Advanced Engineering for Natural Disaster Identification, Mitigation, Prevention and Response

Group 4 : Robotics

"Applied Swarm Robotics"

Members

- University of Leeds

  Jordan Boyle (Mechanical Eng.)

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  Mehmet Dogar (Computing)

  Jongrae Kim (Mechanical Eng.)

  Robert Richardson (Mechanical Eng.)

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- Kyoto University

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Robotics: Future Enabling Technology

We are facing the challenge of

Private environments

- maintaining and enhancing Personal assistance for physical and psychological welfare

Economic environments

- Affordable economic and social welfare
- Ageing of population (at home, at work, in the society…)

Physical environments

- Conserving and monitoring the planet
- **Natural and man-made disasters**

Urban environments

- Growing urban centers
- Maintaining the quality of life at urban scale

AI/HI and Robot/Human

- 2030 AI=HI
- 2050 AI>HI Singularity
- ????? Robot > Human ?

- Robot helps human
- Robot works instead of human
- Robot accomplishes tasks that human can not do

2 Facts

- Necessity of Robot Technology
  - Disaster and rescue
  - Aging society
  - Health care
  - …
- UK and Japan are the leading nations in robotics

Robotics in UL and UK

- UL and UK partners are in particular strong in
  - Rescue robot systems
  - Physical Human-Robot Collaboration
  - Bio-inspired robotics
  - Optimization and Control
  - Swarm robotics
  - Humanoid robotics
  - Cognitive Science
  - Neuroscience
  - …

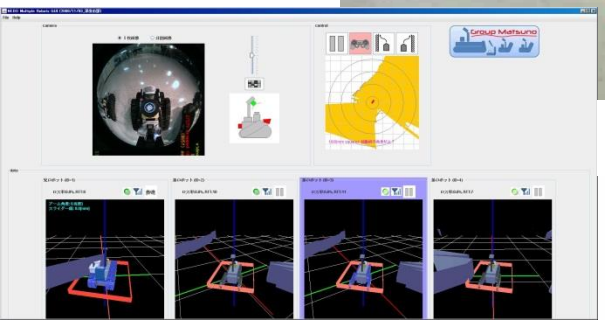
Robotics@Kyoto University

Robot

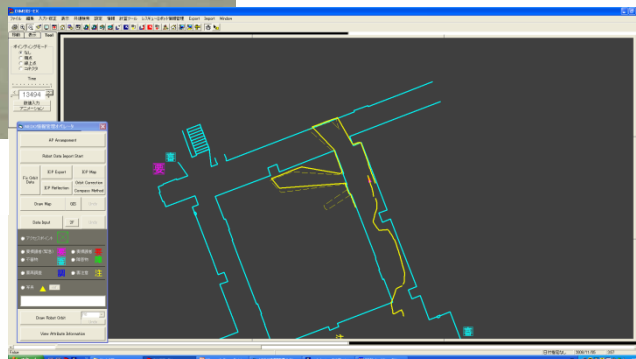
Network

Rescue Robot System

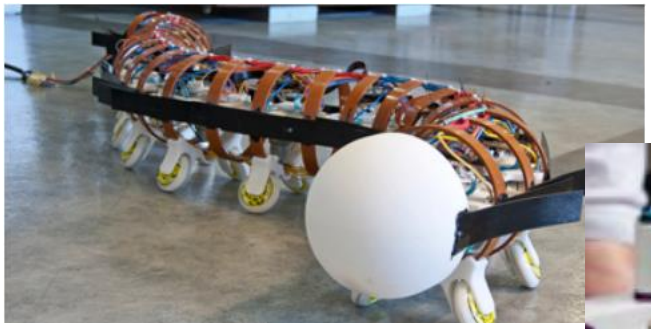
GUI



GIS



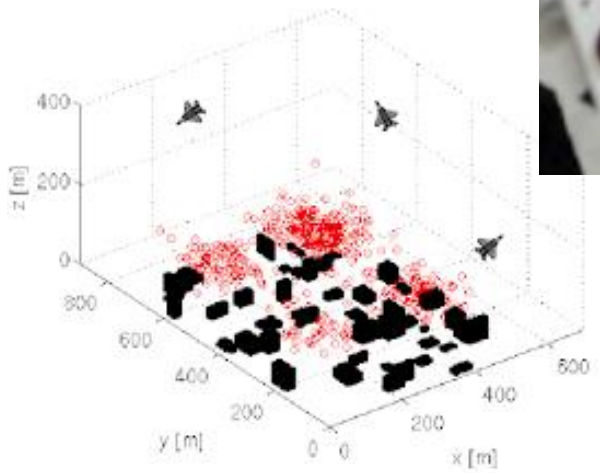
Robotics@Leeds



Bio-inspired

Rehab / Medical

Self-repairing cities



Optimization & control

Physical h-r collaboration

Next actions

- Organizing workshops in international conferences
  - SWARM2019, DARS2020, SWARM2020, …
- Writing a survey paper / organizing a special issue. Tentative title: “Barriers to and opportunities for real-world swarm robotic deployments” **Focus on applications**
- Preparation of UK-Japanese joint proposal for research project in the field of human centered robotics
  - Rescue robot system
  - Human robot interaction
  - Service Robot
  - …
- Funding through JST or JSPS in Japan and the RCUK in UK.
- Desired: Support for preparation of the joint proposal through the Universities
- Essential: Funding to attend SWARM2019 in Japan.
  - Prof. Matsuno is in the Organising Committee.

Discussed ideas

- Are there any real world successful deployments of swarms?
  - Very few
  - One case where they were used to clean an oil slick
  - Arguably Amazon warehouse robots
  - Arguably the recent UAV light show (art)
- What would it take to get more swarms deployed in real life?
- How should we define swarm robotics?
  - How many individuals required?>10?>100?>1000?
  - Or is the key point decentralized control giving cooperative behaviour.
- Swarm challenges:
  - Energy limitations / acquisition
  - Locomotion mechanism
- Arguably an aquatic swarm robot is easiest, because its a good balance of energy efficiency and lack of obstacles
  - Consider sea gliders or sailing boats
  - Flying is energy inefficient but doesn't need to worry about obstacles
  - Ground robots have the biggest issue with obstacles
- Semi-autonomous / semi-decentralized swarms / rescue robots
- Self Assembly

Harvard University