

國立中央大學數學系

專題演講

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演講題目：**Early Detection and Classification of Liver Fibrosis with Machine Learning Methods: Image-Based Biomarkers and Data-driven Computational Techniques in Dynamic Contrast-Enhanced MRI**

演講時間：2024年01月09日(星期二) 10:00 a.m. ~ 11:00 a.m.

演講地點：中央大學鴻經館M107

Abstract：

This study aims to address the limitations of current non-invasive diagnostic methods for detecting early stages of liver fibrosis by proposing a machine learning (ML) approach for prediction. The research comprises two parts, involving experiments on mice and clinical data from human subjects.

Mouse Experiment: Mice were categorized into healthy (A_0), mild (A_1), moderate (A_2), or severe (A_3) liver fibrosis stages. Support Vector Machines (SVM) were employed as classifiers using two types of features: Euler numbers (EN) and estimated porosity related to liver fibrosis. Model comparisons included SVM models with solely estimated porosity, solely Euler numbers, and a combination of all features. Binary and grayscale images were used for training Convolutional Neural Network (CNN) models in the baseline. Human Clinical Data: Clinical data from 62 patients, including blood tests and dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) signal curves, were utilized for human liver fibrosis classification. New features simulating liver properties, such as porosity, diffusion rate, and flow speeds of the portal vein and hepatic artery, were introduced. K-Nearest Neighbors (KNN) and Naive Bayes (NB) models were employed, focusing on F0-3 vs F4-6 and F0-5 vs F6 classifications.

Mouse Experiment: Model comparisons revealed that the SVM model using solely estimated porosity as a feature achieved superior performance across all categories with an accuracy of 93.3%, particularly excelling in the mild (A_1) stage. Human Clinical Data: The ML models achieved excellent results in F0-3 vs F4-6 and F0-5 vs F6 classifications, with an overall three-class accuracy of 69.4%. The introduction of simulated liver signal concentration models significantly enhanced accuracy in liver fibrosis assessment.

This study demonstrates the potential of ML techniques, including SVM and CNN models, for predicting liver fibrosis stages. The use of simulated liver properties as features in human data contributes to a deeper understanding of liver fibrosis, presenting new avenues for research and potential improvements in diagnostic accuracy. The findings underscore the significance of ML applications in advancing liver disease assessment and treatment.

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