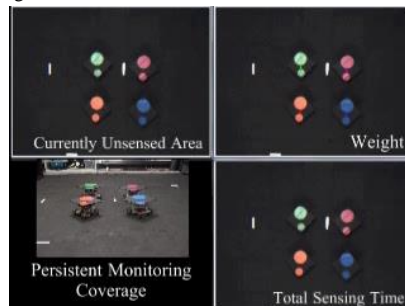(or select from the history)

ID

Password

iPad   PC

Tokyo Institute of Technology · Fujita Laboratory · 3

Slide 4

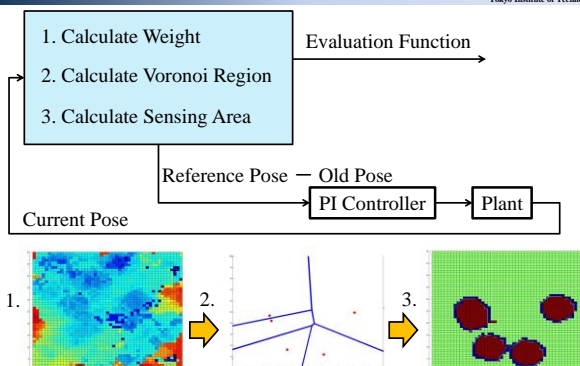## Persistent Coverage: Movie

Tokyo Institute of Technology

Persistent Coverage:
Sense relatively unsensed area as well as important area

・Agents go to large weight area
・Weight=
　Designated weight
　+ Search weight

Currently Unsensed Area — Weight
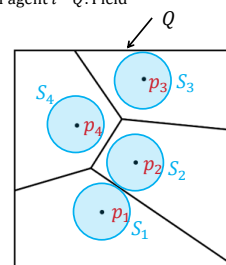Persistent Monitoring Coverage — Total Sensing Time

Tokyo Institute of Technology · Fujita Laboratory

Slide 5

Persistent Coverage: Block Diagram

Tokyo Institute of Technology

1. Calculate Weight
2. Calculate Voronoi Region
3. Calculate Sensing Area

Evaluation Function

Reference Pose － Old Pose

Current Pose

PI Controller → Plant

1.   2.   3.

Tokyo Institute of Technology · Fujita Laboratory · 5

Slide 6

Persistent Coverage: Evaluation Function

Tokyo Institute of Technology

$$H(p) = -\sum_{i=1}^{n} \int_{S_i} (q - p_i)^2 \varphi(q) dq - \int_{Q - \sum_{i=1}^{n} S_i} b\varphi(q) dq$$

i: Agent　　p_i: Position of agent i　S_i: Sensing area of agent i　Q: Field
$\varphi(q_i)$: Weight at q_i　b: Normal vector gain

Large $H(p) \Rightarrow$ Good performance
To make $H(p)$ large…　　　$((q - p_i)^2 < b)$
・Small $Q - \sum_{i=1}^{n} S_i$
$\Rightarrow$ Many agents, Large sensing area
・Small $(q - p_i)^2 \Rightarrow$ Many agents

Q

S_4　p_4　p_3 S_3　p_2 S_2　p_1 S_1

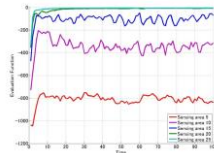Tokyo Institute of Technology · Fujita Laboratory · 6

Persistent Coverage: Simulation

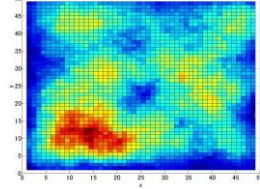Tokyo Institute of Technology

Evaluation Function (Agents:1~5)

Evaluation Function (Sensing area:5~25)

Total Sensing Time
(Agents:5 Sensing area:5)

Designated Weight:(10,10)

Tokyo Institute of Technology   Fujita Laboratory   **7**

Future Works

Tokyo Institute of Technology

Achievement (interim presentation)
・Human Controlled Coverage
・Persistent Coverage
(・Attitude Synchronization)

Future works
・TAFC simulator
Humans and robots collaborate as peers.
⇒Humans can compensate for weakness of a program.

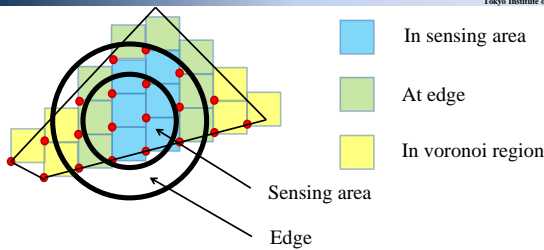Applying to persistent coverage…
Humans can change weight of each robot.

Tokyo Institute of Technology   Fujita Laboratory   **8**

Mesh

Tokyo Institute of Technology

In sensing area

At edge

In voronoi region

Sensing area

Edge

If the red point is in sensing area or edge of sensing area, then the square is in it.

Tokyo Institute of Technology   Fujita Laboratory   **9**
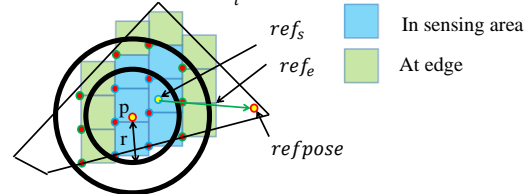
Reference Pose

Tokyo Institute of Technology

$$refpose = ref_s + ref_e$$

Centroid s_i: ith red point in sensing area

$$ref_s = \frac{\sum_i \varphi(s_i)s_i}{\sum_i \varphi(s_i)}$$

Normal Vector e_i: ith red point at edge of sensing area

$$ref_e = (b - r^2) \sum_i \varphi(e_i)(e_i - p)/\|e_i - p\|$$

ref_s

ref_e

In sensing area

At edge

$refpose$

Tokyo Institute of Technology   Fujita Laboratory   **10**