An automatic approach to improving patient selection for chemotherapy

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Chemotherapy for Cancer Patients

Colorectal cancer is the second largest cause of cancer mortality in the UK, with over 16,000 deaths per year. Depending on how advanced a patient’s cancer is, treatment generally consists of a combination of chemotherapy and radiotherapy. Both of these therapies are toxic, can be prone to severe side effects, and in some cases, are lethal.

Not all patients respond well to these treatments, and ultimately their cancer is not stopped. Therefore, treating patients with chemotherapy and radiotherapy should only be considered if the patient is going to respond to them.

Predicting Response to Therapy

Currently, the ratio of tumour to stroma cells is calculated manually, using systematic random points (usually 300) per patient sample. Classifying each point is laborious, time consuming and prone to error. As a result, automating the process is highly desirable.

An annotated tumour with 300 systematic points (left). Zoomed in views of the points (right).

Each point on the tissue is visually inspected by a pathologist and a classification is given.

Using this data, image patches can be extracted from the cancer image, and used to train a computer program.

Automating the Process

Our research uses these image patches and their tumour/stroma classification to train a computer algorithm. Features are extracted from each patch, and the algorithm uses them to learn what tumour patches look like, compared to stroma patches.

The features we use include colour, intensity and texture of the images, as well as more advanced characteristics such as cell size, shape and location.

Visual interpretations of some of the features that can be extracted from the image patches

Once the algorithm has been trained, it can be used to automatically calculate the tumour:stroma ratio of any given cancer sample.

Initial testing shows an accuracy rate of 85% for detecting tumour and 74% for detecting stroma. Ongoing research is being carried out to improve the accuracy of the algorithm for use in clinical trials.

Benefits to Patients

- Faster decision times – 97% faster than a pathologist
- Consistent evaluation with no human subjectivity
- Pathologists can spend more time evaluating cases

A sample image of a cancer with labelled examples of epithelial (tumour) & connective tissue (stroma) cells

A patient’s response to therapy can be predicted by looking at samples of their tissue, taken from a biopsy of the cancer. The ratio of tumour cells and the connective tissue, called stroma, within the cancer (tumour:stroma ratio) gives pathologists an indication of how well the cancer will react to treatment.