

Desert ant navigational behaviour

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Ants in the Pants

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What is it all about?



Figure : Cataglyphis Fortis ¹

¹<http://www.lambrinos.ch> December 5th 2015



What is it all about?

Some facts:

- one ant, one prey \rightarrow no further communication needed
- Why is time, hence the shortest way back so crucial?
- Distances in relation to ant's size.

Speed of *cataglyphis fortis* $\approx 1 \frac{m}{s}$



What is it all about?

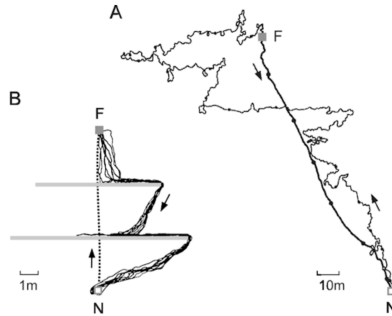


Figure : Foraging walks Wehner2003



How do they do it?

- Path integration



How do they do it?

- Path integration and
- Local Orientation

How do they do it?

Algorithm ReturnToMyNest()

```
while not at nest do  
    execute global vector;  
    update global vector;  
    if local vector recognised then  
        while local vector > 0 do  
            execute local vector;  
            update local vector;  
            update global vector;  
        end  
    end  
end  
return
```

Algorithm 1: Returning to the nest

Motivations Goals

- is the path integrator model Wehner1988 applicable for general scenarios or only within the tight constraints given by the experiment of Wehner1988?

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- is the path integrator model Wehner1988 applicable for general scenarios or only within the tight constraints given by the experiment of Wehner1988?
- are we able to predict what happens, when we alter the environment?
- Can the ants survive if we rid the environment completely of any landmarks?



Path integrator-model ¹

$$\varphi(n+1) = \varphi(n) + k \cdot \frac{(\pi + \delta) \cdot (\pi - \delta) \cdot \delta}{l(n)}$$

$$l(n+1) = l(n) + 1 - \frac{|\delta|}{\pi}$$

¹Wehner1988



Path integrator-model ¹

Fitting constant k :

$$k = 0.1316$$

Turning angle δ :

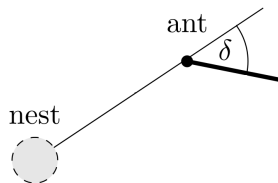


Figure : angle δ

Discussion of the path integrator

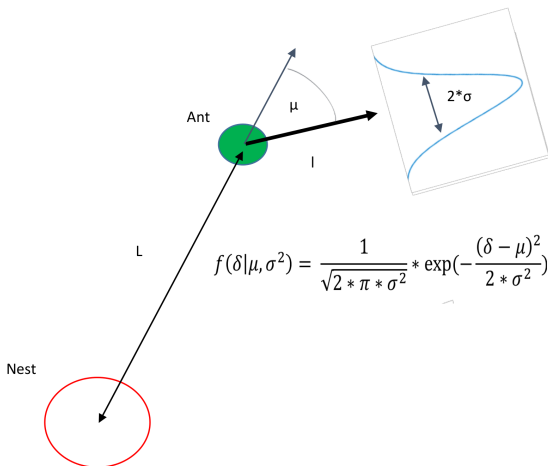


Figure : Path integrator experiment

Discussion of the path integrator

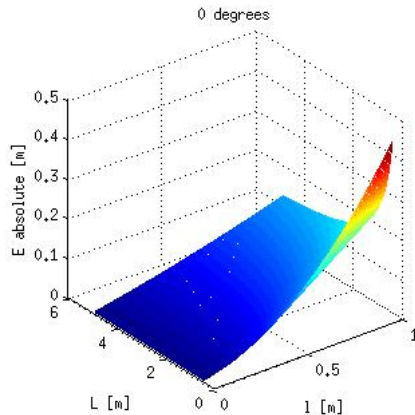


Figure : 0 degrees

Discussion of the path integrator

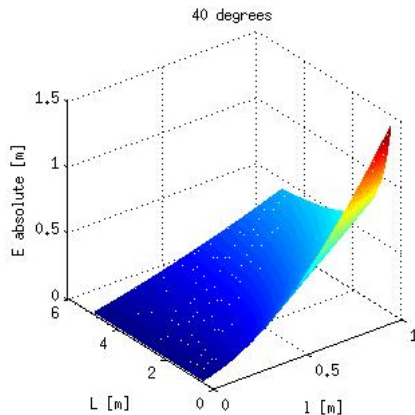


Figure : 40 degrees

Discussion of the path integrator

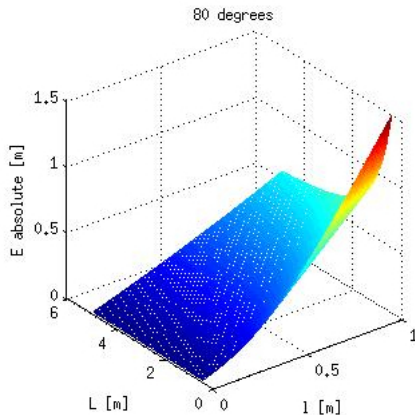


Figure : 80 degrees

Discussion of the path integrator

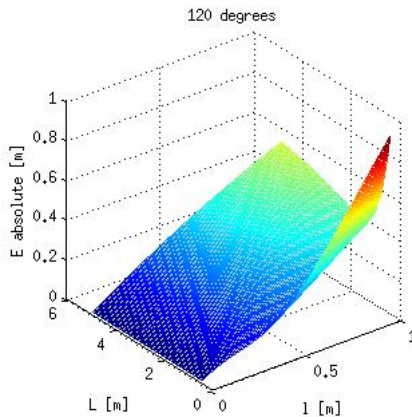


Figure : 120 degrees

Discussion of the ant's random walk

Ansatz: $\sigma = dt^c \cdot \sigma_0 \quad c \in (0, 1]$

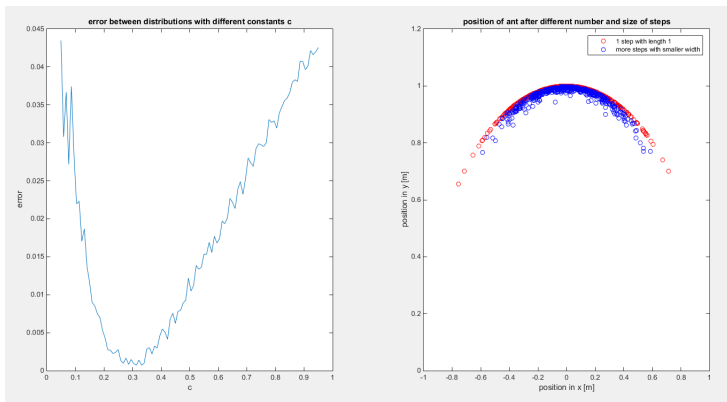


Figure : Variance for stepwidth

Verification of the path integrator

1. ant walks 12 m in a fixed direction
2. then turns an angle α walks 5 more meters, where it finds food
3. the ant returns with a certain error.

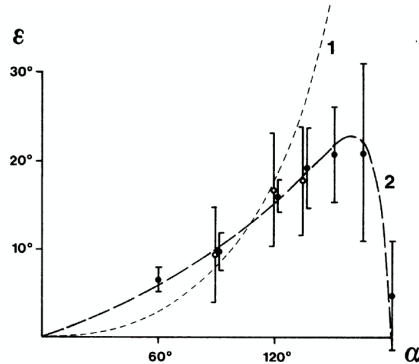


Figure : Angular Error according to Wehner1988

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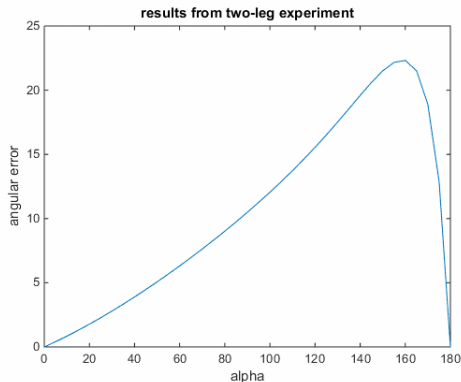


Figure : Angular error produced by our model

Verification of the path integrator

Comparison

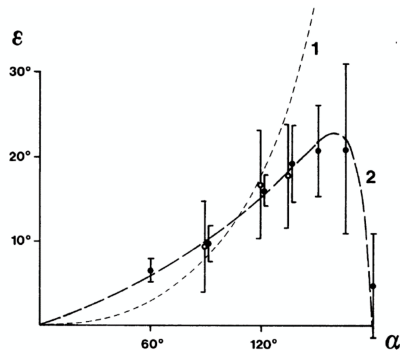
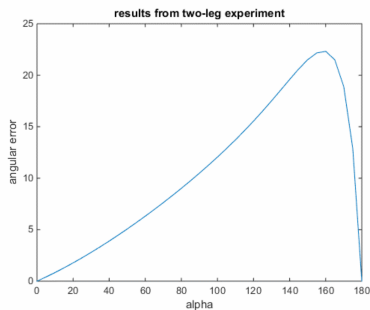


Figure : Comparison

Local Orientation

- familiar landmarks are memorized in the correct sequence.

Local Orientation

- familiar landmarks are memorized in the correct sequence.
- number of steps to follow and direction representing the local vector.

Outlook and Conclusions

- Does our model meet the requirements?
- Are we able to predict ant behaviour?
- Outlook

Thanks for your attention

Questions ?