



Group Meeting Synchronization with Human Interaction



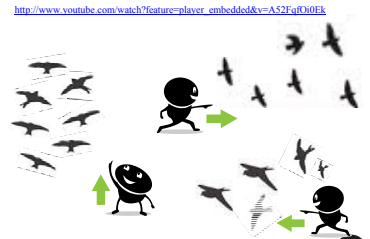
Namba Yuto
18th June, 2013



Objective

Controlling a Quadrotor Using Kinect

Quad + Kinect



Controlling Swarms



Problem Settings (Consensus Estimator)

Settings

Four Agents $\mathcal{A}_1, \mathcal{A}_2, \mathcal{A}_3, \mathcal{A}_4$

Agent's position $x = [x_1 \ x_2 \ x_3 \ x_4]^T$

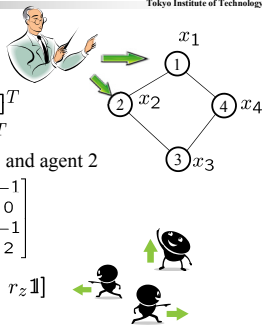
Command Vector $E = [1 \ 1 \ 0 \ 0]^T$

human can send a command to agent 1 and agent 2

Graph Laplacian

$$L = \begin{bmatrix} 2 & -1 & 0 & -1 \\ -1 & 2 & -1 & 0 \\ 0 & -1 & 2 & -1 \\ -1 & 0 & -1 & 2 \end{bmatrix}$$

Desired Motion Image $r = [r_x \mathbb{1} \ r_y \mathbb{1} \ r_z \mathbb{1}]$



Dynamics

$$\dot{v} = -Lx$$

$$\dot{x} = -Lx + Lv + Ev_d \rightarrow \lim_{t \rightarrow \infty} (x_i - x_j) = 0, \forall i, j$$



$$\lim_{t \rightarrow \infty} (v_i - v_j) = 0, \forall i, j$$



Key Point

Consensus

Dynamics

$$\dot{x} = -Lx$$

Energy Function

$$V = \frac{1}{2}x^T Lx$$

Derivative of V

$$\dot{V} = -x^T L^2 x < 0$$

Passive

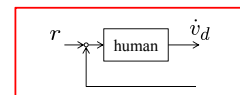
Human Interaction

$$\begin{aligned} \dot{v} &= -Lx \\ \dot{x} &= -Lx + Lv + Ev_d \end{aligned}$$

$$V = \frac{1}{2}(u-r)^T(u-r) + \frac{1}{2}x^T L^2 x$$

$$\dot{V} = (u-r)^T \dot{v} - u^T L u - u^T L^2 x$$

Not Passive

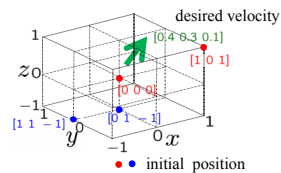
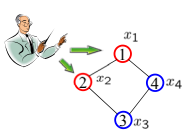


Feedback the information to a human to delete the extra term

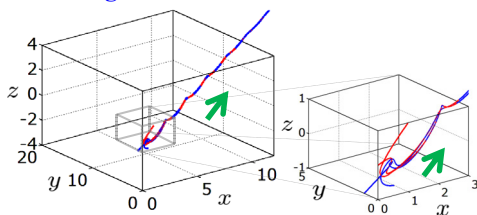


Simulation Result

Simulation Settings



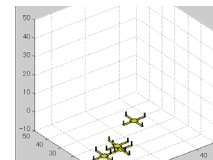
3D Plot of Agent's Position



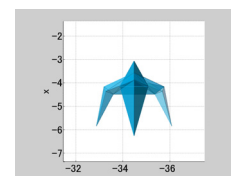
Simulation Movie

First My Movie

$$r = [0.4 \ 0.3 \ 0.1]$$



Aoki's Movie

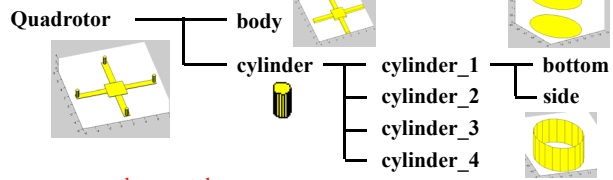




Progress of Making Movie

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Patch



→ these patches use many memory :
 limitation of the number of agents

Improve the movie

- increase the number of agents
- change the human's command in the middle of the simulation
- change the point of view according to the agent's position

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Simulation Movie ver. 2.0

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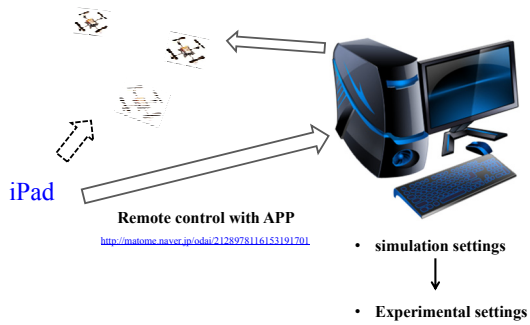
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Future works

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Experiment with iPad



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