Polarization-based Digital Histology of Ex Vivo Skin samples and Deep Learning

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Polarization-based techniques have been widely used as optical method to detect various benign and malignant formations [1]. When the optical set-up is coupled and calibrated with matrix photodetector, a transition to digital histology can be made by visualizing the regions of interest and their inner structure [2]. In this study, various healthy, degenerative and malignant, human, ex vivo, skin samples have been used to perform the polarimetric measurements at 700 nm, after being initially diagnosed and annotated by the physicians. The measured Mueller matrices were filtered with the Cloude's physical realizability filtering algorithm [3]. After, a data set was created by using as predictors the Mueller matrix elements, each one being an image with the native resolution of the camera. To increase the data size, image segmentation techniques were also used. The aim is to improve the diagnostic accuracy of medical doctors by feeding the data set to a deep learning algorithm, thus creating the model Skin-HDT700, based on Convolutional Neural Networks (CNNs) for multiclass, image classification. The results were found promising to differentiate between all skin lesions on a pixel level with classification accuracy ~ 92 %. By this way, the combination of Mueller polarimetry and artificial intelligence appears to be promising to detect different skin lesions on an earlier stage of development, thus supporting medical doctors in their diagnostic conclusions.

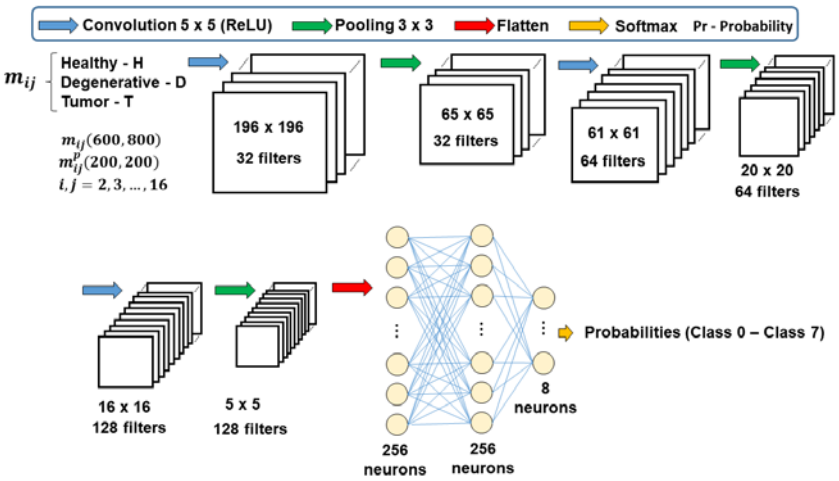

Fig. 1: Skin-HDT700 model architecture**.**

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