

Center for Automation and Robotics Research Sheffield Robotics

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Sheffield Robotics

- **Sheffield Robotics** is a joint venture between two Sheffield Universities, UK: University of Sheffield and Sheffield Hallam University (inaugurated in 2011)
- **Areas of research interest**
 - Robotics Technology
 - Biomimetric and brain-based robots
 - Human Robot Interaction
 - Robotics and humanities
 - Application of robotics in creative practice and research
 - Assistive robotics
- **Associated areas : Virtual Reality**
<http://makinen.hallam.shu.ac.uk:9000/wifi/user/account/>
 - Serious Games
<http://steelminions.com>
<http://www.sheffieldrobotics.ac.uk/>

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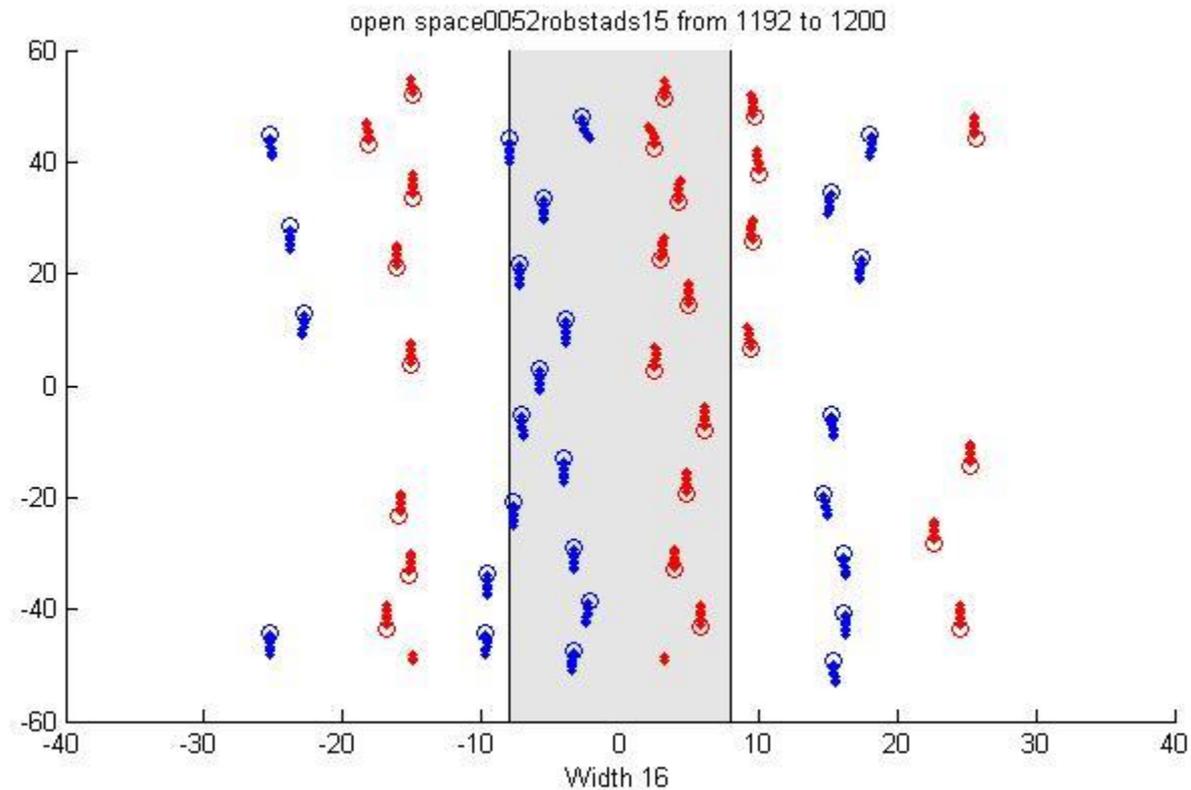
- team: Lyuba Alboul, Alessandro di Nuovo, Daniela Conti, Inna Popa, PhD and MSc students

(Robot) Swarms

the fabrics of group behaviours

- Group Behaviour is an observers' notion
 - the agents may not know they form a group
- Challenge: unravelling group behaviours
 - which are the basic 'elements' generating the group behaviour

52 Robots in Open Space, 6 lanes

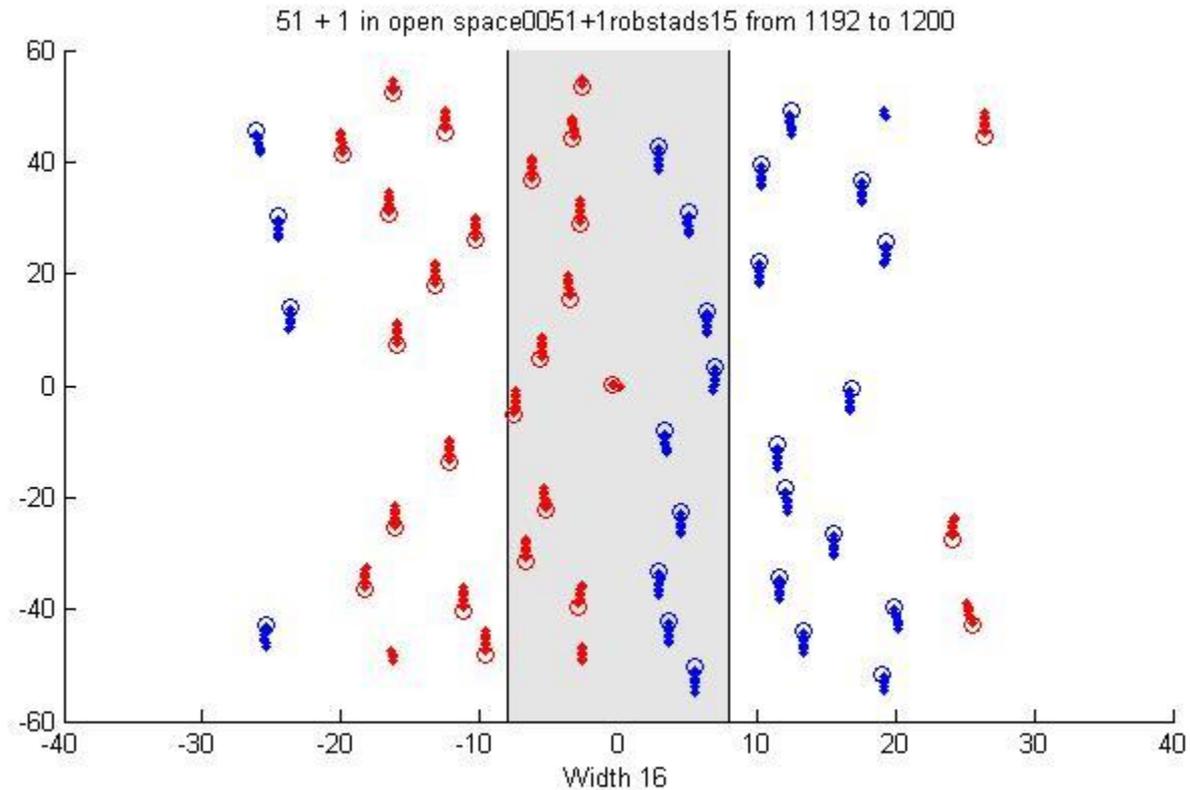


1200 clock ticks



51 Robots +1 Maverick,

4 lanes



1200 clock ticks



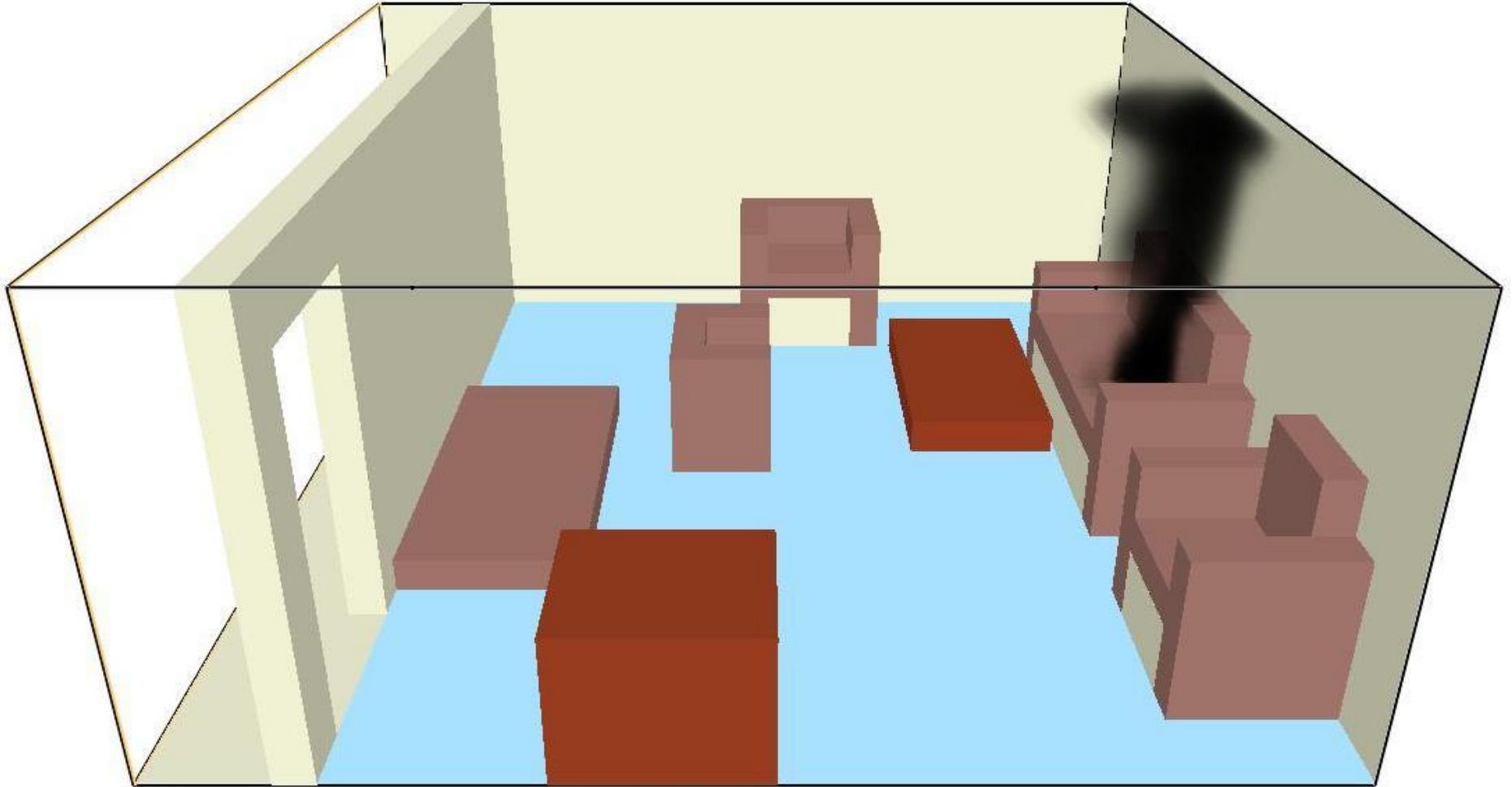
The Fabrics of Group Behaviours: Open Issues

- *From what do group-behaviours emerge?*
 - Revealing the mechanisms
 - Control of Agents
 - Role of environment
 - Resilience to faulty robots
 - robots breaking down
 - deviating/misbehaving robots

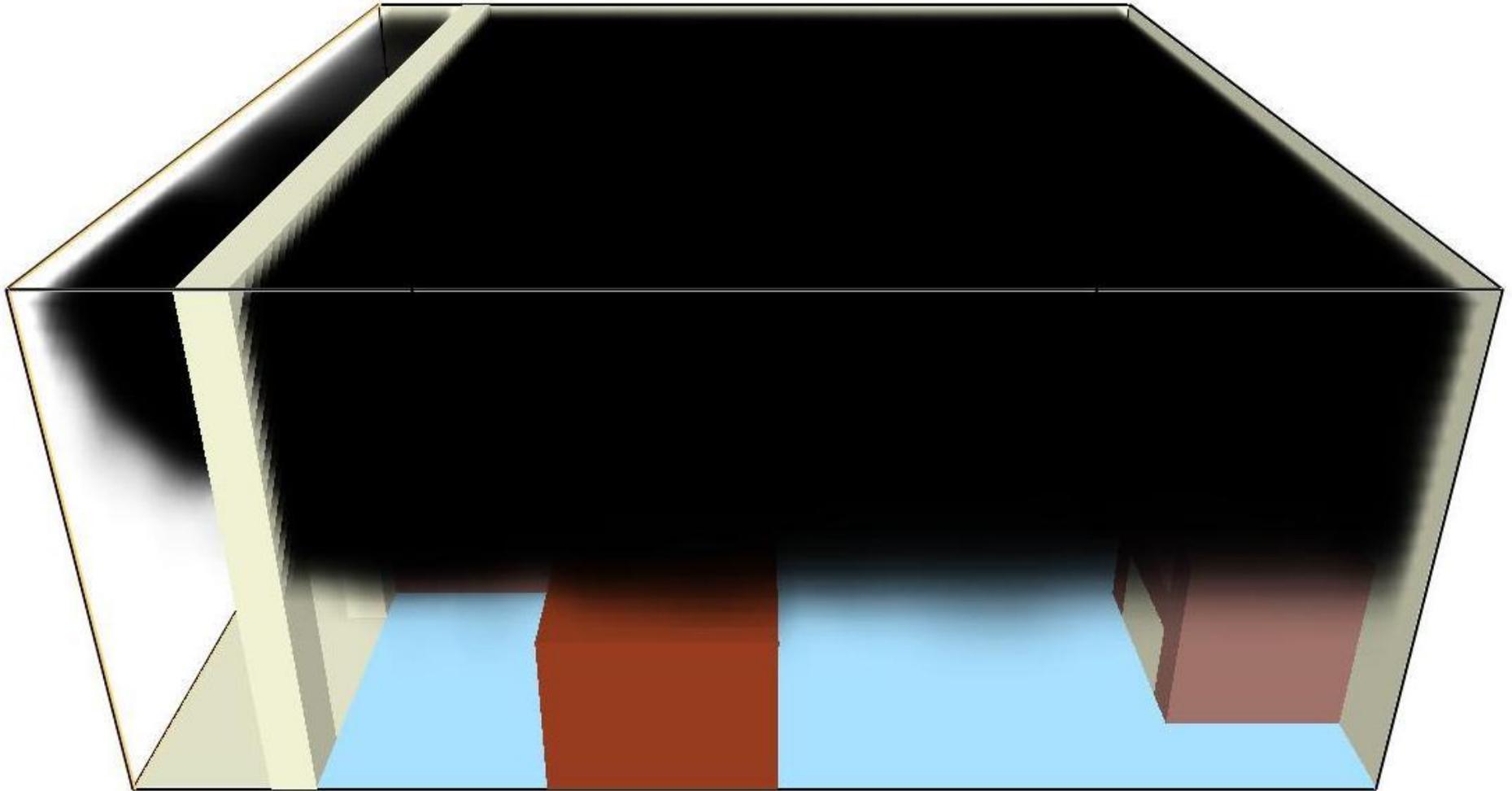
Robot Swarms in Search and Rescue

- Smoke is a problem
 - No visibility for a human being
 - Toxic for a human
- Smoke and Robots
 - different 'sensors'
 - no worry about the toxic environment

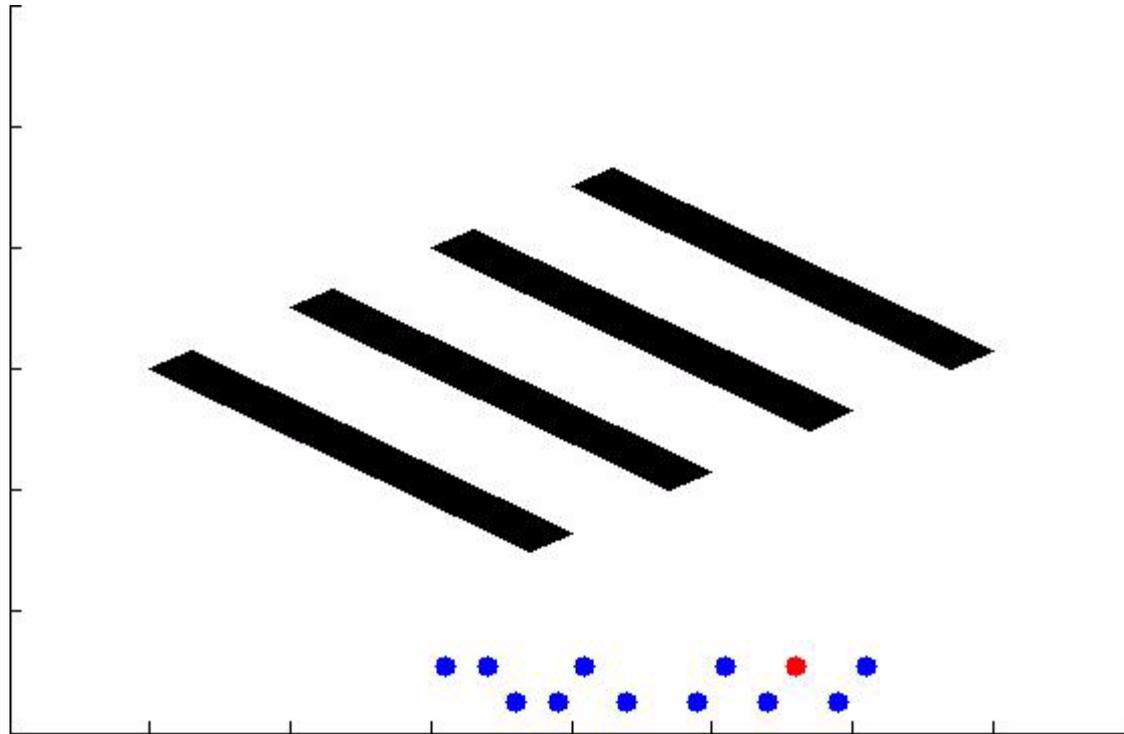
Room fire, start (0.5 minute)



Room fire, 20 minutes



Warehouse Search



Interaction

Robot Swarm ↔ Human

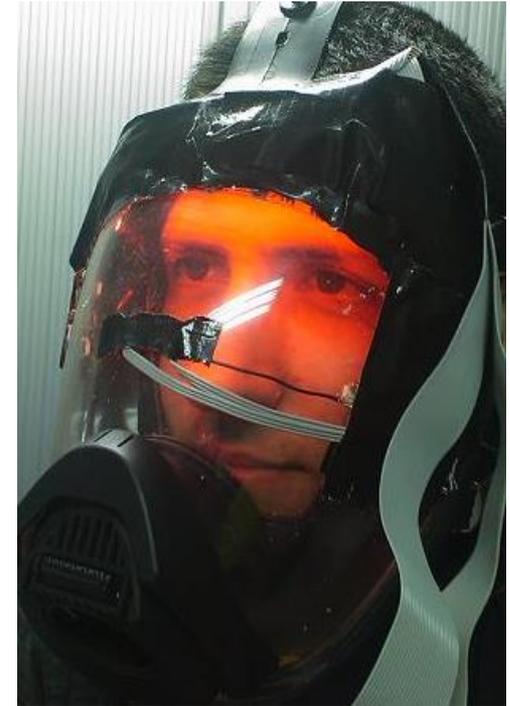
- Ff are under considerable mental and physical stress.
 - The robots should not complicate the navigation task of the human, not physical, not cognitive
- Signals from Human to Robots
- Signals from Robots to Human

Human to Robots

- Robots just assume the human is one of them.



Robots to Human



Visor design with
Minimal Cognitive Load

Interface Trial



The fire fighters do not go off the wall!

Robot Swarm to Human



Reins Project (EPSRC)

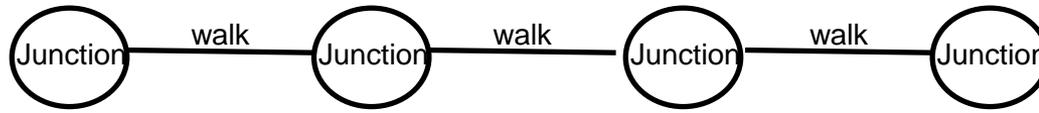
- Application: a human-robot (search) team
 - for **no-visibility** conditions
- Aim:
 - Exploring the communicational landscape for (haptic) human-robot interaction

Following the robot, Final Aim



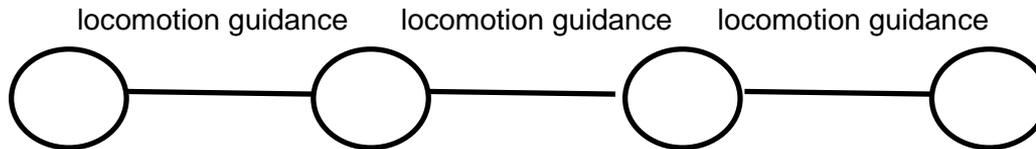
REINS

Guide dog Guidance



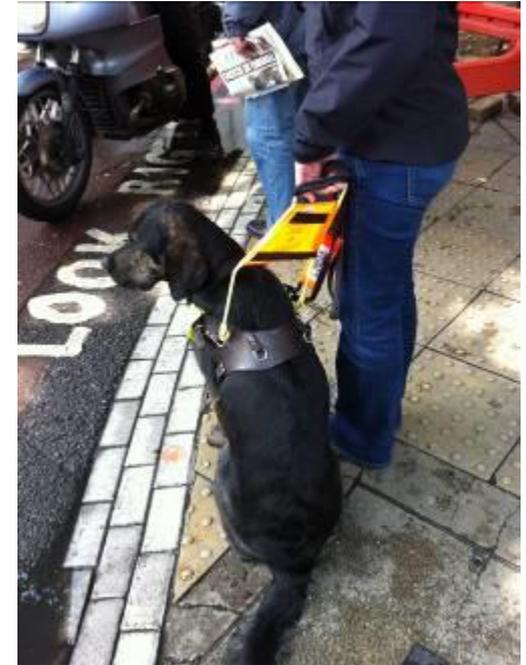
Team

Dog



Handler

navigation decision navigation decision navigation decision navigation decision



REINS: Focus on Locomotion Guidance

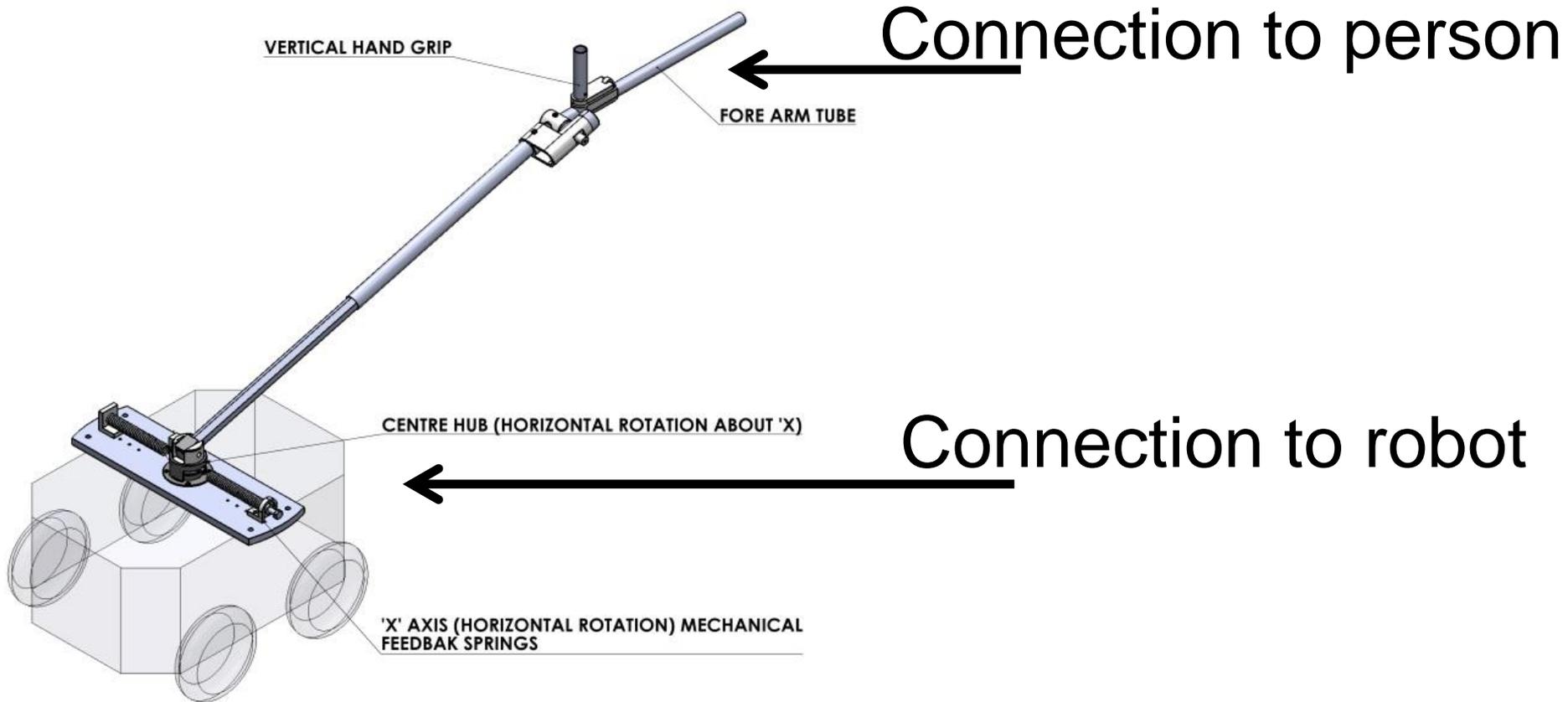


Robot Guide: Handler's experience

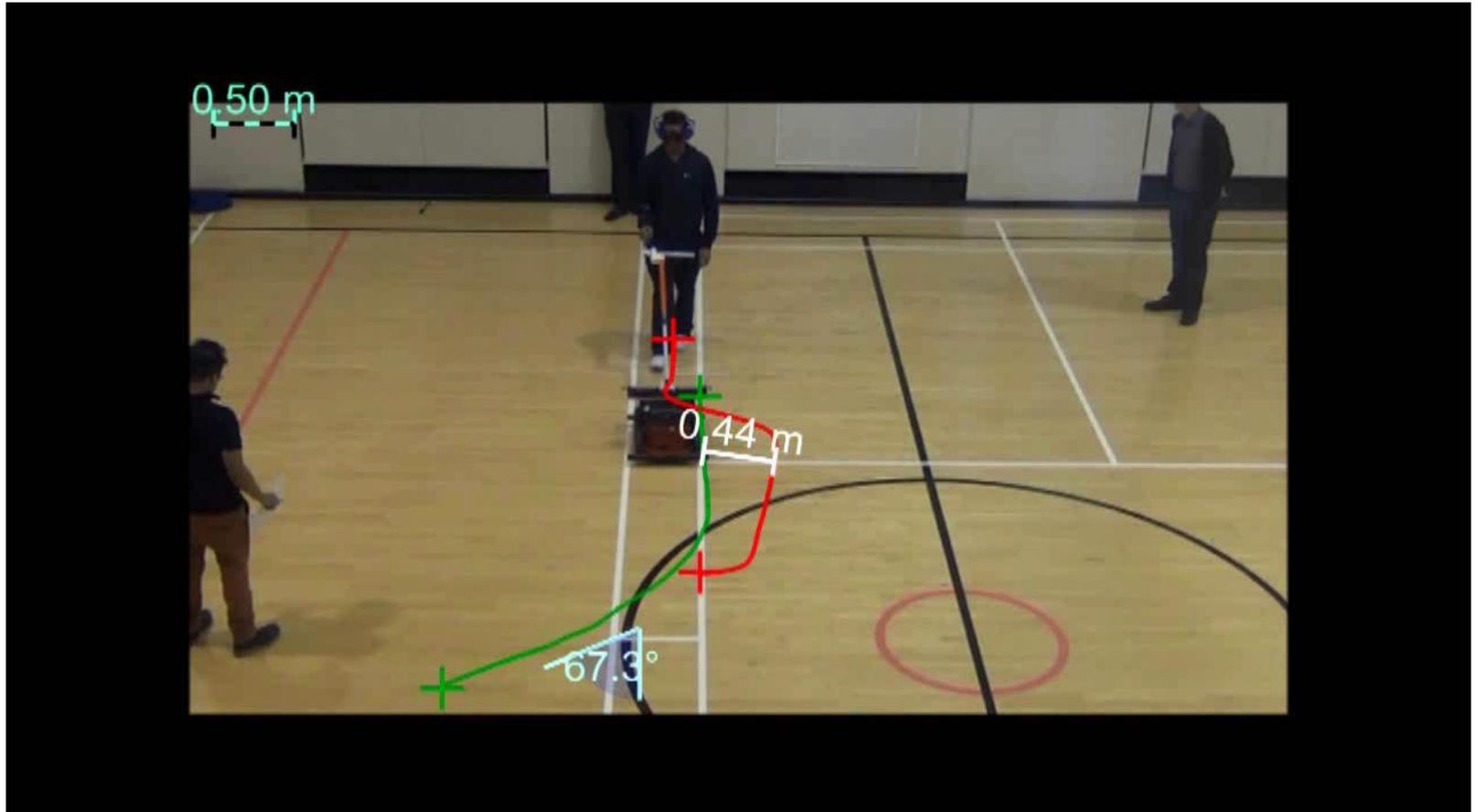
- The handler needs to 'know' where the robot is:
 - Distance: how far away is the robot?
 - length handle
 - Orientation:
 - handheld
 - not enough



Robot Guide: designing a connection



Following the robot



Safe path

- Connection
 - Ball free mechanism

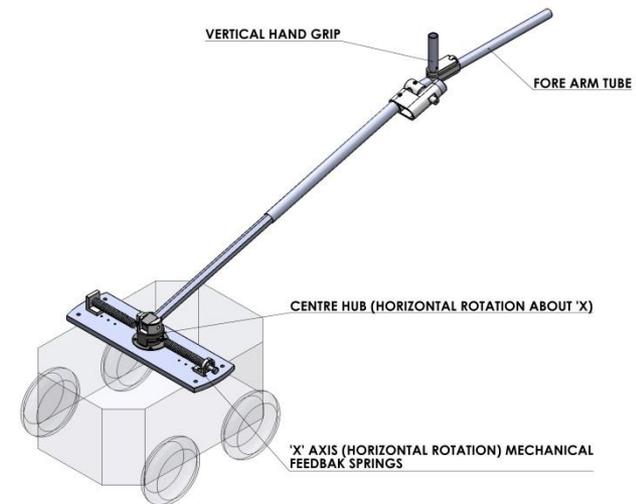
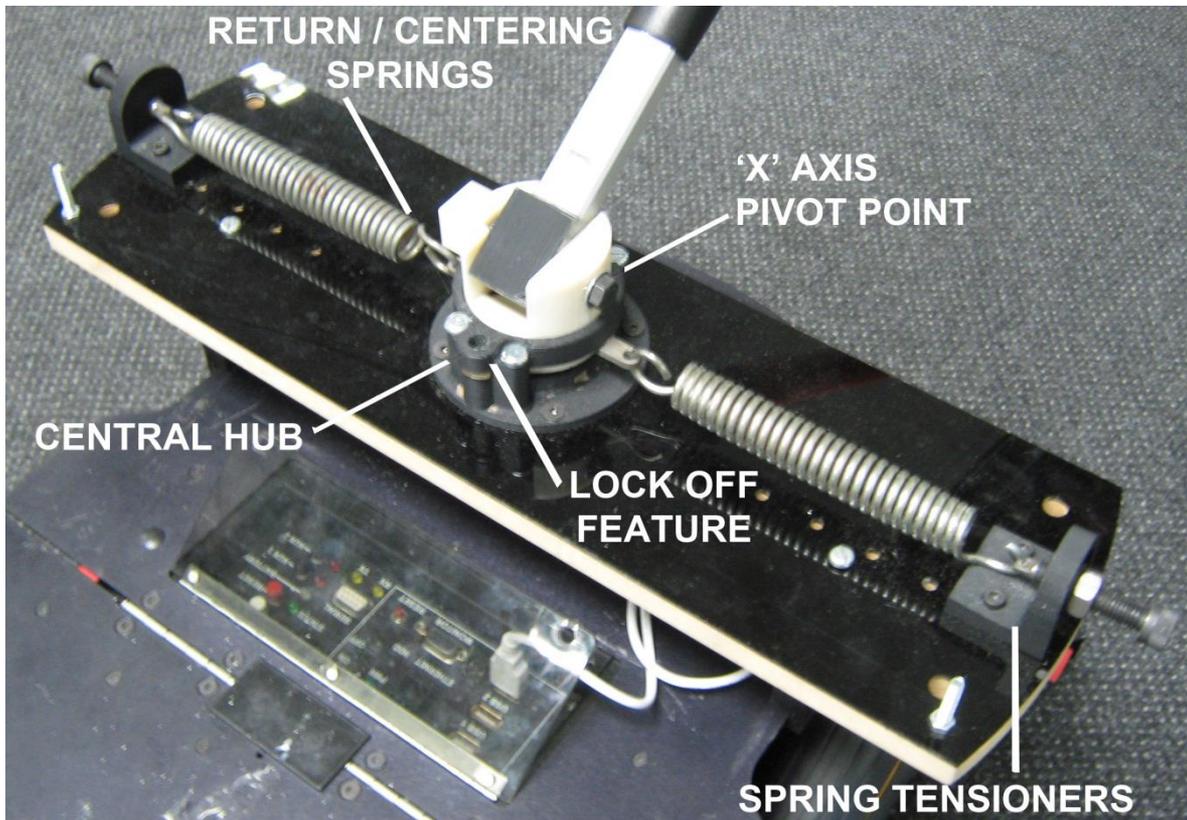


Unsafe

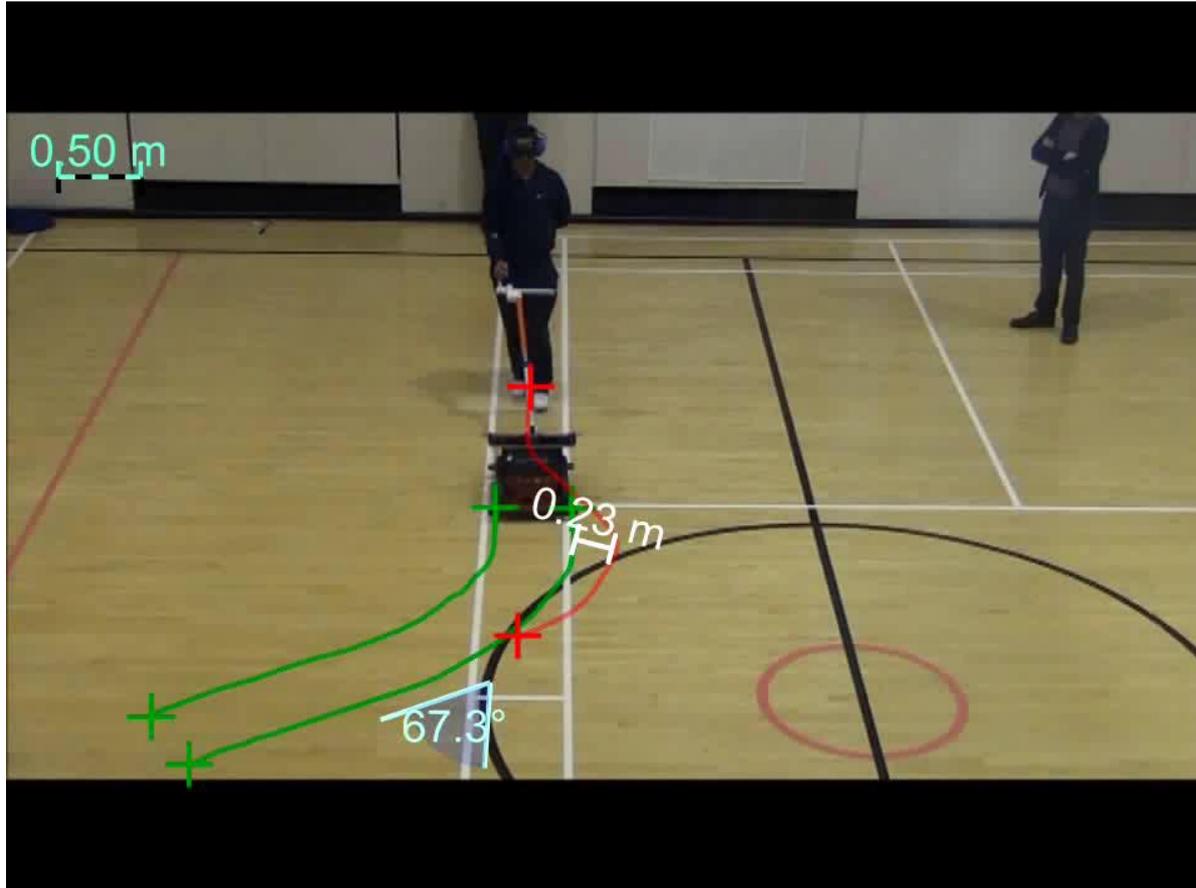
 CARR



Handle connection



Following the robot



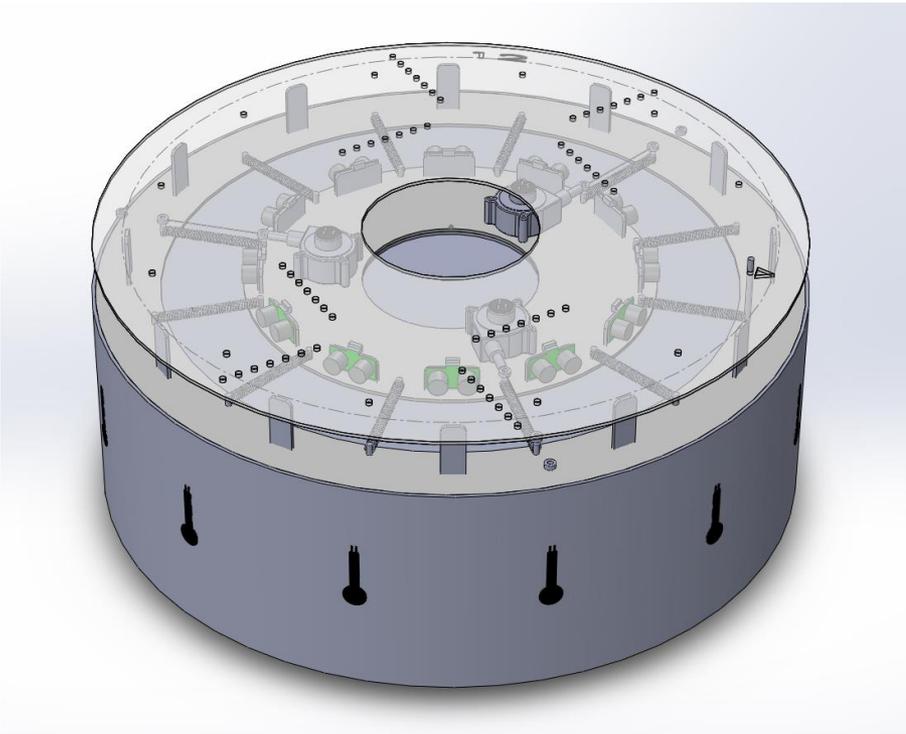
Search and Rescue

- Two distinct problems:
 - Locomotion Guidance
 - supposes the robot knows safe passage
 - no information to the handler
 - Exploration of the surroundings
 - feet over floor (2D)
 - arms in front body and face (3D)



Exploring surroundings

- Source for rich data generation



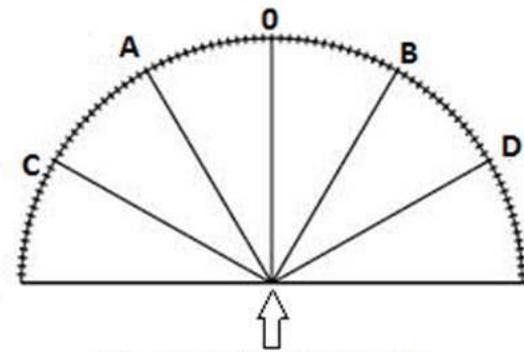
Exploring surroundings

- Presenting the data to human:
 - test of vibration motors

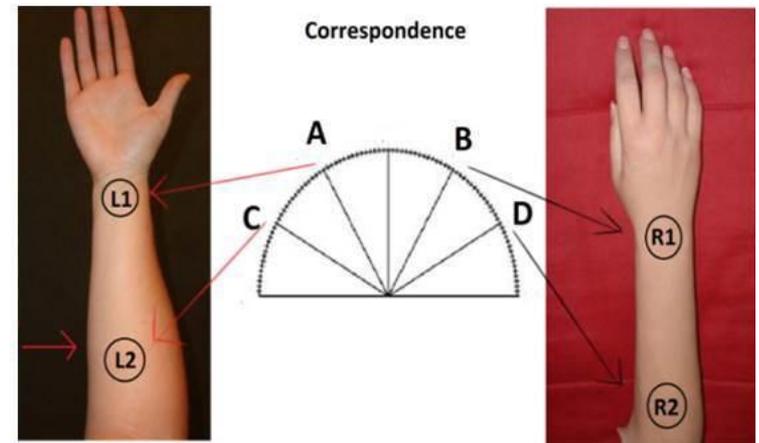


Exploring surroundings (Current)

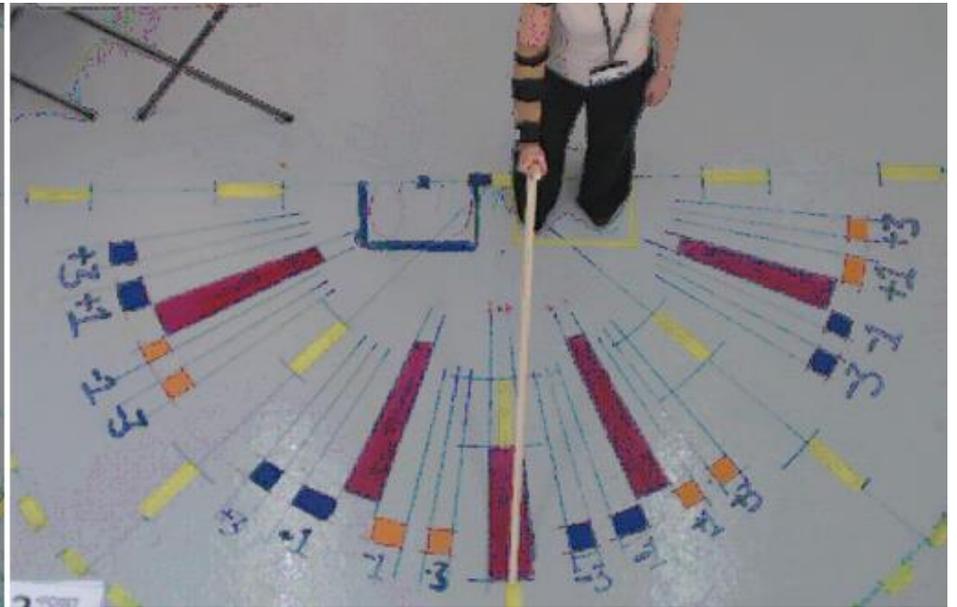
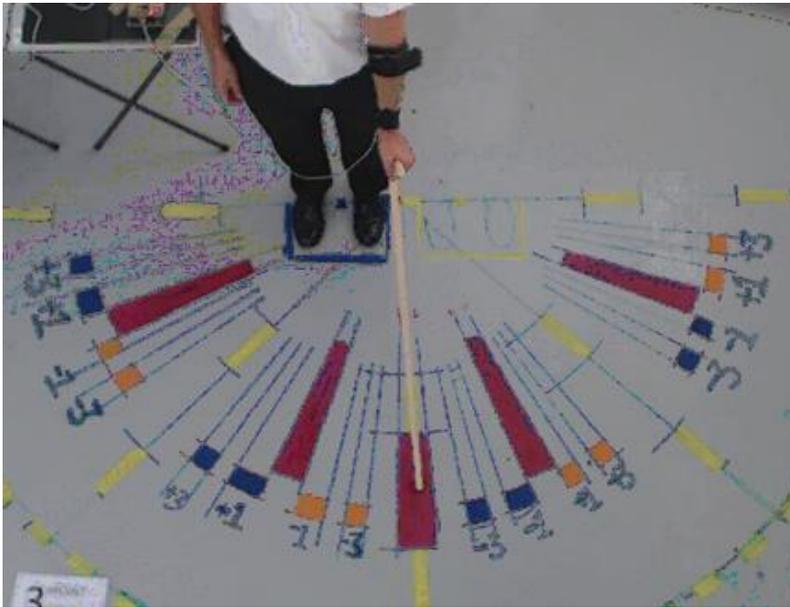
- Make Correspondence



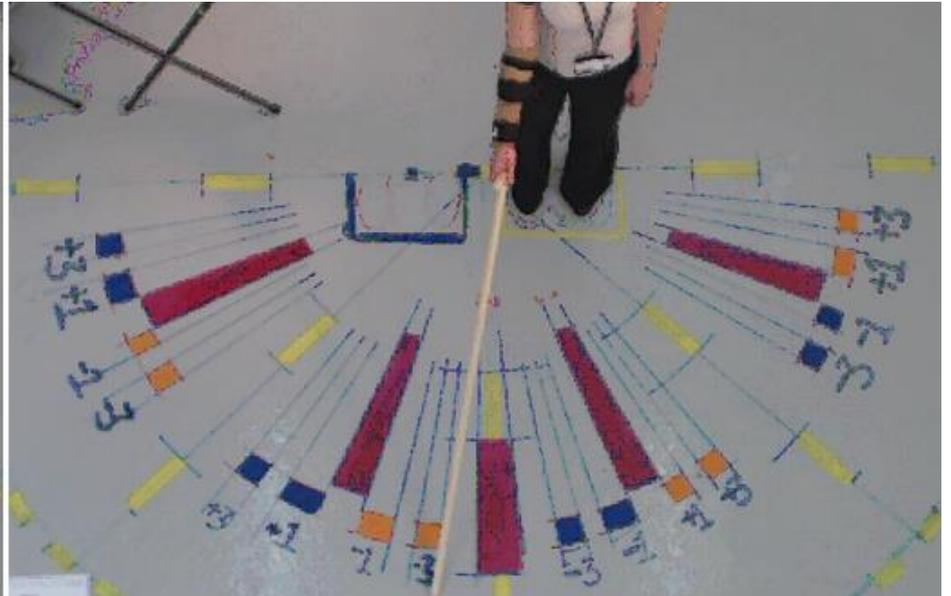
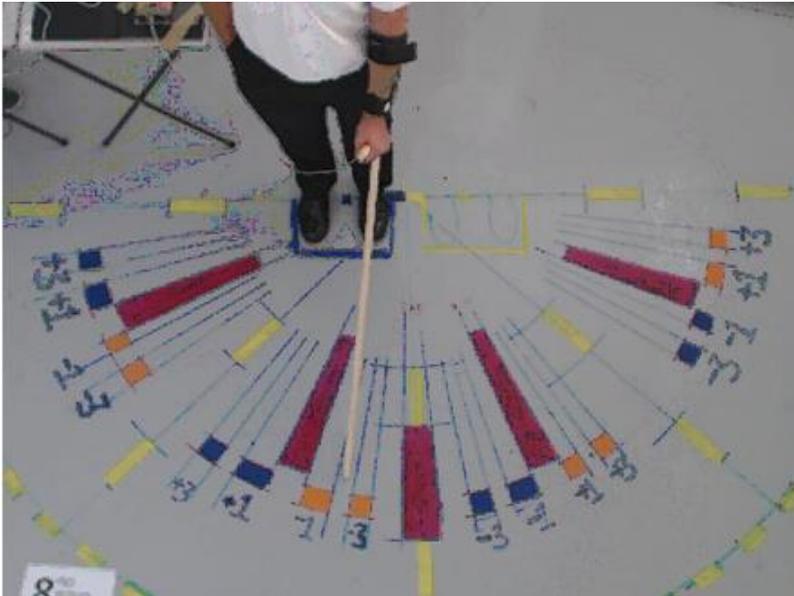
Hypothetical moving direction



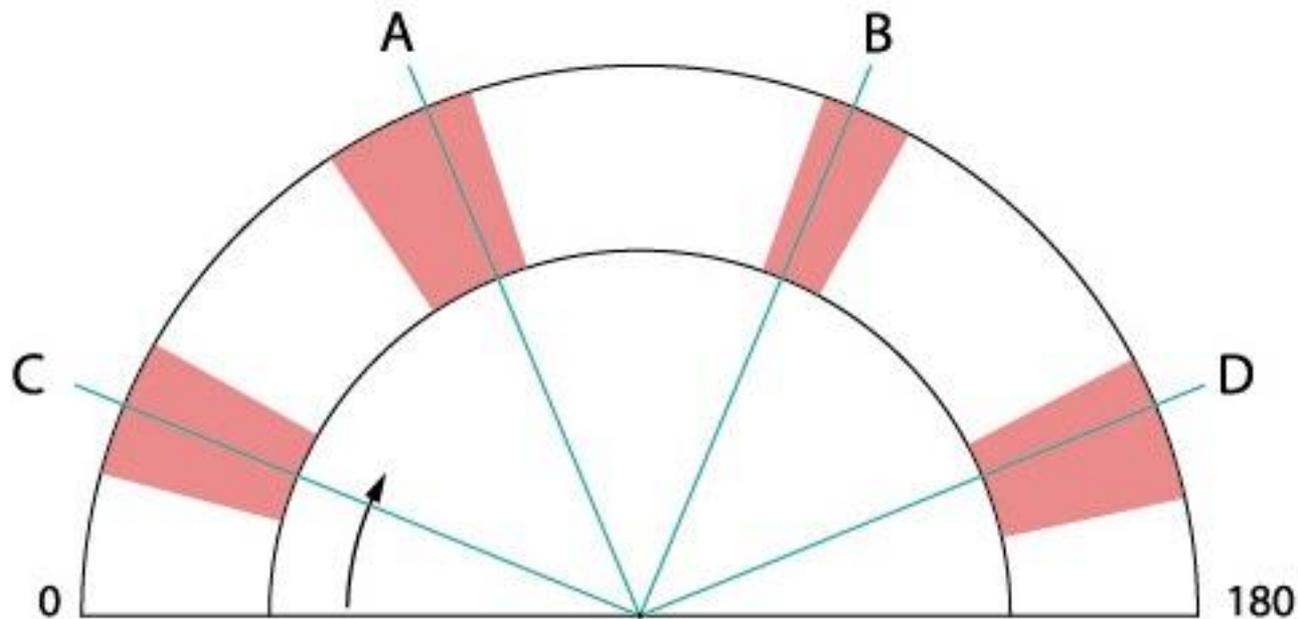
Testing relevance of vibration signal



Relevance of vibration signal, orientation from ...?



Relevance of vibration signal, error (in red)



New Idea

- Use the robot as a walking assistant and possibly guide



Accompanying behaviour



All 3 versions of the robots displayed. All of the pictures have hyperlink to 3d model.



[Version 01](#)



[Version 02](#)



[Version 03](#)

Internal state of the robot



DELPER ROBOT VERSION 01

Comparison of two scenarios of colour changing.



DELPER ROBOT VERSION 02



Calm happy robot changes colour of light very smoothly.

Controlled Autonomous Robot for Early diagnosis and Rehabilitation of Autism and Intellectual Disability (CARER-AID)

- This project envisions a humanoid robot as a supervised autonomous assistant that will support caregivers in early diagnosis and to improve the treatment of individuals with Autism Spectrum Disorder (ASD) associated with Intellectual Disability (ID).
- The robot can be part of the diagnostic team during the administration of the psycho-diagnostic tests in order to enrich the data that the psychologist can use to refine the diagnosis.

<https://www.researchgate.net/project/CARER-AID-Controlled-Autonomous-Robot-for-Early-diagnosis-and-Rehabilitation-of-Autism-and-Intellectual-Disability>

@Alessandro di Nuovo



Clinical experiments

- Robot has been embedded in the therapy (TEACCH approach) for four weeks
- 6 hospitalised children with ASD and ID.



imitation



emotions

Summary

- The Fabrics of Group Behaviours;
 - *From what do group-behaviours emerge?*
- Human-robot Interaction in **no-visibility** conditions
 - Human to robot swarm; easy
 - Robots to human
 - haptic interaction
 - *How to create trust and confidence?*



Collaborators

- Lyuba Alboul
- Peter Jones
- Alan Holloway
- Heath Reed
- Alessandro Soranzo
- Carol Cooper
- Alessandro di Nuovo
- George Chliveros (2006-2012)
- Amir Naghsh (2006-2013)

Ayan Ghosh
Alireza Janani
Joan Saez Pons
Inna Popa

Guardians Partners

South Yorkshire Fire and Rescue
DE, ES, PT, TR, BE

Reins Partners

South Yorkshire Fire and Rescue
King's College London

Further Reading

1. Swarm Robotics

PENDERS, Jacques and ALBOUL, Lyuba (2012). Emerging robot swarm traffic. *International Journal of Intelligent Computing and Cybernetics*, **5** (3), 312-339. <http://shura.shu.ac.uk/4189/>

2. Robot Swarms in Search and Rescue

PENDERS, Jacques, ALBOUL, Lyuba, WITKOWSKI, Ulf, NAGHSH, Amir, SAEZ-PONS, Joan, HERBRECHTSMEIER, Stefan and HABBAL, Mohamed El (2011). [A robot swarm assisting a human fire-fighter](http://shura.shu.ac.uk/3600/). *Advanced Robotics*, **25** (1-2), 93-117. <http://shura.shu.ac.uk/3600/>

3. Human Robot Interaction (no-visibility)

GHOSH, Ayan, PENDERS, Jacques, JONES, Peter, REED, Heath and SORRANZO, A (2014). [Exploring haptic feedback for robot to human communication](#). In: SHARKEY, Paul, PARETO, Lena, BROEREN, Jurgen and RYDMARK, Martin, (eds.) *The 10th International Conference on Disability, Virtual Reality and Associated Technologies, Proceedings*. Reading, University of Reading, 309-312.

GHOSH, Ayan, PENDERS, Jacques, JONES, Peter and REED, Heath (2014). [Experience of using a haptic interface to follow a robot without visual feedback](#). In: *Proceedings of the 23rd IEEE International Symposium on Robot and Human Interactive Communication*. Edinburgh, 25-29 August. IEEE, 329-334.

- <http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=7122303>

- PENDERS, Jacques and GHOSH, Human robot interaction in the absence of visual and aural feedback: Exploring the haptic sense. *Procedia computer science*, **71**, 185-195 2016.

- <http://www.sciencedirect.com/science/article/pii/S1877050915036583>

1. Dementia

- COOPER, Carol, [PROCTER, Paula](#) and [PENDERS, Jacques](#) (2016). [Dementia and robotics: people with advancing dementia and their carers driving an exploration into an engineering solution to maintaining safe exercise regimes](#). In: SERMEUS, Walter, [PROCTER, Paula](#) and WEBSTER, Patrick, (eds.) *Nursing informatics 2016, eHealth for all : entry level collaboration - from project to realization*. Studies in Health Technology and Informatics (225). IOS Press, 545-55

Thank You

Questions?

Papers:

<http://shura.shu.ac.uk/view/creators/2780.html>