

Visual Attention on Bimodal Laser Data



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Autonome Intelligente
Systeme

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1. Attention for Robotics

Challenge: Implement attentional mechanisms for robotics

Attention helps select relevant parts from sensory input. Important for humans, useful also in robotics!

Attention-supportable robot tasks:

- Manipulation of objects (e.g., grasping)
- Obstacle avoidance
- Detection of landmarks for localization



Kurt 2 with 3D laser scanner

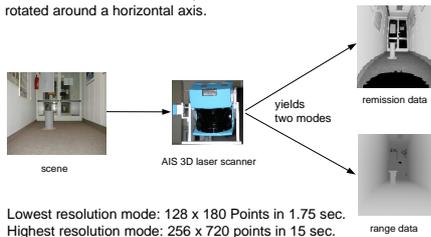
3. A 3D laser scanner as sensor

Humans use different senses (eyes, ears, ...).
Existing models usually use only vision.
Robots are well suited to use additional sensors.

Additional sensors can provide additional information, e.g., depth. Depth information can be very useful for object detection!

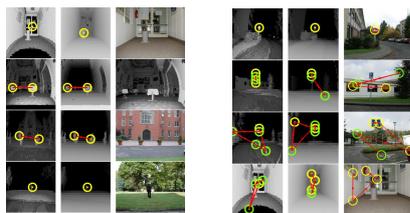
The multi-modal custom 3D laser scanner

A horizontal 2D scanner is step-rotated around a horizontal axis.



Lowest resolution mode: 128 x 180 Points in 1.75 sec.
Highest resolution mode: 256 x 720 points in 15 sec.

5. Results



Most of the *Foci of Attention (FOAs)* show an object of potential interest.

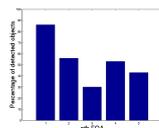
The different modes are specialized to different object attributes => best results should be achieved by combination.

Evaluation:

Regard first 5 FOAs of remission and range images of 15 scenes
= 5 * (2*15) = 150 FOAs.

81 FOAs (54%) show objects of potential interest.

86% of first FOAs show an object of potential interest.

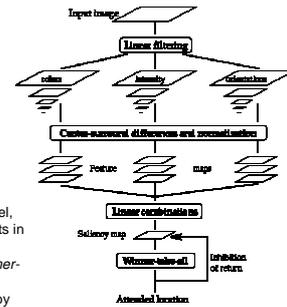


2. The attentional model

The visual attention model by Itti, Koch and Niebur

Implementation of the Koch-Ullman model

Based on the „Feature Integration Theory“

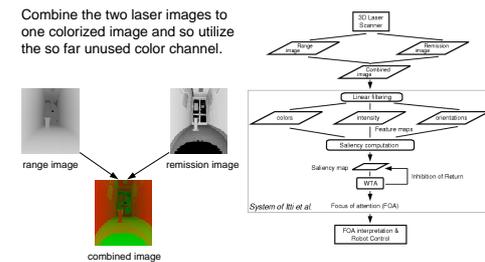


Key ideas:

- compute color, intensity, and orientations in parallel,
- collect conspicuous points in a saliency map,
- generate focus by a winner-take-all network,
- inhibit attended regions by inhibition of return method.

4. The extended model

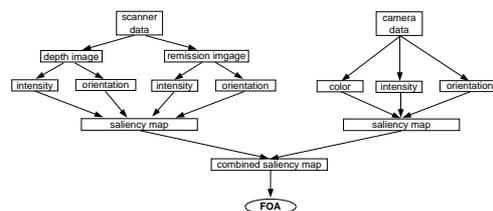
Combine the two laser images to one colorized image and so utilize the so far unused color channel.



6. Future work

- Extend the model to combine laser and camera data

Planned model:



- Integrate *top-down influences* depending on the robot's task, e.g.: (task = find an object to grasp) => increase depth influence (task = detect a red poster) => increase color influence

7. References

Frintrop, Rome, Surmann, Nüchter: "An Attentive Multi-modal Laser „Eye“", accepted for ICVS '03
Itti, Koch, Niebur: "A model of saliency-based visual attention for rapid scene analysis", in IEEE Trans. Patt. Anal. Mach. Intell. '98
Koch, Ullman: "Shifts in selective visual attention: Towards the underlying neural circuitry", in Human Neurobiology 85
Surmann et al.: "A 3D laser range finder for autonomous mobile robots", in Proc. ISR '01
Treisman, Gelade: "A feature-integration theory of attention", in Cognitive Psychology 80

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