Automatic Alignment and Comparison of Petri Dish Images Containing Cell Colonies

by

Safar A. Alqahtani

Submitted to the Institute of Information & Mathematical Sciences
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Abstract

This work proposes a novel approach comprising of a chain of algorithms, for comparing, matching and aligning pairs of cell colony images taken at different stages on a Petri dish. The objective is to provide an assistive tool for microbiologists to quantify the loss or growth of cell colonies on two Petri dishes, by mapping cell colonies between a pair of images. This problem is highly non-trivial, as the shape, size and position of the corresponding colonies vary randomly. In addition, the cell colony images for comparison were taken at different times and from slightly different perspectives (i.e. effects of shearing); therefore, amplifying the complexity of the problem. Preliminary studies show that approaches purely based on SIFT or SURF, as well as algorithms used in astronomy, do not perform well on the problem domain. We therefore introduce a new approach to addressing these problems. A novel iterative technique that combines triangulation algorithms with the RANSAC alignment algorithm and AdaBoost classifier for alignment validation is proposed. Using 60 pairs of images of Petri dishes containing real biological cell colonies, we demonstrate the efficacy of the new algorithm in comparison to existing ones found in the literature. Empirical results show that the new proposed algorithm, we call K-NT for cell colonies matching, performed 4 times more accurate than other existing triangulation-based pattern matching algorithms. In the last stage of processing, we were able to generate an AdaBoost classifier with an accuracy of 98.5% that helps validate if an image was successfully aligned or not.

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