Human - Robot Swarm Interaction for Entertainment

From animation display to gesture based control

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ABSTRACT

This work shows experimental results with three systems that take real-time user input to direct a robot swarm formed by tens of small robots. These are: real-time drawing, gesture based interaction with an RGB-D sensor and control via a hand-held tablet computer.

Categories and Subject Descriptors

I.2 [**Artificial Intelligence**]: Robotics

1. MOTIVATION

Successful applications of large multi-robot teams include industrial automation and entertainment, with future applications likely to include search-and-rescue and inspection. In complex tasks, where a human must provide (in real-time) high-level control of the robot swarm, intuitive or readily-learnt interfaces are necessary. Enabling a human operator to control a robot swarm with hundreds of robots is still an open problem due to its high dimensionality. Methods to reduce the number of degrees of freedom to a few meaningful ones and automate the interaction are required. In this work we show three implementations, applicable in the area of entertainment robotics, of intuitive methods for real-time human swarm interaction.

2. HUMAN - SWARM INTERACTION

This work shows experimental results with three systems that take real-time user input to direct a robot swarm and achieve intuitive real-time interaction. A team of the small differentially driven robots described in [2] are employed.

- The user interface is via *real-time drawing*. A single drawing or an animation can be created and the robots automatically adopt a physical configuration to represent the drawn figure. The computation of robot position, robot motion, and robot color is automatic, including scaling to the available number of robots following the algorithms presented in [2] and [3].

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- The user interface is via a *hand-held tablet*, which tracks the robots and computes collision-free trajectories following the optimization described in [1]. Augmented reality and a multi-player setup are also shown.

- The user interface is via an *RGB-D sensor*, used to recognize human gesture and to determine the commands that are sent to a group comprising tens of robots. Two approaches are presented. In the first approach, the robots are unconstrained in position and motion and deictic gestures are used. The user can select subsets of robots including individual robots, change their colors and positions, and move them along trajectories. In the second approach representational gestures are used. The robots are in a pre-defined configuration, for example a cartoon face, and there are defined modes for warping the configuration directly.

3. CONCLUSIONS

This work has demonstrated methods for real-time interaction between a human and a swarm of robots, with applications in entertainment and toy robots. Three methods that take real-time user input to direct a robot swarm have been described and tested with a team of small robots. These provide interaction via a drawing interface, a hand-held tablet computer and gesture based via an RGB-D sensor. All methods have been shown to provide intuitive interaction and were quickly learnt by unexperienced users.

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5. REFERENCES

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