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:// [illegible] December 5th 2015

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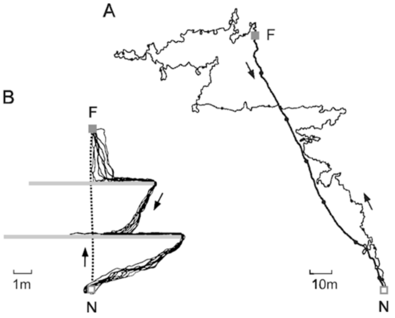
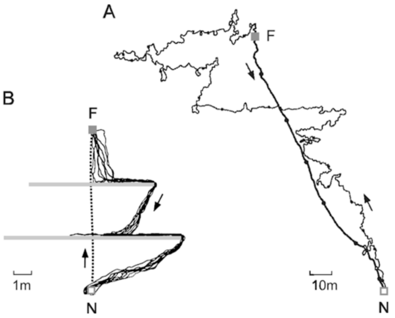


Figure : Foraging walks Wehner2003

What is it all about?

- one ant, one prey → no further communication needed



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- Why is time, hence the shortest way back so crucial?

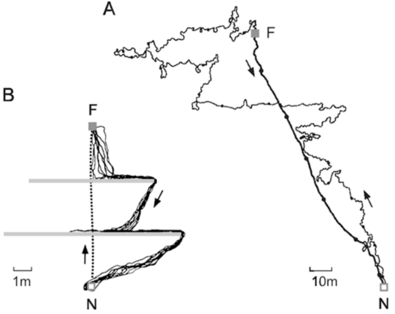

Figure : Foraging walks Wehner2003

What is it all about?

- 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 $\approx 1\frac{m}{s}$

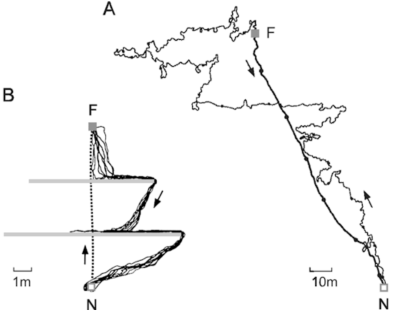

Figure : Foraging walks Wehner2003

How do they do it?

- Pathintegration

How do they do it?

- Pathintegration 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?

Pathintegrator-model [1]

$$
\begin{aligned}
\varphi_(n+1) =& \varphi(n) + k \cdot \frac{(\pi+\delta)\cdot(\pi-\delta)\cdot\delta}{l(n)} \\
l(n+1) =& l(n) + 1 - \frac{|\delta|}{\pi}
\end{aligned}
$$

where $k = 0.1316$ is a fitting constant , δ is the angle with which the ant is turning its current direction and the step width is assumed to be 1.

[1] Wehner1988

Discussion of the pathintegrator

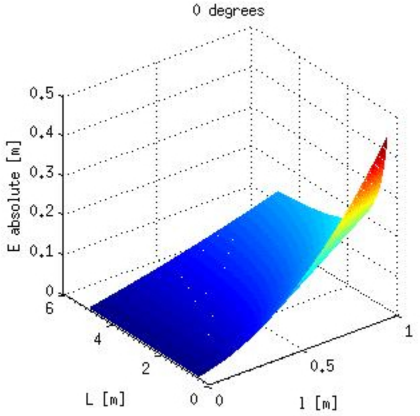

Figure : 0 degrees

Discussion of the pathintegrator

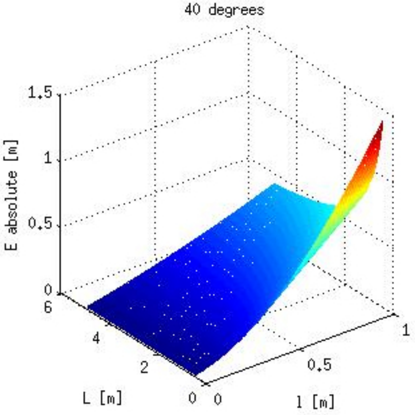

Figure : 40 degrees

Discussion of the pathintegrator

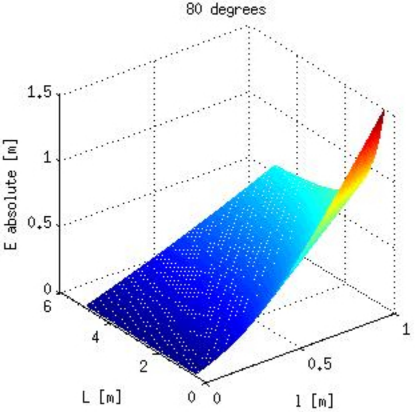

Figure : 80 degrees

Discussion of the pathintegrator

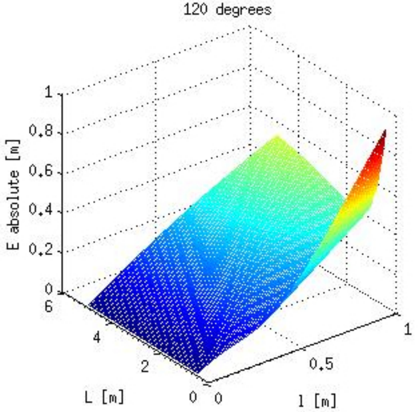

Figure : 120 degrees

Discussion of the ant's random walk

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

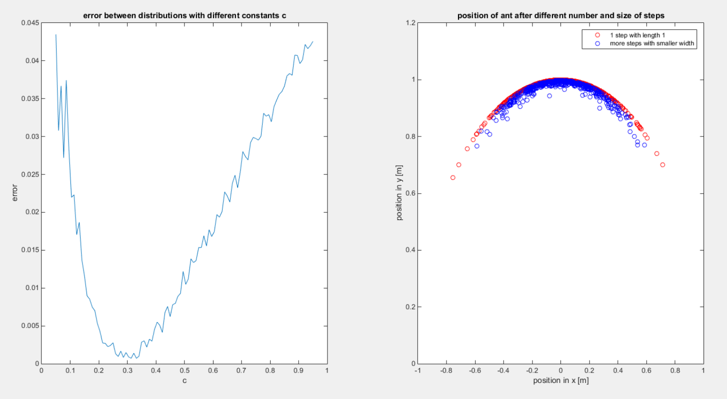

Figure : Variance for stepwidth

Verification of the pathintegrator

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.

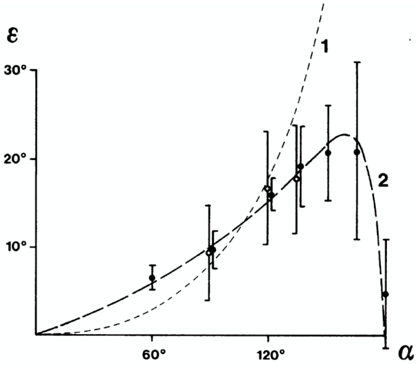

Figure : Angular Error according to Wehner1988

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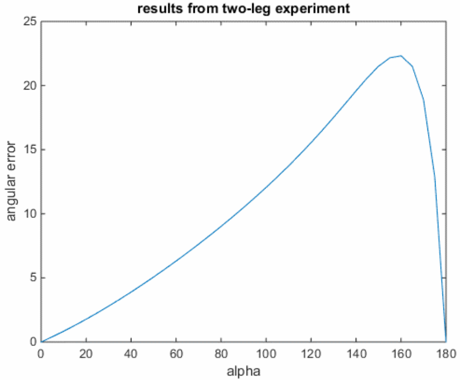
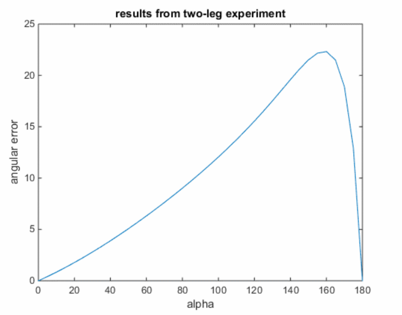


Figure : Angular error produced by our model

Verification of the pathintegrator

Comparison



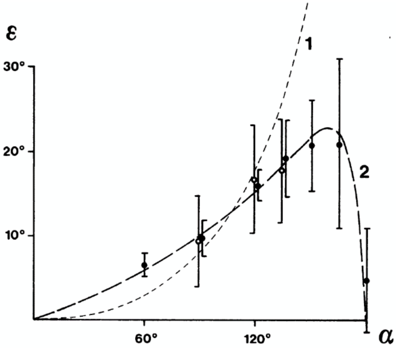


Figure : Comparison

Local Orientation

- familiar landmarks are memorized in the correct sequence.

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- 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 ?