The Neighbour-Sensing model of hyphal growth as an experimental tool

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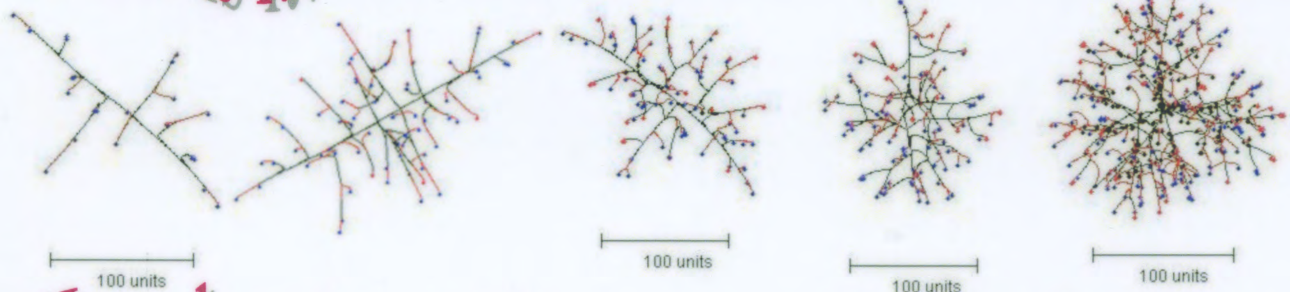
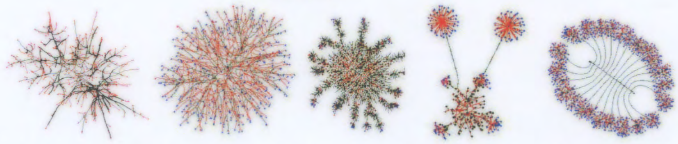
What is it?

The Neighbour-Sensing model is a new, vector-based, mathematical model that 'grows' a simulated mycelium. As the cyberhyphal tips grow out into the modelling space the model tracks where they've been and those tracks become the hyphal threads of the cybermycelium. Most mathematical models leave you with the mathematics. We give you a fully-fledged Java™ application with user-friendly interface to interact with the model and an on-screen, 3-dimensional visualization. So you can SEE your cyberfungus growing.

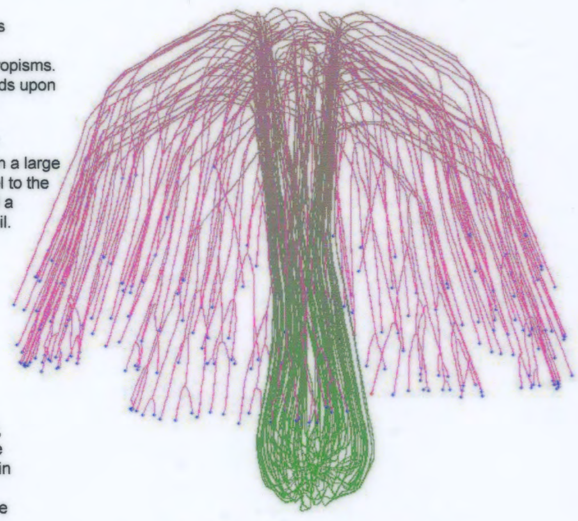


How does it work?



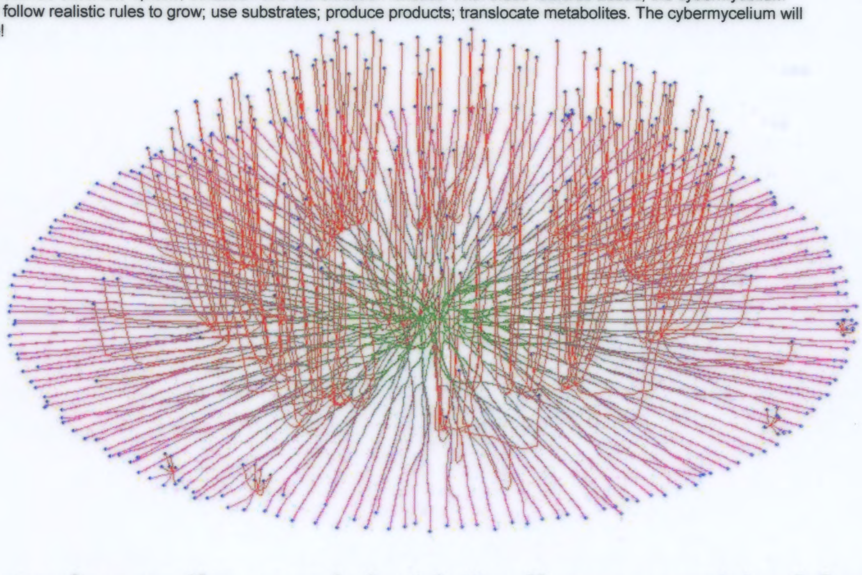
The essential part of the Neighbour-Sensing model is a hyphal tip able to venture into cyberspace itself, as an active agent following the rules it has been given. Each tip has position in three-dimensional space, it has a growth vector and it has length, and an ability to branch.

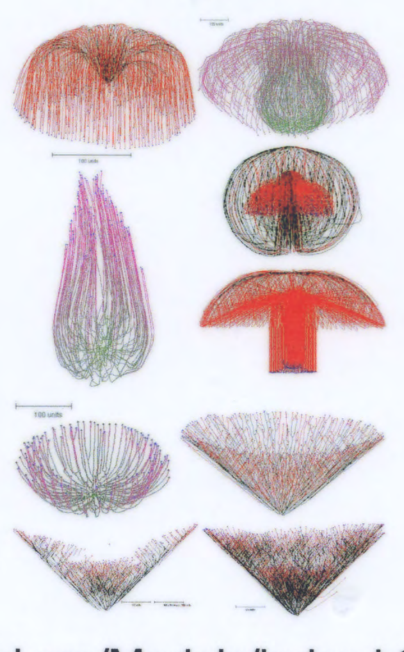
The program starts out with just one hyphal tip, which is equivalent to the fungal spore. Each time the program runs through its algorithm the tip advances by a growth vector (initially set by the user) and may branch (with an initial probability set by the user). Real hyphal tips grow in accordance with their reactions to the effects of one or more tropisms. In this Neighbour-Sensing mathematical model of hyphal growth the growth vector of each virtual hyphal tip depends upon values derived from its surrounding virtual mycelium. Effectively, the virtual hyphal tip is sensing the neighbouring mycelium. The published model features seven tropisms: negative autotropism, based on the hyphal density field; secondary long range autotropism (that attenuates with either direct or inverse proportionality to the square root of distance); tertiary long range autotropism, which attenuates as rapidly as the negative autotropism but can be given a large impact value; two galvanotropisms based on the physics of an electric field produced by the hypha which is parallel to the hyphal long axis; a gravitropism, which orients hyphae relative to the vertical axis of the user's monitor screen, and a horizontal plane tropism, which provides a way of simulating colonies growing in or on a substratum like agar or soil.



What does it do?

What do you want to do with it? The rate of growth of the cyberfungus is up to you and the power of your computer, so you could do more experiments in an afternoon's computing than you could do in a year in the laboratory. There might be some experiments that are impossible, or at least very difficult, to carry out with live fungi; but they're within the scope of the Neighbour-Sensing model. The Neighbour-Sensing model is now sufficiently advanced for parameters to be defined that simulate specific *in silico* cyberfungi. Do it for one – do it for many: establish a 'culture collection' of cyber species that can be chosen from a menu like the characters of a computer game. Since the Neighbour-Sensing model 'grows' a realistic mycelium and tracks all of the hyphal segments so generated, looking further into the future, it should be possible to assign to those hyphal segments the algebraic characteristics defined to describe substrate uptake, utilization and translocation kinetics. With these features added, the cybermycelium will follow realistic rules to grow; use substrates; produce products; translocate metabolites. The cybermycelium will live!





Experience the model at http://www.world-of-fungi.org/Models/index.htm