



## Biology: uniformity and diversity

*Spiders: Theseus the virtual spider*

Narrator

Computer modelling based on actual measurements provides a powerful way of exploring these emergent properties of web construction.

Thiemo Krink, University of Aarhus, Denmark

Computer is a very useful tool for analysing web building behaviour because we can try out our ideas that we otherwise can never be sure of, if our ideas are complete, and if they are consistent about what they tell us about what a real spider is doing. One of our basic ideas in this web building simulation is that the spider is mainly solving a two dimensional geometrical task, and therefore the rules are geometrical of course. So the spiders there measure angles and distances. An evolutionary process has shaped these type of measurements, which are sort of rules of thumb as well that the spider is using. It's not 100% accurate in what it's doing. But still it's sufficiently accurate to produce a robust behavioural pattern.

Narrator

This is Theseus, the virtual spider. It uses a few simple rules to recreate a capture spiral on the digitised framework of a real orb web. One consequence of the interplay between these rules is that Theseus reverses its direction now and again.

And one of the ideas of this reversal is to fill out given frame, the space that is given by the frame of the web. As much as possible in the beginning and then to do some zigzag movements to fill out the space as good as possible. And then as soon as the spider gets closer and closer to the hub, to the centre of the web, then it tries to transform the shape of the spiral into a sort of more regular circular shapes form. In order to have a more regular spacing between successive spiral turns.

Narrator

The behaviour of the virtual spider is determined entirely by what it detects in its immediate surroundings.

Thiemo Krink

This virtual spider has no concept of the global picture of the map. Everything it does it just touches around in its neighbourhood. It uses its forelegs and tries to measure distances and introduce threads with that. And based on this local behaviour or constructs the whole complexity of the web. It's some type of emergent result from that interaction. That's quite beautiful. It's quite a challenging task as well.

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