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Paper Title:	Early-Stage Cholangiocarcinoma Detection Using Surface-Enhanced Raman Spectroscopy and 1D CNN with Discrete Wavelet Transform
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Abstract

This Early detection of cholangiocarcinoma (CCA) is critical for improving patient prognosis and survival rates. Surface-Enhanced Raman Spectroscopy (SERS) offers a promising non-invasive diagnostic tool due to its high sensitivity and specificity. In this study, we propose a novel approach combining Discrete Wavelet Transform (DWT) and a one-dimensional Convolutional Neural Network (1D CNN) for the detection and differentiation of first stage CCA from precancerous, inflammation, and healthy states using SERS data. Our method is compared with a traditional Principal Component Analysis (PCA) followed by Support Vector Machine (SVM) classification. In contrast, the PCA + SVM method could only differentiate late-stage CCA and healthy states due to the nonlinearity of the SERS dataset. Receiver Operating Characteristic (ROC) curve analysis further validates the superior performance of our proposed method. We studied on hamster serum and the concept can be extended to human serum in the near future work.
