Physarum polycephalum, the cell on a quest

Developing a robot guided by *Physarum polycephalum* is one of the first steps in realising a biological computer, a computer with a living part. *P. polycephalum* is a unicellular, self-spreading, slime mould. Even though it has no nervous system or complex senses, the organism systematically searches for food and creates highly efficient networks in an apparently intelligent manner. In this profile assignment (secondary school coursework), the ability of *P. polycephalum* to find the shortest route to food in a complex environment is investigated to assess whether the organism could be used for applications in society.

The apparent sense of direction of *P. polycephalum* is investigated with the help of a self-designed maze. Firstly, the theoretical part of the paper considers what *P. polycephalum* is and how it can be studied. Secondly, the organism is cultured from sclerotium, a latent life phase, to plasmodium, a life phase in which the organism can grow rapidly. Subsequently, the plasmodium is placed in a maze with three routes of different lengths between the start and finishing points. To assess whether the organism efficiently reaches the end point via the shortest route, a distinction is made between degree of success, efficiency in time and efficiency in distance (i.e. energy consumption). Lastly, to exclude the possibility that the organism reaches the end point via the shortest route by chance, the success percentage is compared to a simplified computer model that calculates the probability that *P. polycephalum* will take the shortest route if all of its choices were purely due to chance.

This experiments revealed that *P. polycephalum* was successful in 89% of the cases, i.e. it grew via the shortest route from the start to the end point. The efficiency in time was 34%, and the efficiency in terms of energy consumption was 54%, thus the search of the organism had limited efficiency. The computer model calculated that the organism would reach the end point via the shortest route in 46% of the cases, which is less than 89%, the result for *P. polycephalum*.

The organism is therefore highly accurate in finding the shortest route because it solves the maze far better than the computer model that found the shortest route by chance. The results suggest that *P. polycephalum* can be used in systems that require networks containing shortest routes for efficient transportation, like a public transport system. However, the efficiency of the network design process limits the suitability of this organism for applications in which real time efficiency is important, like navigation systems. Depending on the requirements of a biological computer, it might be possible to use *P. polycephalum*.