TOWARD FINDING THE BEST MACHINE LEARNING CLASSIFIER FOR LIBS-BASED TISSUE DIFFERENTIATION

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Abstract:

Lasers have become generally accepted devices in surgical applications, especially as a cutting tool, for cutting both soft and hard tissues including bone (laserosteotomy). It has been shown that applying lasers in osteotomy have important advantages over mechanical tools, including faster healing, more precise cut and functional cutting geometries as well as less trauma [1, 2]. However, the ability of detecting the type of tissue that being cut during surgery can extend the application and safety of laserosteotomes in practice. As a result, the laser could be stopped automatically in case of cutting a tissue that should be preserved. Authors have previously demonstrated that laser-induced breakdown spectroscopy (LIBS) is a potential candidate to differentiate surrounding soft tissue from the bone in *ex vivo* condition [3]. In the current study, different machine learning classifiers were examined to find the best possible method to differentiate bone from soft tissues based on LIBS data. These methods include decision tree, K Nearest Neighbor (KNN), linear and quadratic Support Vector Machine (SVM) as well as linear and quadratic discriminant analysis. All classifiers were applied on LIBS data obtained from bone, muscle, and fat tissues using an Nd:YAG laser and an Echelle spectrometer. Confusion matrix and Receiver Operating Characteristic (ROC) curve were obtained for each classifier afterwards. Moreover, in order to estimate the model's performance on new data and also to protect the model against overfitting, cross-validation was applied. All mentioned examinations were performed with MATLAB (R2017b).

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