RoMaNS – Robotic Manipulation for Nuclear Sort and Segregation

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€6.8million 3 year R&I project
(€6.4million EU, €400k UK)
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Nuclear sort and segregation problem

- Cleanup of legacy nuclear waste *in the UK alone* is the largest environmental remediation project in the whole of Europe.
  - UK has 1.4 million cubic metres of intermediate level waste (ILW) alone.
  - At a single UK site (Sellafield), 69,600 cubic metres of ILW waste will have to be placed into 179,000 storage containers in near future.

- Much of this was stored decades ago, in containers with unknown (or partially known) contents and mixed contamination levels.
  - Old containers must be cut open.
  - Their contents must be examined, sorted and separated.
  - Highly contaminated waste must be extracted and placed into special new storage containers

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New BEP Testbed at NNL – beyond SOA in UK nuclear robotics

• BEP plant at Sellafield will take in legacy waste in skips, cut open containers, inspect/sort/segregate and re-package in newer, safer containers.
• 500 kg payload 6-axis KUKA robot arms
• Exciting – MAJOR investment by UK nuclear in advanced, modern robotics

But so far..

• No autonomy.
• No telepresence or haptics.
• No compliance or force control.
• Limited visualisation.
• Limited situational awareness.

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RoMaNS research activities

Plant-representative industrial test-bed

Advanced autonomy
Simulation and visualisation
Advanced tele-presence
New master-slave hardware
Main robotics and AI challenges

Huge variety of materials and objects
Presented in chaotic self-occluding heaps
Need for very complex manipulative actions

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Some tasters of the science being done

“Continuous machine learning” for vision

Deep learning for activity understanding

Learning from demonstration for grasping:
- Unknown objects
- Arbitrary shapes
- Partial views/point-clouds
- Deformable objects
- “Click-and-grasp” operator assistance tool

Reinforcement learning:
- Bi-manual “disentangling”
- Robust reactive grasping
- Semi-autonomous grasp learning

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Challenges – what doesn’t work yet?

- Object recognition and vision in highly cluttered scenes
- Semantic level scene understanding
- Learning of simple physics and object interactions
- High level activity recognition and understanding
- Grasping – beyond the level of simple geometry
How are we doing so far?

- Quite early to say – we are only 11 months into the project

- Some successes:
  - Advanced autonomous grasping of arbitrary shapes
  - Advanced visual tracking of deformable objects against severe clutter
  - Some new insights into variable autonomy and human-robot interaction

- Project designed to grow low TRL levels and progressively feed them into high TRL demonstrator as they mature.
Thankyou for your attention!

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coming soon...