

Experimental Analysis of Smelling Braitenberg Vehicles

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- 4) Experimental Setup
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1 Motivation

■ Mobile Nose - Research

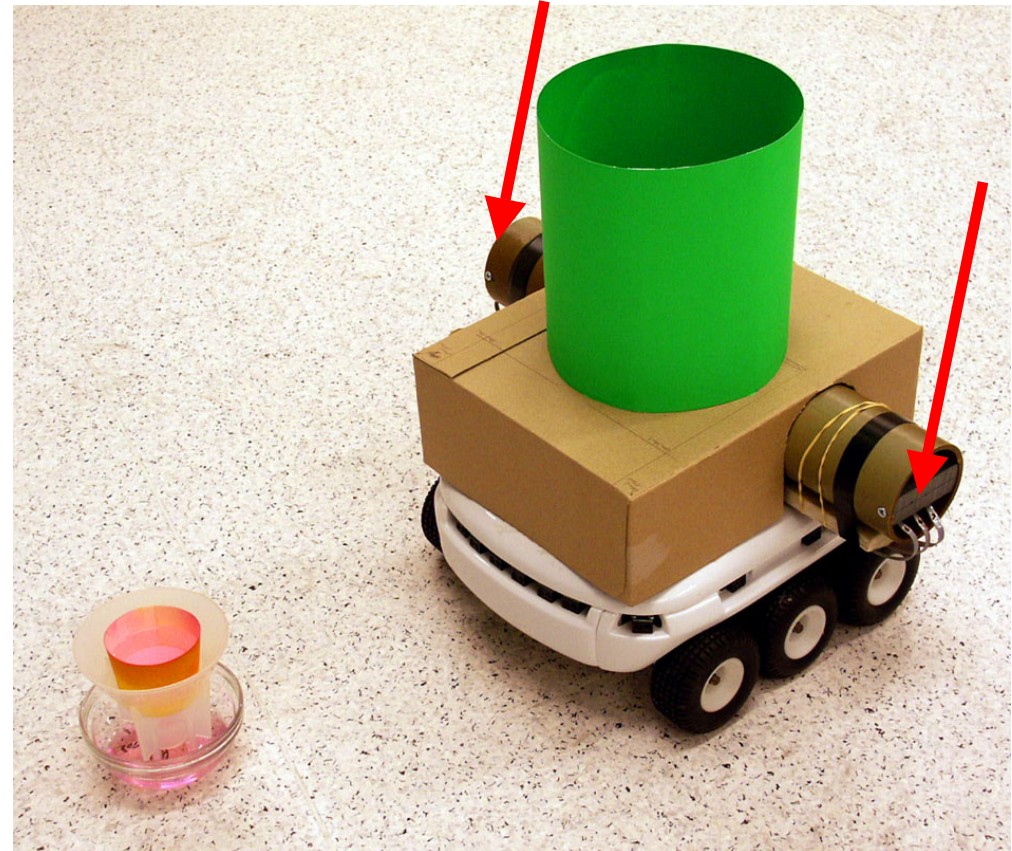
- physical properties of gas transport
- understand how animals use odours to navigate

■ Mobile Nose - Applications

- cover larger scale environments
- inspection robot with smelling ability
- use in rescue robots

2 The Mark III Mobile Nose

- stereo architecture
 - 2 equivalent sets
 - | Figaro TGS 2600
 - | Figaro TGS 2610
 - | Figaro TGS 2620
 - 40 cm separation
 - suction fans



3

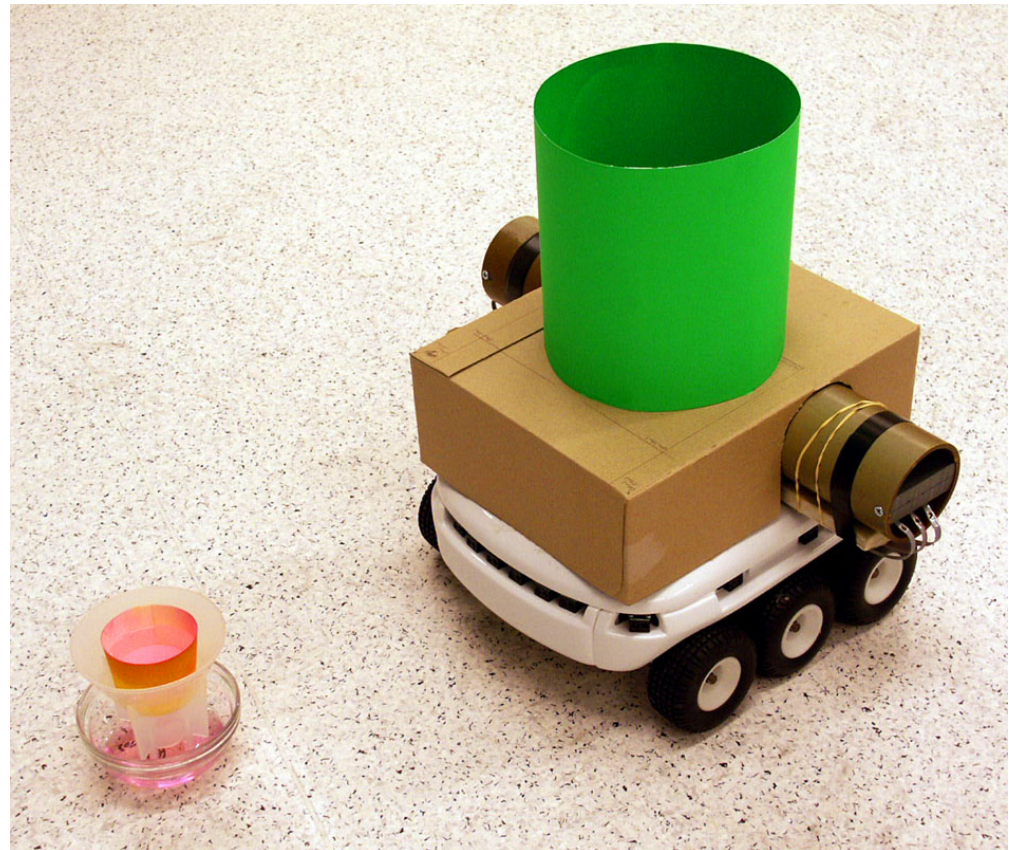
Gas Source Localisation: Main Problems

- delayed response

- $\tau_r \approx 1.8 \text{ s}$

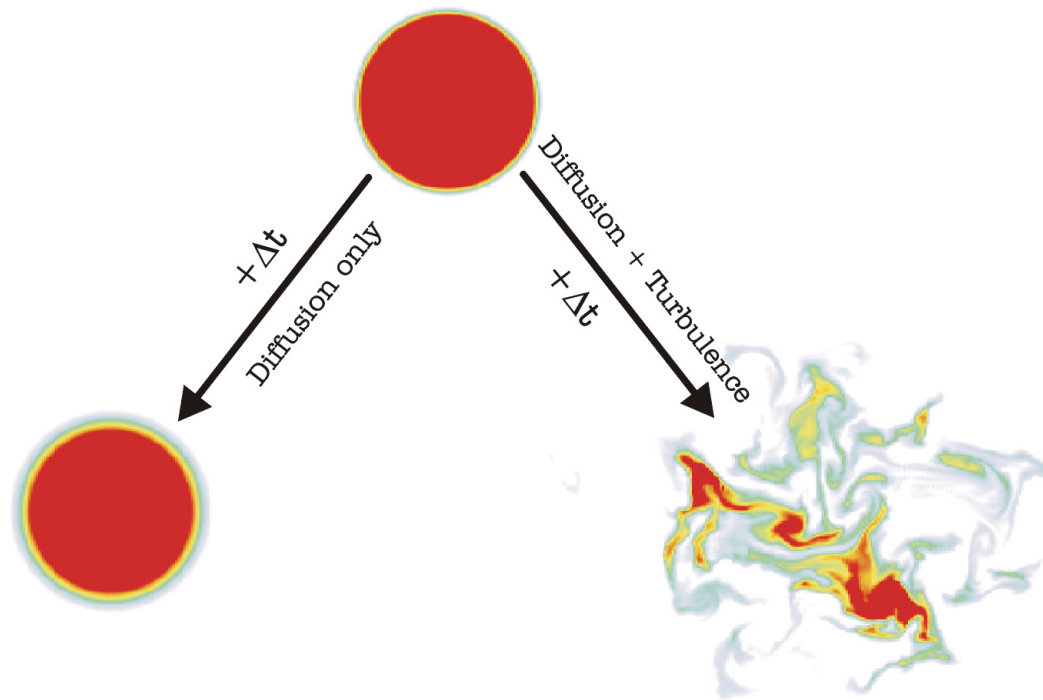
- delayed recovery

- $\tau_d^{(fans)} \approx 11.1 \text{ s}$



3 Gas Source Localisation: Main Problems

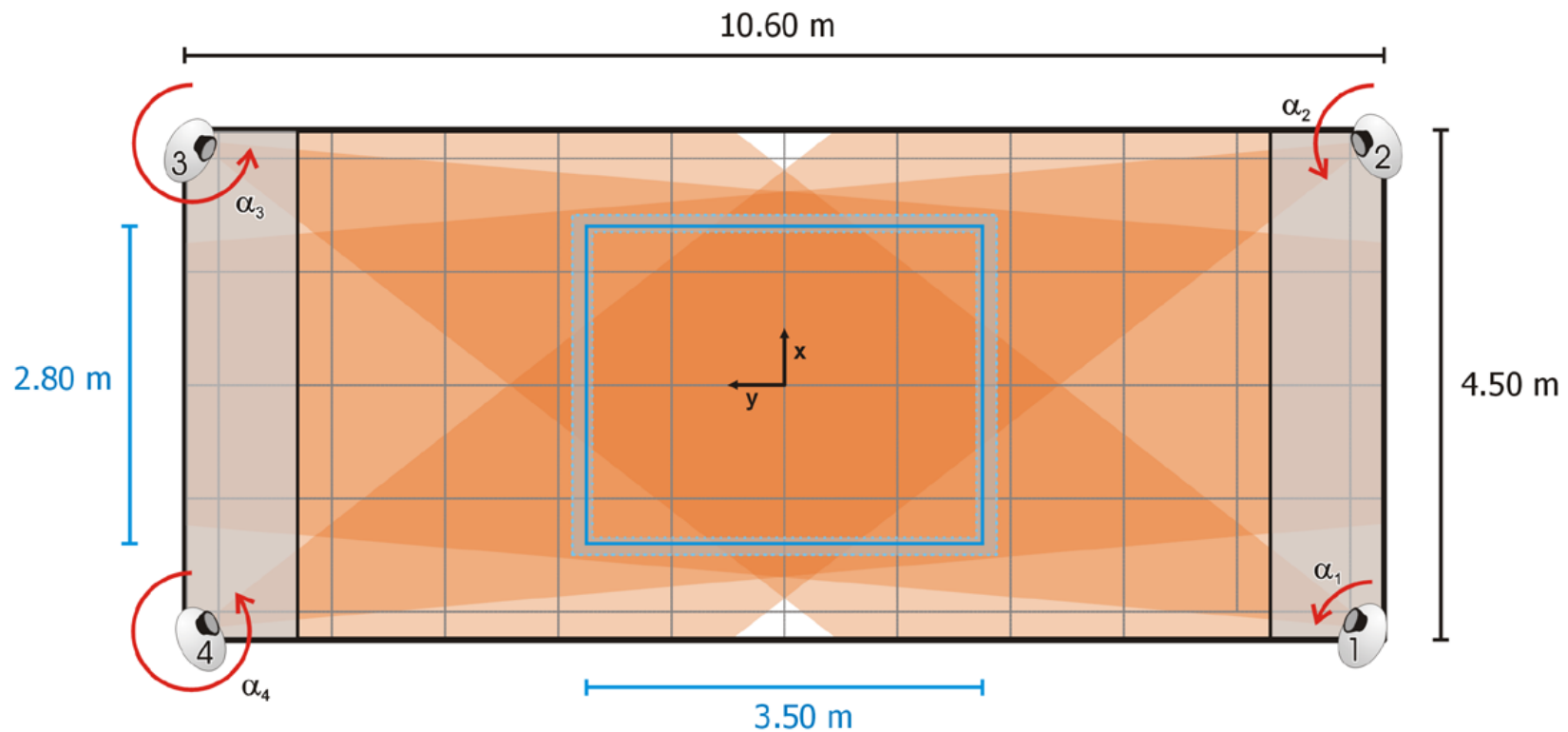
- instantaneous distribution $\neq$ average distribution



Smyth & Moum 2001

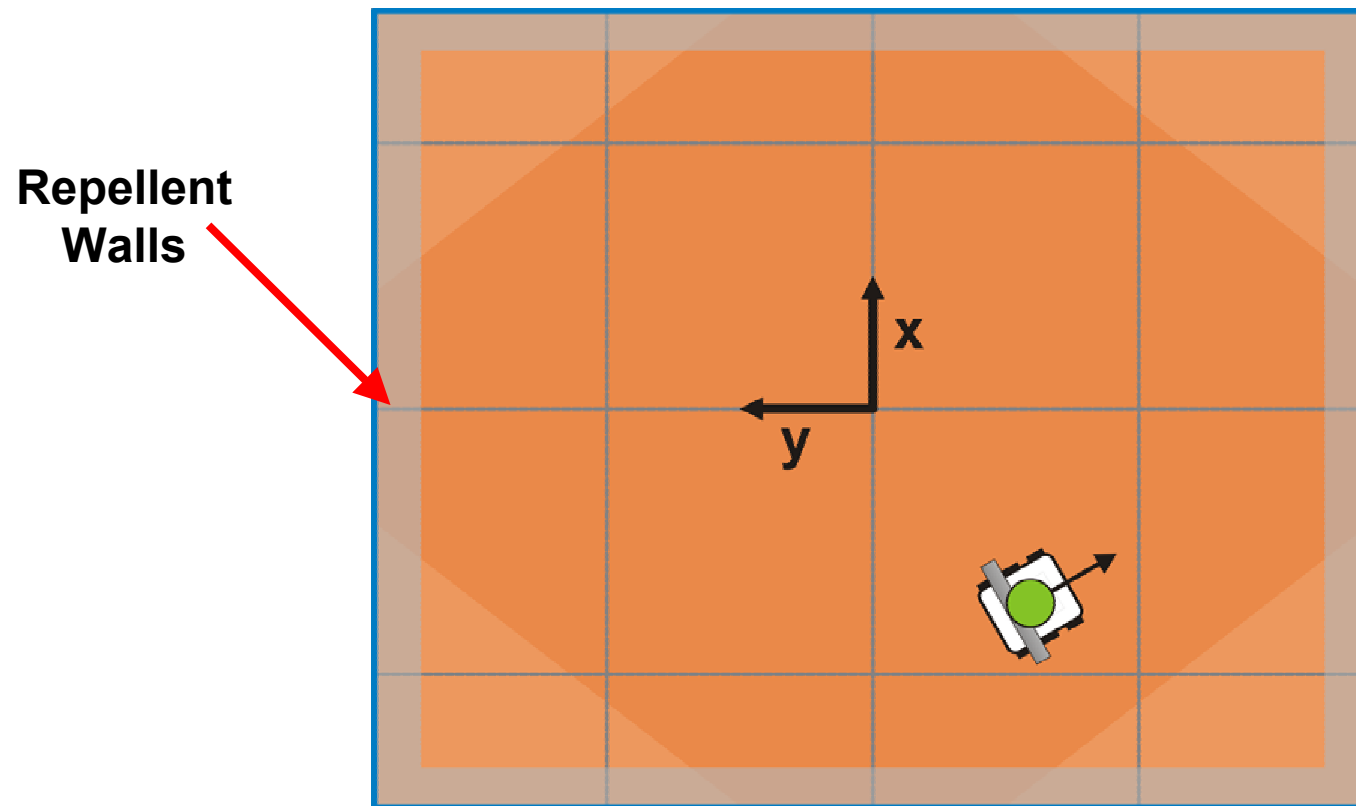
4 Experimental Setup

- a testbed for localisation strategies



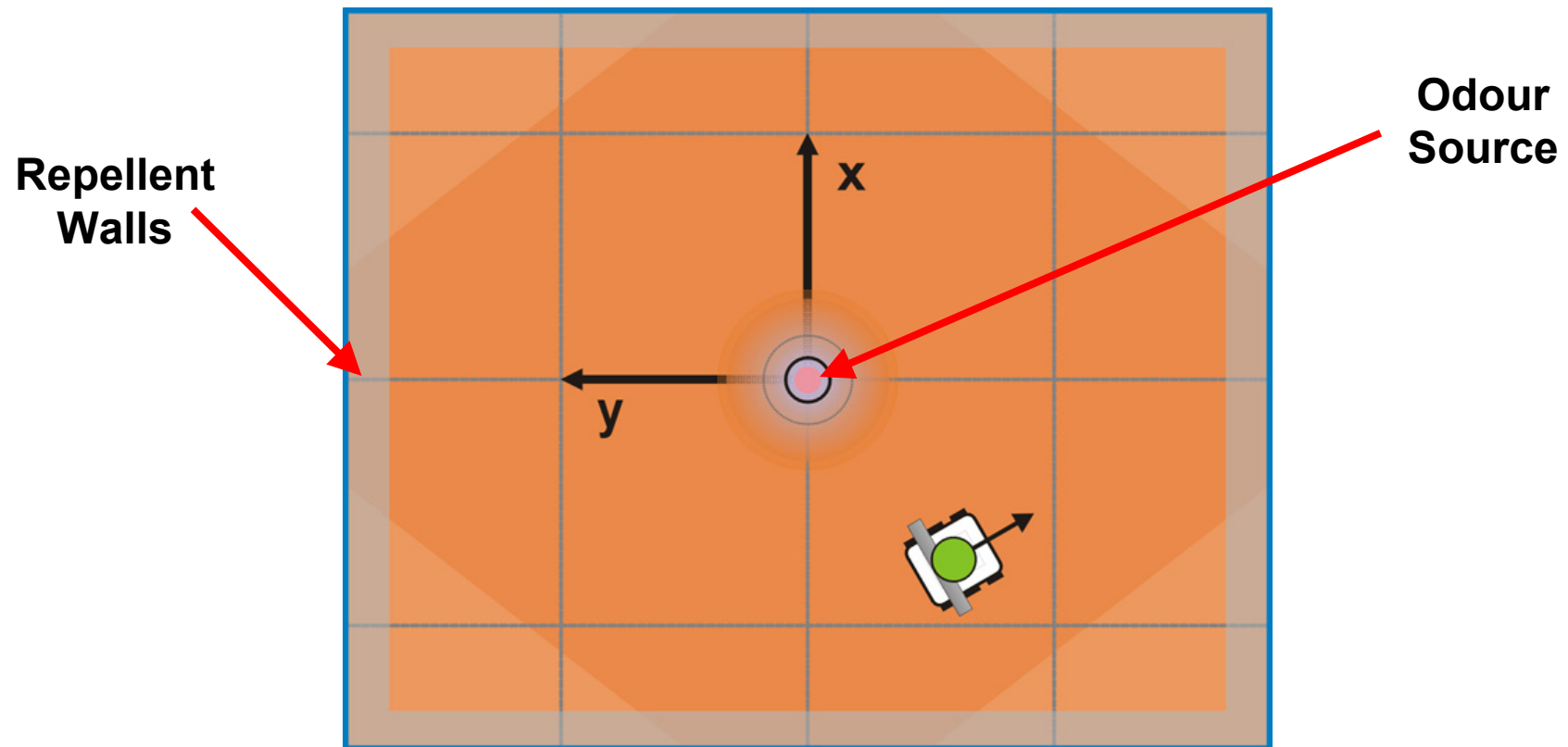
4 Experimental Setup

- a testbed for localisation strategies



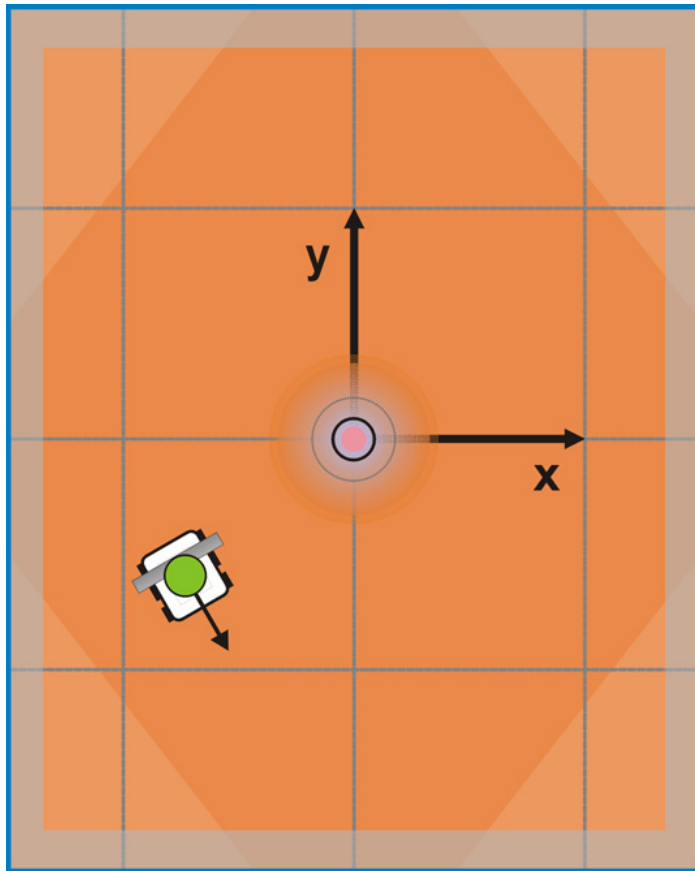
4 Experimental Setup

- a testbed for localisation strategies



4 Experimental Setup

Gas Source Localisation Benchmark

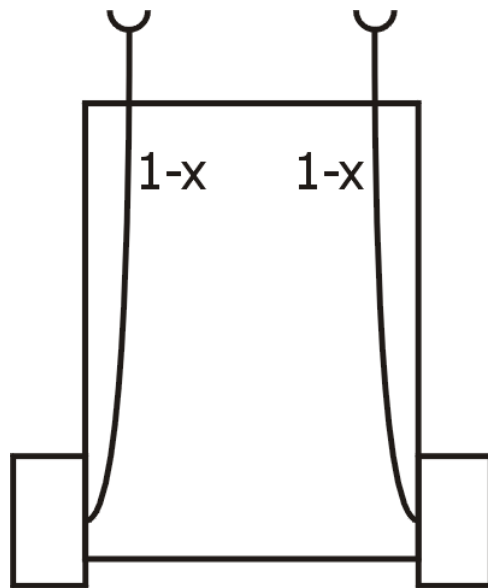


- start
 - random starting position...
 - with min. distance of 100 cm
 - random heading
- source is found ...
 - ... if robot would hit it
- statistics
 - path length, wall bumps, ...

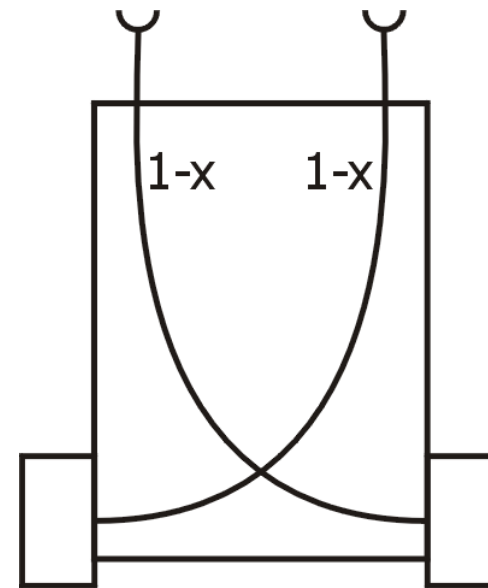
4

Reactive Localisation: Braitenberg Vehicle

- connections: monotonic, inhibitory

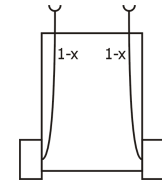


“Permanent Love”

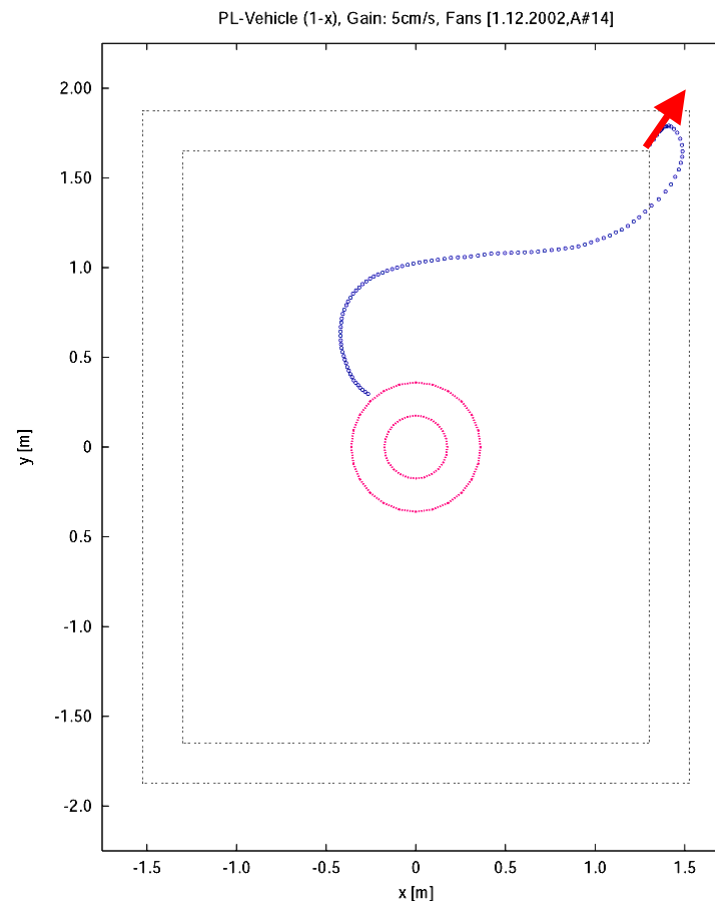
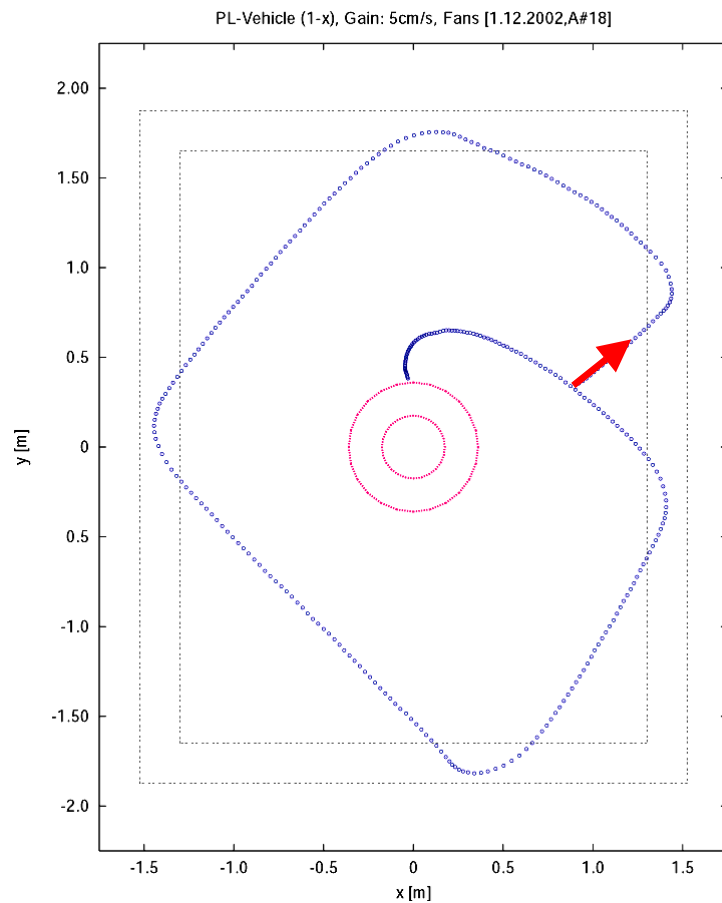


“Exploring Love”

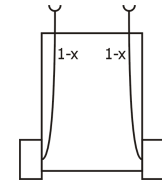
5 Results



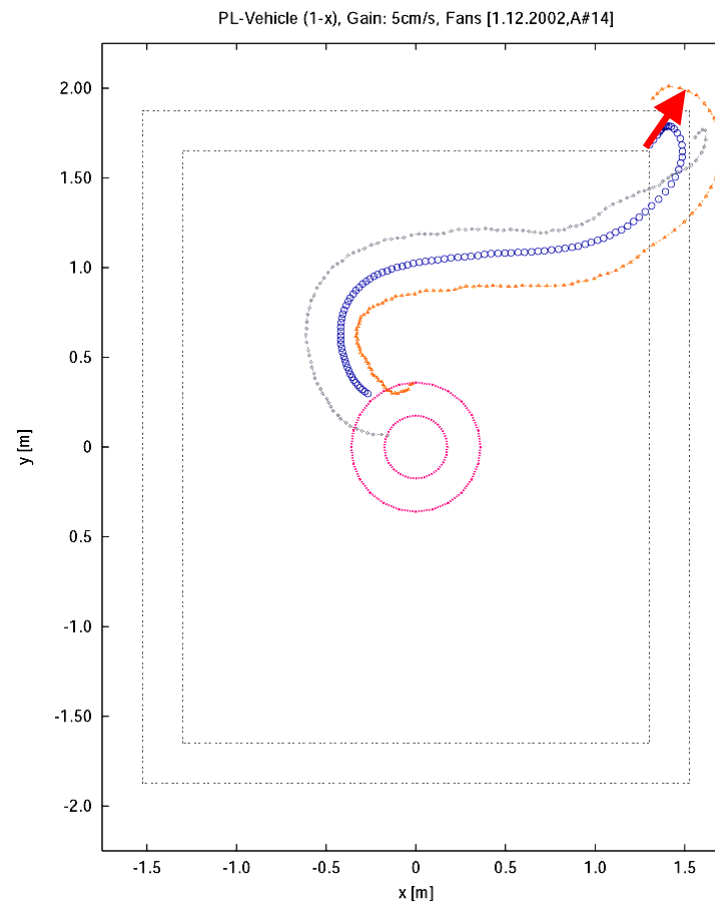
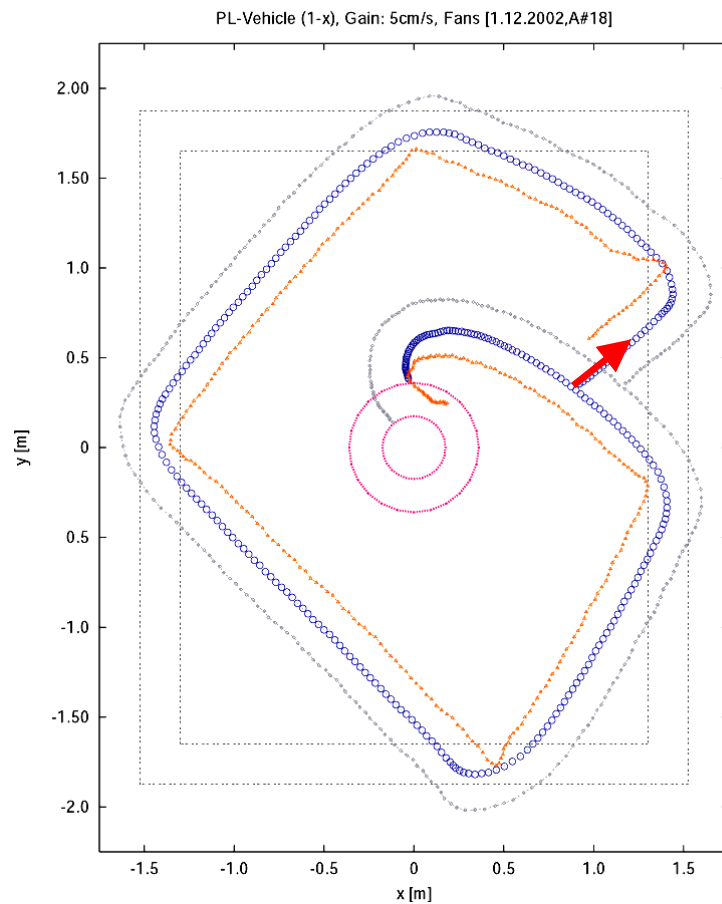
■ “Permanent Love” - looks quite nice sometimes ...



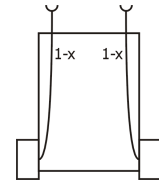
5 Results



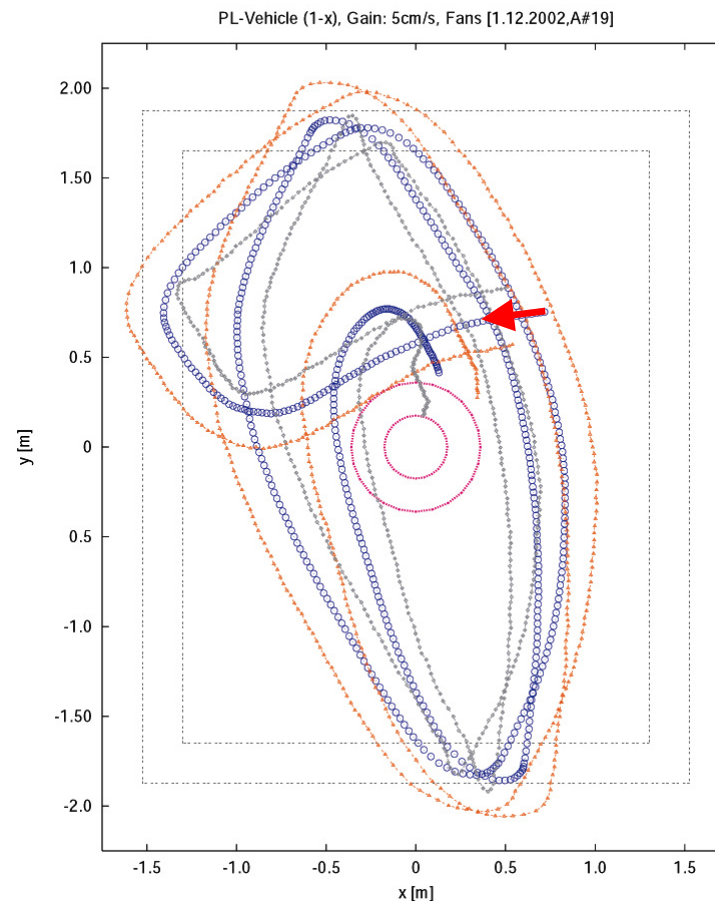
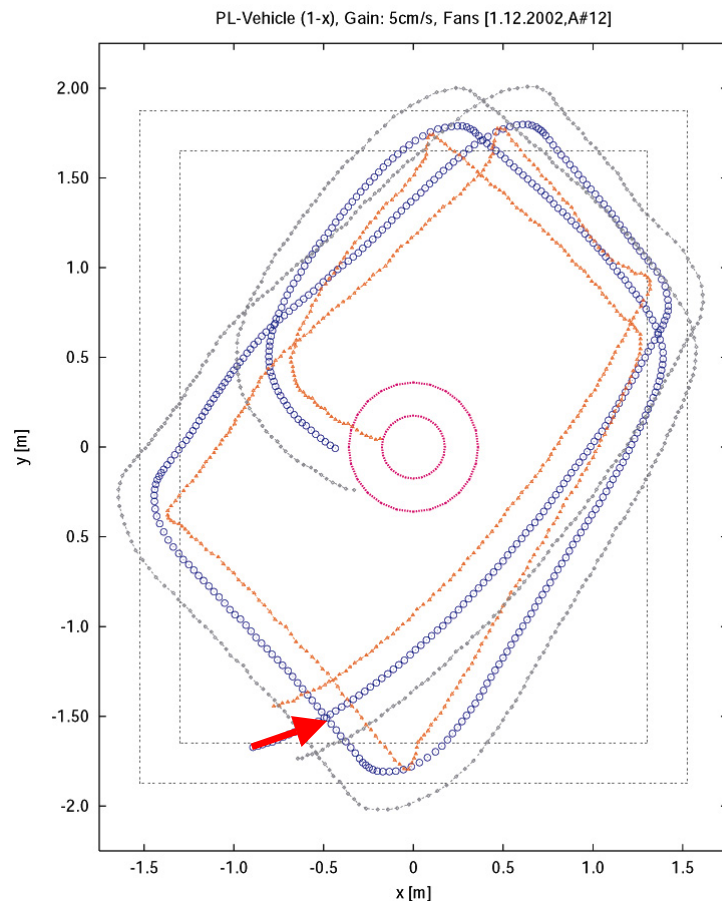
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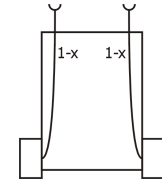
5 Results



... but sometimes changes are hard to explain

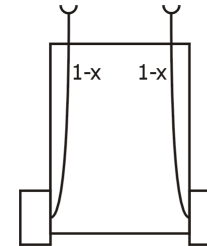
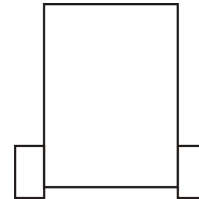


5 Results



Statistics:

Source in the Middle

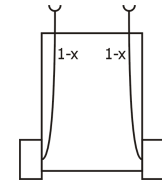


No Odour

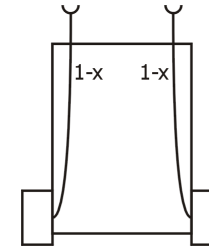
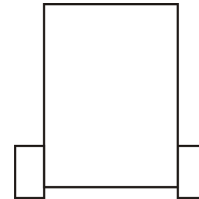
PL-Vehicle

average path length:	9.67 ± 7.66 m	8.49 ± 7.93 m
average distance:	136.7 ± 44.9 cm	121.9 ± 19.8 cm
number of wall hits:	3.49 ± 2.75	2.69 ± 2.59
correlation ρ_{DT} :	-24.4 ± 40.7 %	-37.9 ± 45.9 %

5 Results



Statistics:
Source in a Corner

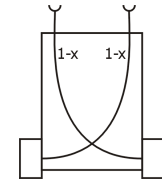


No Odour

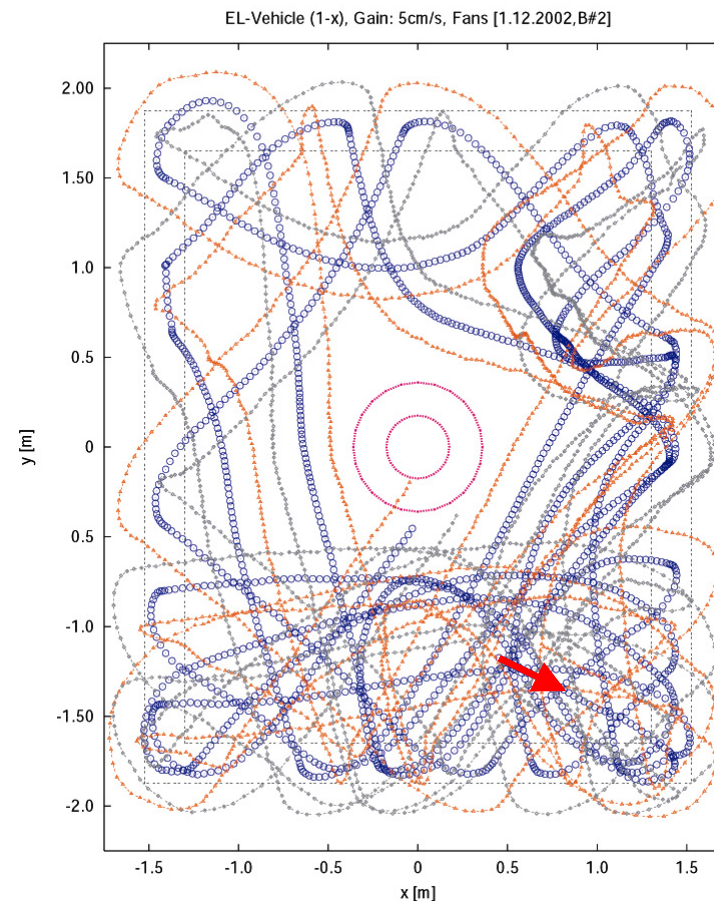
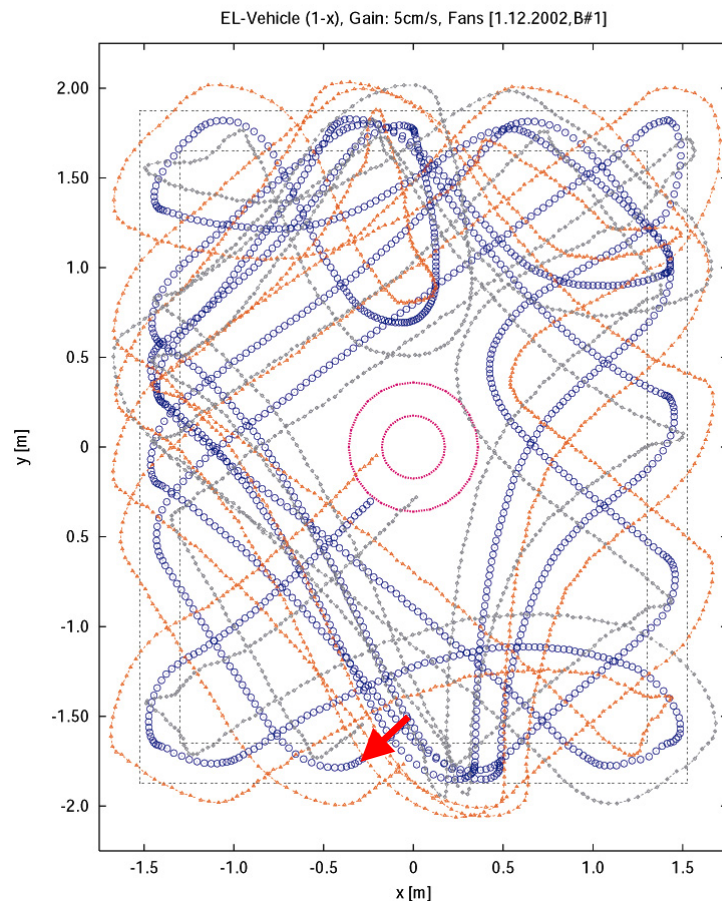
PL-Vehicle

average path length:	20.46 ± 19.38 m	11.69 ± 11.22 m
average distance:	218.7 ± 33.7 cm	187.6 ± 47.5 cm
number of wall hits:	7.24 ± 6.16	5.11 ± 4.49
correlation ρ_{DT}:	-22.7 ± 42.9 %	-59.7 ± 40.9 %

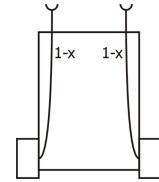
5 Results



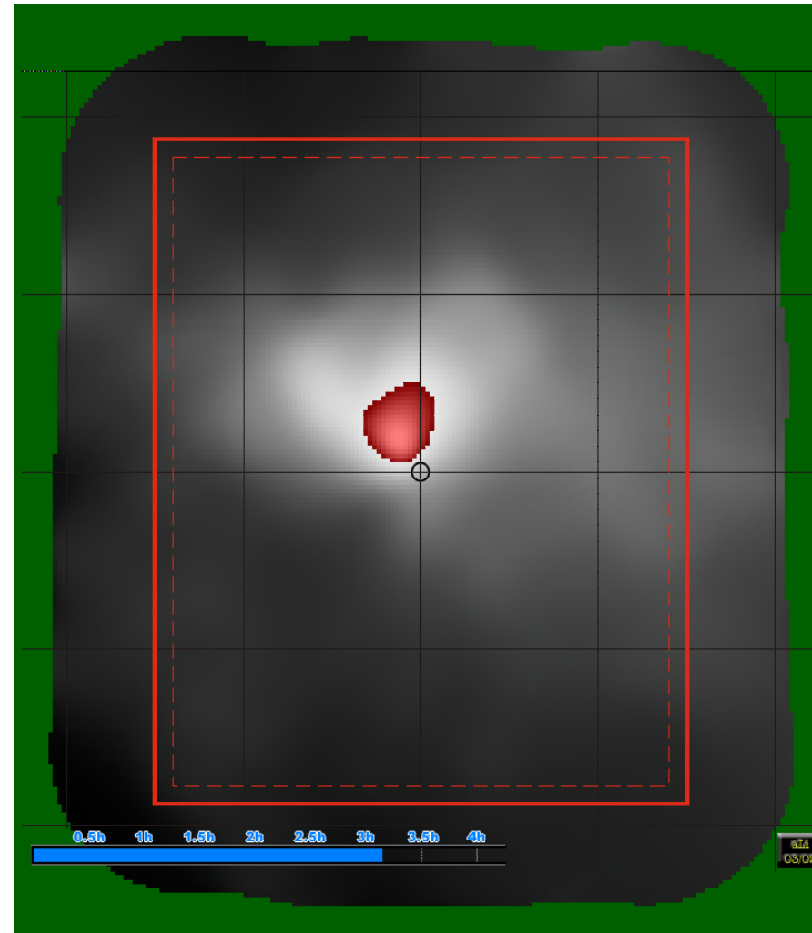
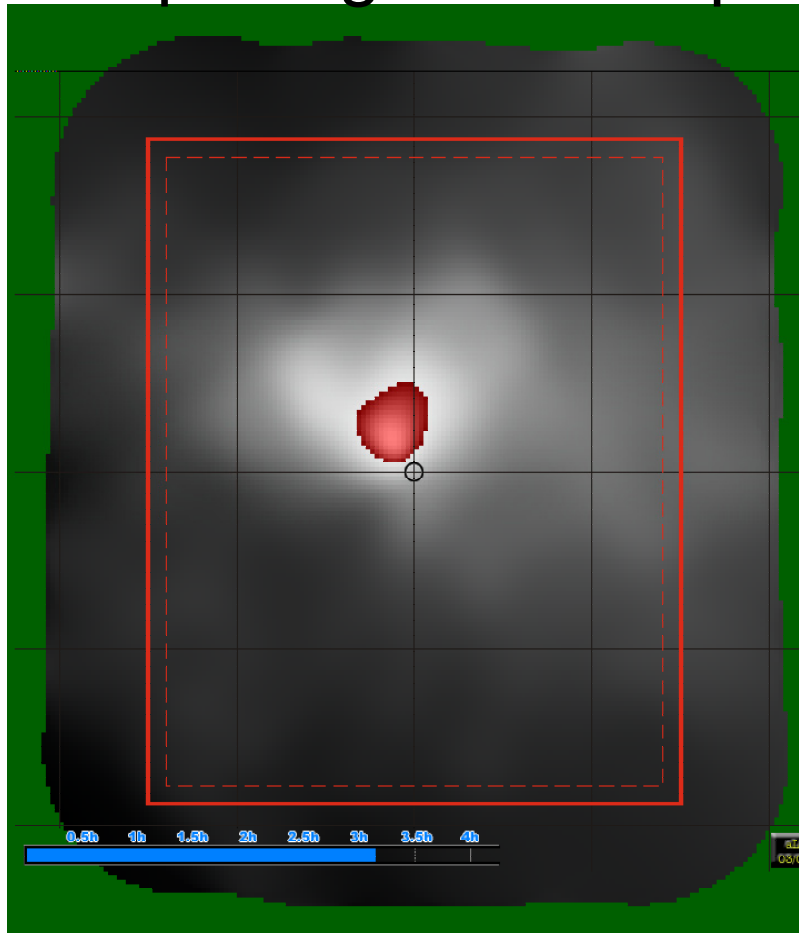
■ “Exploring Love” is quite different ...



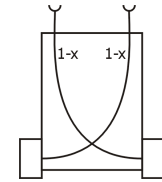
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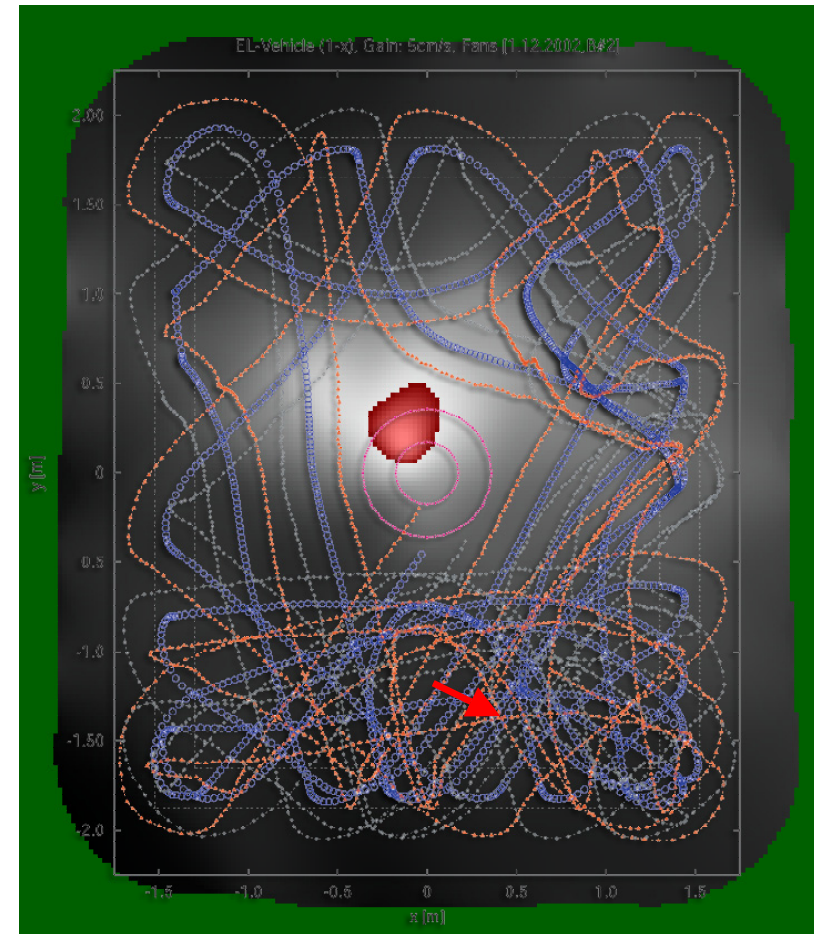
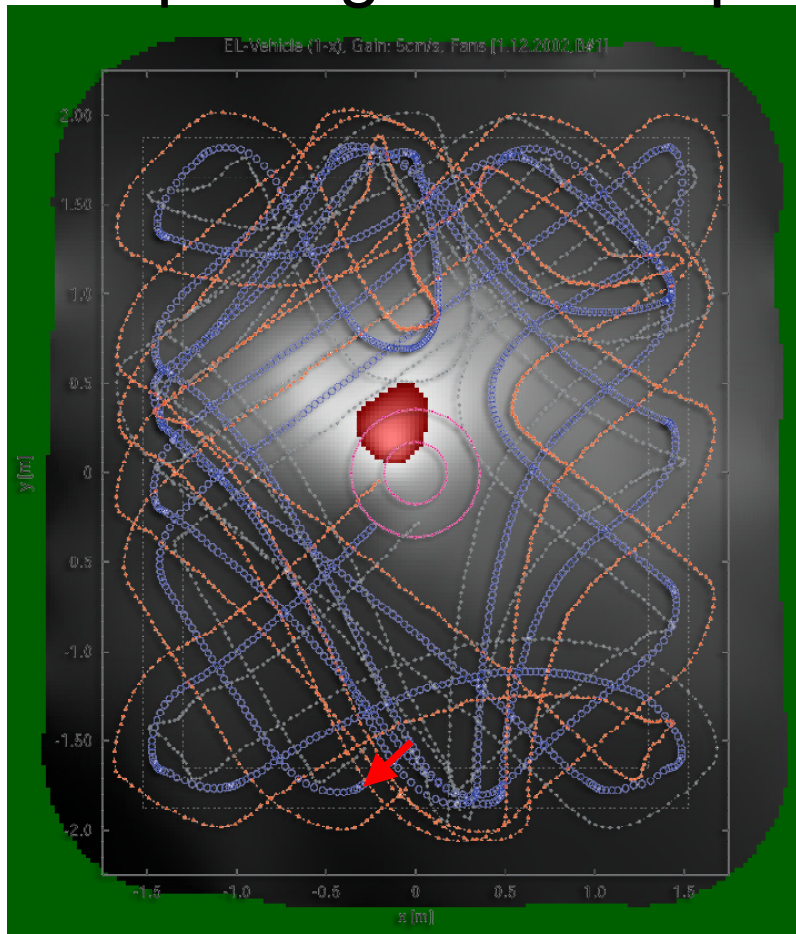
- “Exploring Love” is quite different ...



5 Results

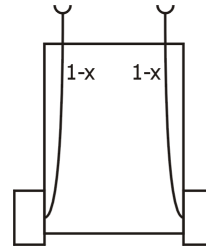


- “Exploring Love” is quite different ...

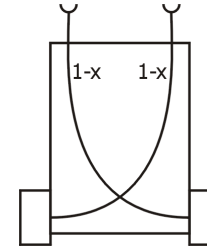


5 Results

Statistics:
Source in the Middle



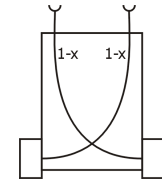
PL-Vehicle



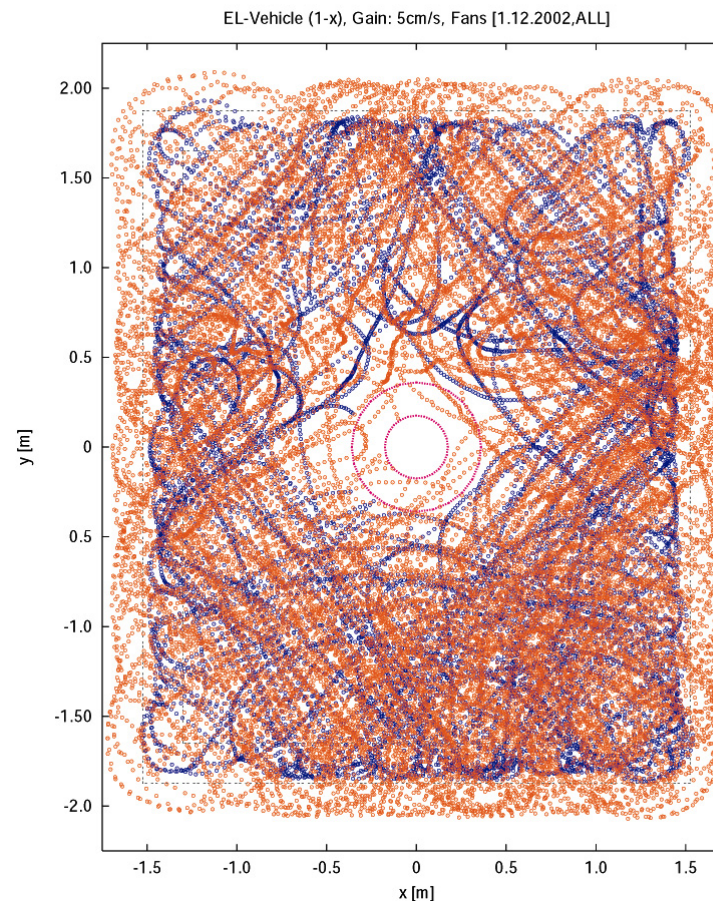
EL-Vehicle

average path length:	8.49 ± 7.93 m	77.27 ± 42.17 m
average distance:	121.9 ± 19.8 cm	139.8 ± 6.1 cm
number of wall hits:	2.69 ± 2.59	32.40 ± 19.55
correlation ρ_{DT}:	-37.9 ± 45.9 %	5.4 ± 3.2 %

5 Results

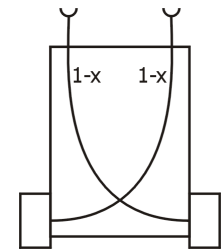
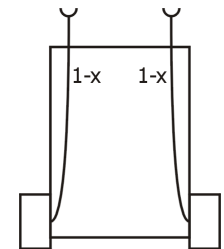


■ ... but it's a nice localisation method too!



6 Summary

- Mark III mobile nose architecture
- testbed for gas source localisation
- "smelling" Braitenberg vehicle: "permanent love"
 - path length to hit gas source decreased
 - $\approx \times 0.5$ compared to random search
- "smelling" Braitenberg vehicle: "exploring love"
 - path length to hit gas source increased ($\approx \times 8$)
 - might be a method to declare a gas source



Experimental Analysis of Smelling Braitenberg Vehicles

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Thank you!

