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Automated Microscopy Platform for High-throughput Analysis of Cellular Characteristics

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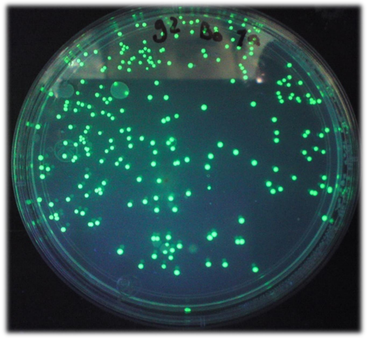
Introduction

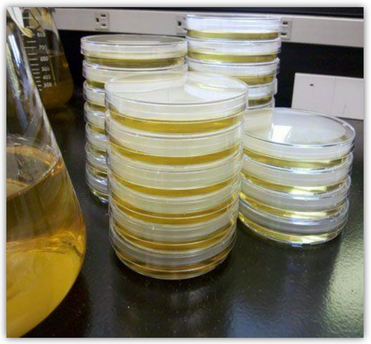
Existing microscopy platforms allow analysis post-hoc, but not in real time. This is an issue in the world of Bioengineering because you are limited to performing further analysis on specimen. The aim of my research was to design a sophisticated system whereby information can be exchanged between the software which acquires images and software that analyzes the images immediately after acquisition. In this system, images would be acquired by the microscope and analyzed by customized scripts (MATLAB, Mathworks) in real time. Specifically MATLAB would wait for new images to be saved on the hard drive, import these images, and perform image segmentation — that is, identify individual cells.

This system would be essential for many applications; rare cancer cells could be further monitored or perturbed ontogenetically. Moreover, a fluorescent protein can be further examined based on brightness and photostability as a proof-of-principle that you can image multiple modalities, and can distinguish, at a single-cell level, between cells that express different fluorescent proteins.

Disadvantages of Traditional Screening

- Manual, time consuming
- Not reliable, as colony brightness depends on proximity to other colonies
- Proteins brighter in bacteria may not be brighter in other cell types (e.g. mammalian cells)
- Difficult to test multiple proteins e.g. brightness under laser illumination, or photostability

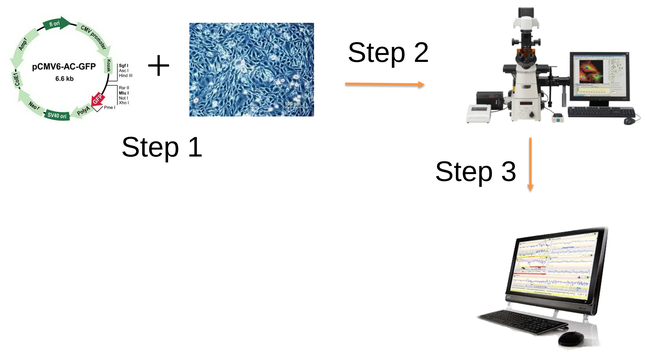




Advantages of Automated Screening

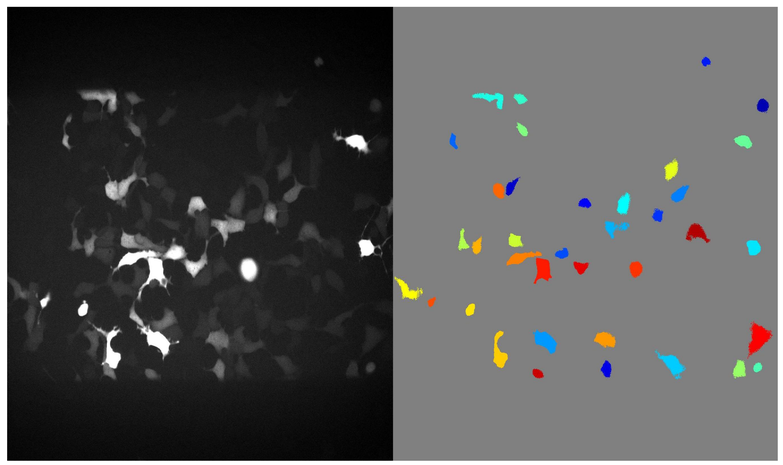
- Screen directly in mammalian cells
- Automated (just press run!)
- Could screen thousands to millions of cells
- Could screen for multiple characteristics e.g. brightness AND photostability

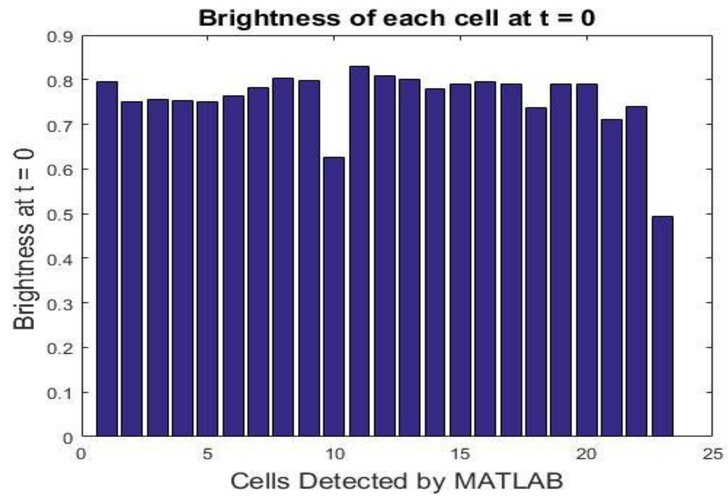
Proposed Overview of an automated Screening System

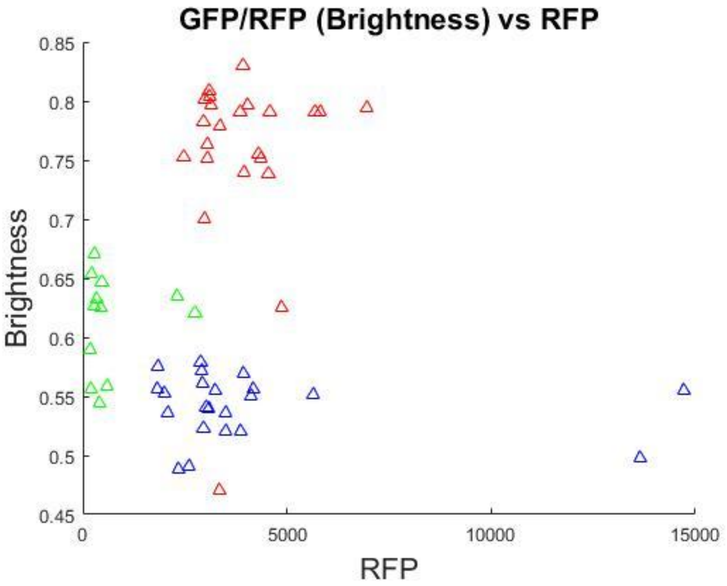


Step 1: Transfect plasmid expressing fluorescent proteins in mammalian cells
Step 2: Acquire images with microscope
Step 3: Send to Analyze, and perform examinations

Results







Conclusions

- We have demonstrated a microscopy-based system for automatic characterization of individual cells
- We can use this system, and further upgrade it to analyze fluorescent proteins and their characteristics
- Examine different kinds of cells

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