Investigate Machine Learning approaches to determine clonogenic assay survival counts

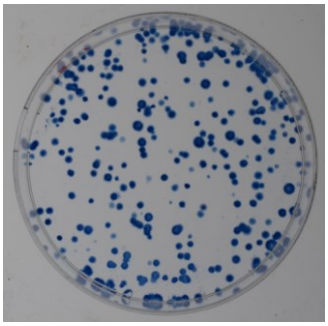
Project: MSc level
Supervisor: Neil Muller
Start date: February 2024

Project Aim / Scope:

The goal of the project is to use machine learning techniques to determine the clonogenic survival counts from the images produced at iThemba LABS, and assess how well these methods perform compared to the existing tools. Of particular interest is how well such a ML system will do on the difficult cases of overlapping clusters.

Abstract:

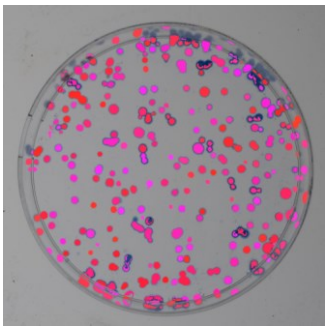
Many radiobiology experiments require evaluating the response of specific cells to specific dose exposures. The clonogenic survival assay is a frequently used method for assessing this ([1], [2]). A petri dish is seeded with a number of cell colonies. After exposure, the cells are dyed and number of surviving colonies can then be counted.



Cell colony petri dish after exposure

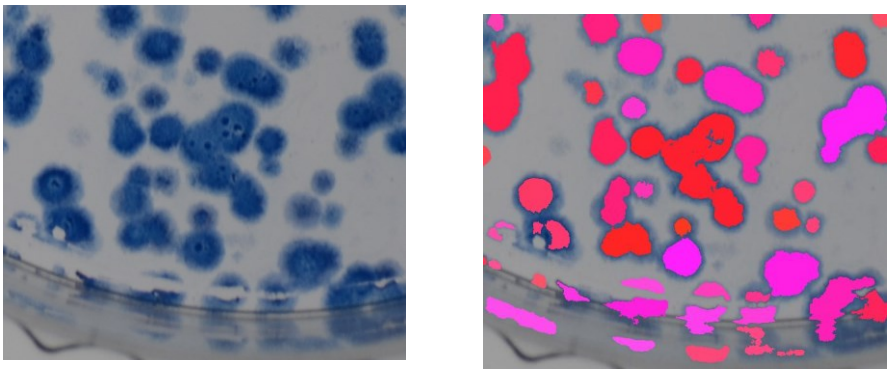
iThemba LABS currently uses a mix of manual counting and an automated system that uses traditional region finding techniques to automatically count the colonies in an image. This works well in situations

were the colonies are separated, but can give incorrect results near the edges of the petri dish (where colony shapes can be distorted and reflections occur) or in areas where colonies overlap.



Extracted colonies

An example of the incorrect classifications with the current is shown below. The central cluster of several colonies has been classified as a single large colony, and some of the reflections in the edge of the petri dish have been incorrectly classified as colonies. These issues can be addressed by manually updating the counts, but a more robust automated solution should be possible using more advanced analysis techniques.



Incorrect extraction, including reflections as colonies and merging overlapping colonies

Relevant References:

[1] Williams J R, et al. “Overview of radiosensitivity of human tumor cells to low-dose-rate irradiation.” Int J Radiat Oncol Biol Phys. 2008

[2] Saunders M. I. “Predictive testing of radiosensitivity in non-small cell carcinoma of the lung.” Lung Cancer. 1994