Desert ant navigational behaviour

Presentation 15th of December 2015

Ants in the Pants
Florian Hasler, Matthias Heinzmann, Andreas Urech, Dominik Werner

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?

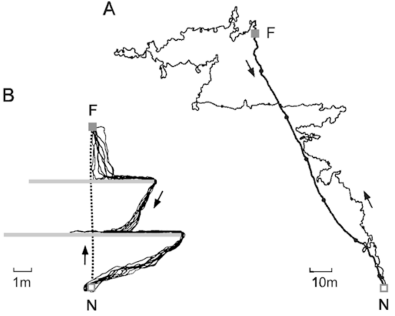

Figure : Foraging walks Wehner2003

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?

Motivations Goals

- 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?

Motivations Goals

- 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]

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

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

[1] Wehner1988

Fitting constant k:
$k = 0.1316$

Turning angle δ:

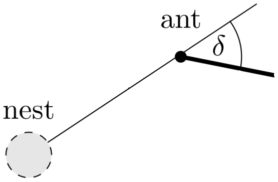

Figure : angle δ

Discussion of the path integrator

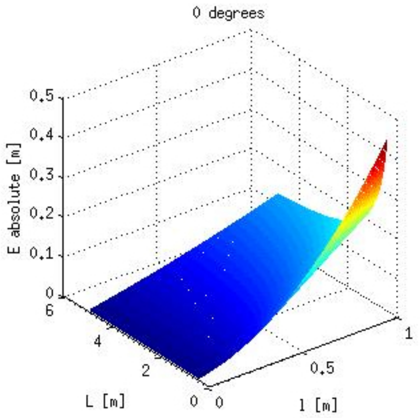

Figure : 0 degrees

Discussion of the path integrator

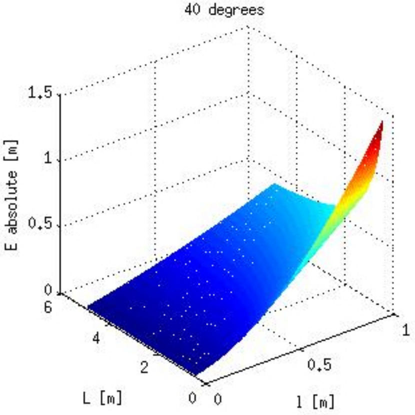

Figure : 40 degrees

Discussion of the path integrator

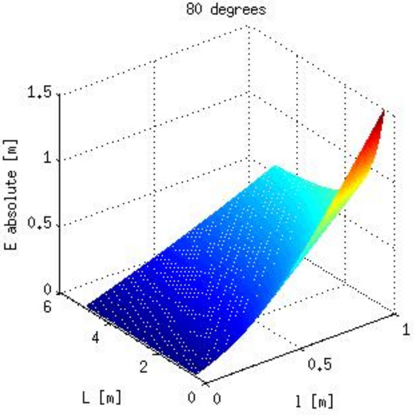

Figure : 80 degrees

Discussion of the path integrator

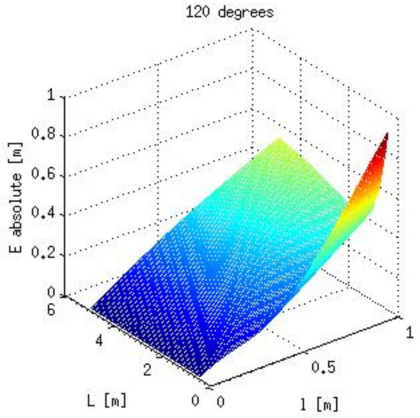

Figure : 120 degrees

Discussion of the ant's random walk

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

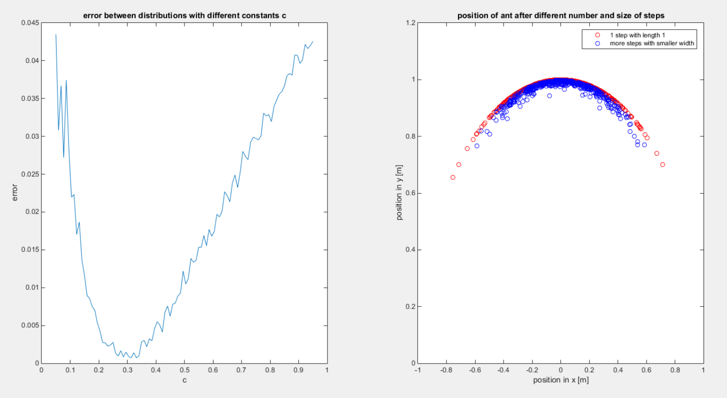

Figure : Variance for stepwidth

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.

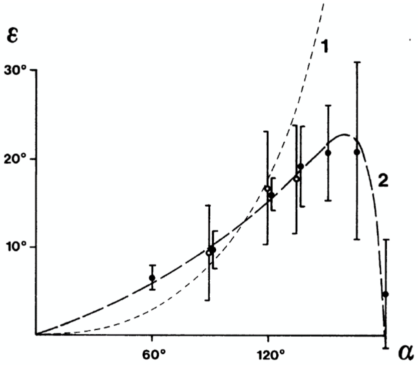

Figure : Angular Error according to Wehner1988

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.

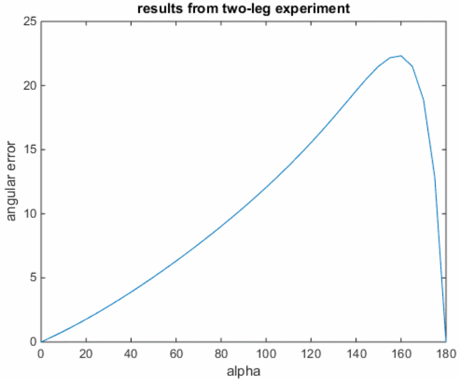

Figure : Angular error produced by our model

Verification of the path integrator

Comparison

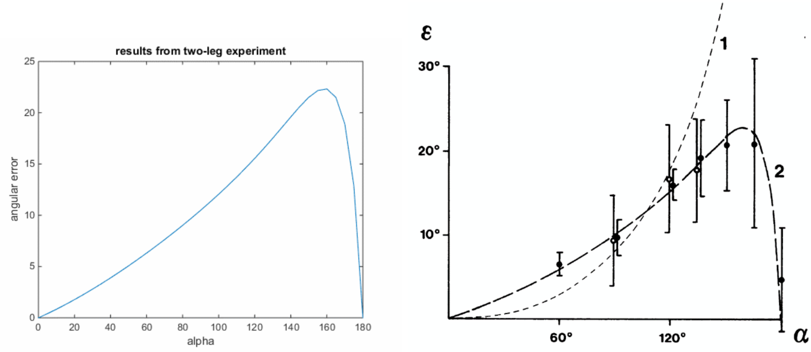

Figure : Comparison

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 ?