Object Recognition Techniques for Bacterial Swarming

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Description

Collective motion occurs in almost all living systems with a big number of units in it. The most prominent examples include bacterial swarming, fish schooling, bird flocking, people gathering, robot swarming etc (Vicsek and Zafeiris [2012]). A lot of patterns, common throughout all these types, can be reproduced with the help of agent-based models. Even though such models provide a qualitative understanding of the collective motion, the link to the experimental data is often limited. The bacterial swarming is very convenient in this respect. The colonies of bacteria are one of the simplest systems that allow a lot of control. They also consist of many similar interacting organisms and exhibit a non-trivial macroscopic behavior (Wensink et al. [2012]). These factors have contributed to the fact that a number of studies have focused on the experimental and theoretical aspects of colony formation and on the related collective behavior. However, since there are a lot of obscured factors influencing the dynamics, the rules determining bacterial swarming patterns remain unclear.

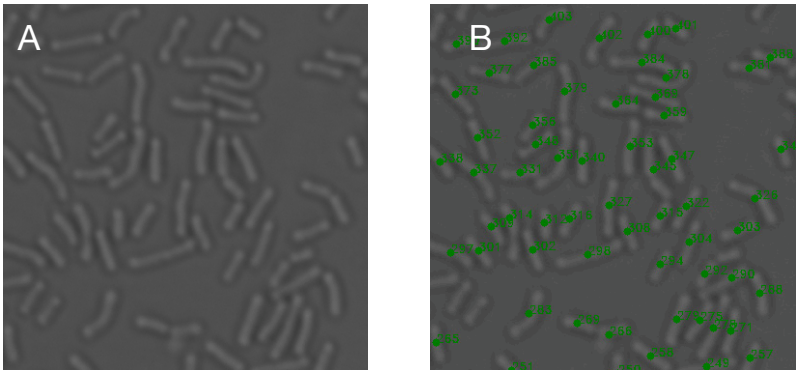

Figure 1: (*A*) A part of the input image of bacterial swarming as observed with a 100X magnification in a microscope, (*B*) the same image overlaid with indexes unique for each detected bacterium.

Objective

We are conducting experiments with *B.subtilis* in microfluidic channels and are capturing the bacterial behavior as a sequence of images (cf. Fig. 1). The current goal is to detect each bacterium correctly on all images. In the current setup, there are several issues that prevent the detection of all bacteria on the original full scale. Thereby, the object recognition techniques based on machine learning models should be considered (Szeliski [2010],Bradski and Kaehler [2008]).

Programming skills

Matlab and/or C++ (STL, OpenCV).

Contact person

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References

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