Artificial Intelligence in Dermatopathology: Will an AI algorithm ever replace the dermatopathologist? A single institutional study

P303

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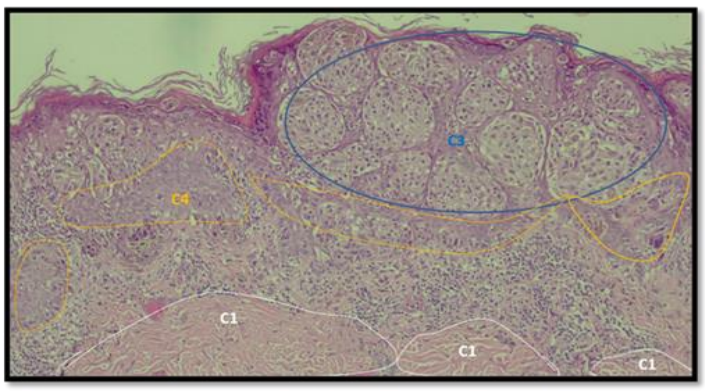
Introduction

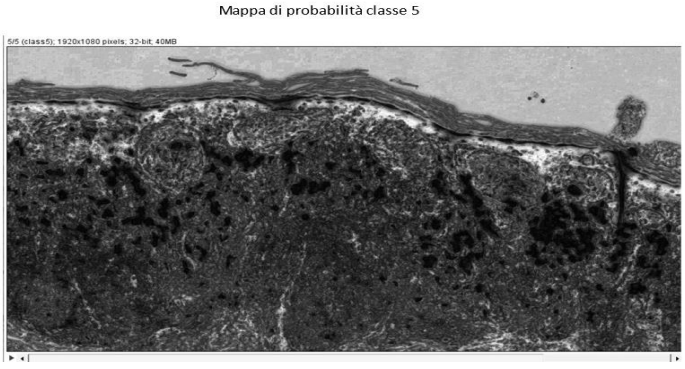
In this work we tried to train an AI algorithm using basic histopathological criteria that indicate and differentiate with a good probability a malignant melanoma from a severe dysplastic nevus (atypical nevus), and we provide information on the results obtained starting from routine histopathological images.

Material and Methods

The artificial intelligence image processing algorithm used to classify and to enhance anomalies contained in the microscope image is the Fast Random Forest (FRF). The learning process of the algorithm is based on a preliminary classification of cluster of pixels of the same image including possible Melanoma's areas: the preliminary identification of Melanoma morphological features represents the labelling approach typical of machine learning supervised algorithms (figure 1).



The FRF testing provides as output the processed image with colored enhanced Melanoma pixel clusters (each class selected in the learning step is represented by a color), probabilistic maps (high probability highlighted by white to identify an anomaly in a specified image region), and algorithm performance indicators (precision, recall, and Receiver Operating Characteristic -ROC- curves) (Figure 2).

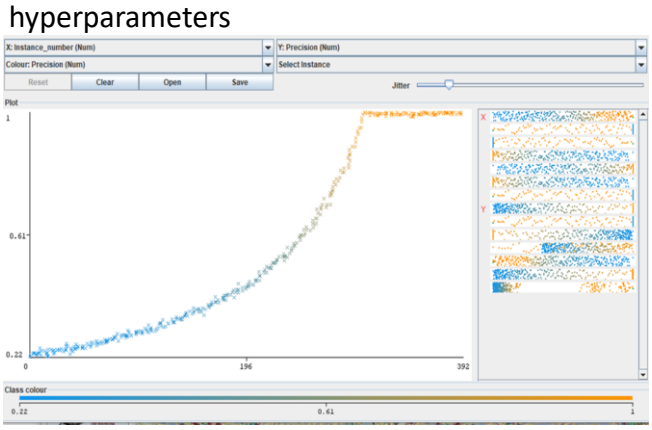


The optimized hyperparameters and filter properties applied for the image FRF processing (features training) are]: Gaussian blur filter, Hessian matrix filter, membrane projections, membrane thickness equals to 1, membrane patch size equals to 19, minimum sigma equals to 1, maximum sigma equals to 16.

Results

For five pixel clusters of the same dimensions occurs a number of about 300 instances (computational cycles) to achieve the maximum precision (equals to 1), with a timing of 2 minutes using a processor Intel(R) Core(TM) i5-7200U CPU, 2.71 GHz

The minimum recall performance parameter (near to 0) is achieved about 392 instances. The ROC curve (representing in the plane the true positive rate versus the false positive rate) is matching with the ideal curve of a perfect classifier (Figure 3). The performance indicators confirm the correct setting of the FRF hyperparameters



The adopted image vision diagnostic protocol, is structured in the following steps: image acquisition by selecting the best zooming of the microscope; preliminary selection of image having a good resolution; preliminary identification of macro-areas of defect in each pre-selected image; dentification of a class of a defect in the selected macro-area; training of the supervised machine learning FRF algorithm, by selecting the micro-defect in the macro-area; executing of the FRF algorithm until image vision performance indicator is good; analysis of the output images enhancing lesion defects. The precision achieved by the FRF algorithm proved to be appropriate with a discordance of 17% respect to dermatopathologist .