

## **Modeling competitive tumour progression with virtual swarms of robots.**

### **Introduction**

It is now possible to visually track single cells within a colony through their life cycle thanks to high-resolution dynamic microscopy with specific staining. We'd like to model the development, proliferation and movement of these tumour cells as a swarm of robots, following a swarming concept developed by our collaborator, Dr. Sabine Hauert, University of Bristol.

### **Data available**

- Video of two, color-coded, types of tumour cells moving, duplicating, and interacting.

### **Overall aim**

Under this model, each cell would correspond, to a robot whose program would be represented by its genetic code. This code would predict its development, growth as well as mobility, adhesiveness and even mutability. Put together these individual, identical, cells would work towards a common goal. However some random mutation in the programming, could affect dramatically the behavior of some cells, eventually reaching the whole colony. Some mutations are known to exist in specific systems of cells with various effects and could be tested in collaboration with collaborators in the college of Medical and Dentistry Sciences. Using staining of cells according to their mutational profile, we will be able to track the evolution, geographically as well as quantitatively of the various subgroups. Furthermore, changes in environment, such as oxygen supply or treatment, might as well disturb differently cells with specific programs. Using such model we aim to predict the overall behavior of a colony under various scenario of mutation and environmental changes.

### **Specific questions**

- 1) Track the cells in the video, their nature, movement, size and existence
- 2) Create a model to match the behaviour of the cells:
  - a. Motility
  - b. Size evolution
  - c. Adhesiveness
  - d. Life/Death
- 3) Modify the various parameters of the cells and their environment to test their effect

### **Prospects for a follow-on PhD project**

If successful, this project would extend into a PhD to study in further details how modifications in the "program" and/or environment would affect the development of the colony. Such reaction to genetic and/or epigenetic modifications would typically apply to tumour development. Long-term development is likely to add the extra dimension of crowd sourcing to optimally match the model to the real movie.

### **Approach in mini-project**

We are going to use available software tools to track cell to evaluate their evolution in number, size and position. We will then create a virtual model with several parameters to reproduce the characteristics of the movie. Having built a sensible model we will then be able to test the effect of varying parameters on the cell behaviour, and interaction.

## References:

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