Optimal Fungal Space Searching Algorithms

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Previous experiments have shown that fungi use an efficient natural algorithm for searching the space available for their growth in micro-confined networks, e.g., mazes. This natural ‘master’ algorithm comprises two ‘slave’ sub-algorithms, i.e., collision-induced branching and directional memory. Collision-induced branching is that the fungus grows without branching until it hit walls or corners. On the other hand, each branch of the fungus is able to ‘remember’ the initial direction of growth, which is called directional memory. While each hypha has to negotiate various geometries, whenever the branch has the opportunity to grow in the direction it had initially, it will follow this with a high probability. It has been shown that the co-existence of both sub-algorithms is more efficient than alternatives, with one, or the other, or both sub-algorithms turned off.

In this project, a novel algorithm was developed based on the fugal space searching algorithm mentioned above to solve mazes. The present contribution compares the performance of the fungal natural algorithm against several standard artificial homologues. It was found that the space-searching fungal algorithm consistently outperforms uninformed algorithms, such as Depth-First-Search (DFS). Furthermore, while the natural algorithm is inferior to informed ones, such as A*, this under-performance does not importantly increase with the increase of the size of the maze. These findings suggest that a systematic effort of harvesting the natural space searching algorithms used by microorganisms is warranted and possibly overdue. These natural algorithms, if efficient, can be reverse-engineered for graph and tree search strategies.