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Automatic Recognition of Human Dendritic Cells Using an Itchy Model

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Abstract

Foodborne illness is now regarded as one of the world's fastest growing diseases, with studies indicating that its prevalence rises sharply each year. Foodborne illness is a public health issue caused by a variety of factors such as food intoxication, allergies, intolerances, and so on. Mycotoxin is one of the food contaminants caused by various mould species, which causes intoxications that can be chronic or acute. As a result, even low concentrations of Mycotoxin are extremely hazardous to human health. As a result, an assessment tool for assessing their impact on immune response is required. Researchers recently approved a new method of investigation using human dendritic cells, but the analysis of these cells' geometric properties is still lacking.

Keywords: Zph • Fungi • Zoophagus • Tetraceros

Introduction

To provide a quick and objective evaluation, automatic classification approaches for microscopic dendritic cell images are being developed. The first classifier proposed is built on support vector machines and Fisher's linear discriminant analysis. Because of the significant confusion between inhibited cells and the other two cell types (mature and immature), the FLD-SVM classifier does not produce satisfactory results. Then, another strategy was proposed to improve dendritic cell recognition results from microscopic images. This strategy is primarily based on fuzzy logic, which allows us to take into account the uncertainties and inaccuracies of the provided data.

Food quality and safety are among the most pressing global concerns, particularly in France. Mycotoxins are food contaminants caused by various mould species, posing a serious public health issue. Mycotoxins are found in a wide range of products intended for human consumption and can cause chronic or acute intoxication. Even at low concentrations, these contaminants are eventually harmful to human health. In this context, we can state that these mycotoxins cause a wide range of toxic effects, ranging from mutagenic, teratogenic, hepatotoxic, neurotoxic, nephrotoxic, estrogenic, carcinogenic, to immunosuppressive. It should be noted that these intoxications are spread through skin contact, ingestion, inhalation, and breastfeeding. In most cases, human food intoxications caused by mycotoxins are unintentional.

Recent in vitro studies have revealed that many mycotoxins have immunosuppressive properties, which are now thought to be their most important properties. This is manifested, among other things, by their ability to alter immune reactions and, as a result, reduce resistance to infections. As a result, the main targets of these toxins are the immunecompetent cells that protect the body from external agents. Dendritic cells, which initiate the primary immune response, are important players in the immune system. Because DCs play such an important role, a decrease in their number or a disruption in their maturation process as a result of a toxic effect can result in immunodepression [1].

Description

This section compares the classification results obtained by the SVM method to those obtained by the FLD-SVM classifier. The FLD-SVM method combines the FLD feature extraction method and the SVM classifier. FLD is used to generate new uncorrelated and relevant features from the input dataset, and SVM is then used to classify these newly discovered components. SVM is a traditional support vector machine that is trained using original DC features extracted from a set of training images. Three binary SVMs with Gaussian kernel functions are used in our experiment to estimate the cell class. We employ a cross-validation technique to assess the performance of the recognised method.

One cell is used for testing at each step, while the remaining examples are used for training. This procedure is repeated N times, where N represents the number of cells in the dataset. The correct classification rates obtained were determined by the DC class assigned and the classifier used. The SVM and FLD-SVM achieve 75.75% and 78.13%, respectively, of the correct classification rate. In other words, the SVM method classifies immature cells, mature cells, and inhibited cells correctly, whereas the FLD-SVM method classifies immature cells, mature cells, and inhibited cells correctly. The confusion matrix for the three different classes of DCs is presented in to better illustrate the FLD-SVM classifier's results. The results demonstrate that feature extraction improves recognition accuracy [2].

The errors are caused primarily by inhibited cells classified as immature and mature cells. Indeed, 48 inhibited cells were labelled as immature, while 20 were labelled as mature. Some inhibited cells are classified as immature because the toxicant prevents them from maturing and thus keeps them at an immature stage when they should be maturing. Furthermore, 44 immature cells were labelled as inhibited. As a result of their similar characteristics, the FLD-SVM misclassifies these DCs. As a result, it is difficult to distinguish between them precisely using SVM, resulting in poor recognition results. In our study, the characteristics of the various classes of DCs frequently overlap and are difficult to distinguish. As a result, traditional classification methods like SVM do not provide reliable cell recognition. As a result, we proposed a classification based on fuzzy logic, which allows us to account for the uncertainties and inaccuracies of incompletely known data. With confidence indices, fuzzy classification can also be used to propose a system to aid in the evaluation of the harmful effects of food contaminants. In other words, we will take the values of the membership functions of each class from the outputs of the inference systems and let the biologist make the final decision on the

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cell's class.The degree of inhibition, for example, will be used by a biologist to evaluate the effects of toxic products on the immune system. An example of the FIS1 system's output for a cell that raises classification concerns. The vertical bar with the output membership functions shows a 2.45 output value, indicating that this cell is 20% inhibited and 40% mature. These rates will assist the biologist in determining the type of cell and assessing the toxicant's effect [3,4].

This paper developed and tested classification techniques for recognising dendritic cells using extracted and selected morphological cell features. Immature, mature, and inhibited cells are identified for a posteriori evaluation of the toxic effects of some contaminants on the immune system. To select uncorrelated and relevant attributes, the first proposed classifier uses SVM and FLD. Because of the significant confusion between the inhibited cells on one side and the other two cell types, the FLD-SVM classifier does not produce satisfactory results (immature and mature). Following that, a second strategy was developed to improve the results of dendritic cell recognition in microscopic images. This one is based on fuzzy logic, which allows us to account for data uncertainties and imprecision [5].

Conclusion

Combining fuzzy logic with a deep learning classifier could improve classification results, but we will need a larger image base to do so. The built fuzzy classification system has also been proposed to biologists as decision support tools for dendritic cell recognition in uncertainty-type cell identification. These fuzzy classification-based tools also provide cell maturation and inhibition rates to assist biologists in determining the serious health consequences of food contaminants. Finally, we would like to point out that this work is being proposed in the context of processing and analysing 2D microscopic images of dendritic cells. However, 3D image analysis could provide biologists with additional information about the toxic effects of food contaminants. The investigation of the three-dimensional aspect of dendritic cells, which begins with the 3D acquisition of these cells is the perspective of the work presented in this paper.

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Conflict of Interest

There are no conflicts of interest by author.

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