# Control of *Living fish shoal* by mixing *Artificial agents*

Tsunehiro ARIMOTO, Zuben BROWN, Khureltulga DASHDAVAA, Taishi KAKIDSUKA, Le-shi LEE, Atsushi SHIBAI and Tsukasa YOSHINAGA
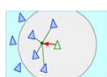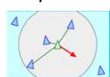
## Background

**Collective animal behavior**

The ordered collective behavior of groups is an emergent property arising from many decentralized individuals.

**Is it possible to control the entire group via a few individuals?**

**Model of group behavior – Boids (C. Reynolds, 1987)**

The set of three rules governing local interaction,
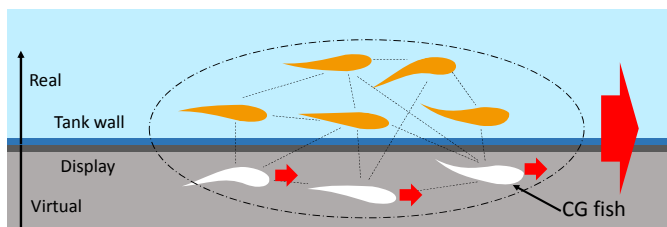
*1. Separation*   *2. Alignment*   *3. Cohesion*,

These rules generate highly collective behavior.

## Purpose & Current plan

- Purpose: Control living fish shoal via Robotic fish

Mixed shoal
Robotic fish
Local interaction generated by real time control of Robotic fish
Living fish
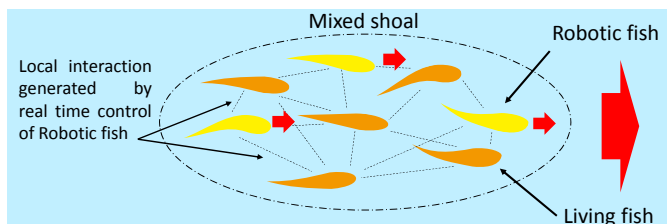
- First we are trialing CG fish instead of Robotic fish

Real
Tank wall
Display
Virtual
CG fish

## Activity reports (Dec. 2013 ~ Mar. 2014)

### Project start (Dec.)

- HWIP Okinawa Camp

Formed the team and made theme, "Control of fish shoal via artificial agents."

### Research design (Jan.)

- Research survey
- Wiki for the project

- Target setting
  - CG agent
  - Explicit interaction between living fish and agents
  - Real time control

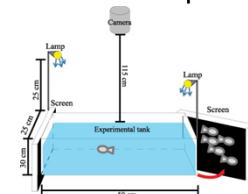- Medaka (*Oryzias latipes*)
  Located at Humanware Lab.

**Arrangements of components (Feb.)**
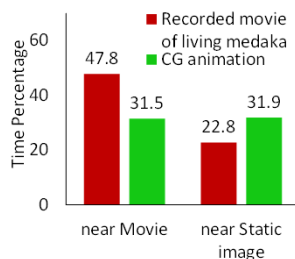
- CG animation
  Following Boids algorithm

### Trial experiment (Mar.)

- Trial of experiment

Two displays settled beside tank walls showing either actual Medaka movie or CG image of fish shoal.
The tank was divided into three region and we recorded the time that fish spent near the moving CG fish compared with other areas.

M. Porfiri et al., *Behavioural Brain Research*, 2012

Time Percentage

■ Recorded movie of living medaka
■ CG animation

near Movie: 47.8, 31.5
near Static image: 22.8, 31.9

Recorded movie of medaka shoal obviously attracted medaka, but our CG animation did not produce the same attraction.
Anyway, we've done an experiment of fish behavior!

### Next

- Improvement of CG animation
- Improved experimental design to better test our purpose