Enhanced Visual Scene Understanding through Human-Robot Dialog

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Robot, please clean my desk!
Example Scene a Robot Can Deal With Today

- Table-top scene with objects
- 3D Reconstruction
- Object, Background separation
- Object recognition
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A Difficult Scene to Untangle

- Object separation necessary for
  1. manipulation
  2. recognising / categorise objects
  3. learning new objects
- Human-in-the-loop helps for separating an object from background and from other objects
Traditional vs. Incremental Dialog Processing

- Java-based Incremental DIalogue framewOrk (Jindigo)
  www.jindigo.com
- OpenSource (sourceforge), modularised and extendible
How is the scene segmentation refined?

- Initial Scene Segmentation
- Questions:
  1. I can see $n$ objects. Is this correct?
  2. Which segment is incorrect?
  3. How are the objects in the wrong segment positioned relative to each other?

- How does a robot incorporate human input into his environment model?
- How to optimise the necessary interaction?

3D point entropy 0.54
hue entropy 0.24

3D point entropy 0.54
hue entropy 0.66
3D point entropy 0.47

Johnson-Roberson et al. (KTH Stockholm)  Scene Understanding through DwR
DwR Nov. 2010
How is the scene segmentation refined? (2)

1. I can see \( n \) objects. Is this correct?

2. Which segment is incorrect?
   - Segment analysis: point and colour distribution → Entropy
   - Machine learning techniques to automatically determine incorrect segments

![Segmentation analysis](image)

- 3D point entropy 0.54
- hue entropy 0.24
- hue entropy 0.66
- 3D point entropy 0.47

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How is the scene segmentation refined? (2)

1. I can see \( n \) objects. Is this correct?

2. Which segment is incorrect?
   - Segment analysis: point and colour distribution → Entropy
   - Machine learning techniques to automatically determine incorrect segments

3. How are the objects in the wrong segment positioned relative to each other?
   - Three options:
     1. On top of each other
     2. Next to each other
     3. In front of one another
   - split of Bounding Box and re-segmentation

3D point entropy 0.54   hue entropy 0.24
hue entropy 0.66   3D point entropy 0.47
How much does the Initial Segmentation improve?

- Test on 20 scenes with initially wrong segmentation
Conclusion

- Integration of
  1. System for vision-based segmentation of object from each other and from background
  2. Incremental dialog system

- for improved scene understanding.

- Helps with
  1. Recognition and Categorisation of objects
  2. Learning of new objects
Thanks you for your Attention!

Questions?