

Improving the automatic diagnosis of hepatocellular carcinoma with contrastive learning

Emma Sarfati

▶ To cite this version:

Emma Sarfati. Improving the automatic diagnosis of hepatocellular carcinoma with contrastive learning. ECR 2024: European Congress of Radiology, Feb 2024, Vienne (AUT), Austria. hal-04480600

HAL Id: hal-04480600

https://hal.science/hal-04480600

Submitted on 1 Mar 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Improving the automatic diagnosis of hepatocellular carcinoma with contrastive learning

Poster No.: C-15300

Congress: ECR24

Authorblock: E. Sarfati; Paris/FR

Disclosures:

Ms. Emma Sarfati: Employee: Guerbet

Keywords: Liver, CT, Computer Applications-Detection, diagnosis, Cancer

Any information contained in this PDF file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited. You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

Purpose or Learning Objective:

Several deep learning methods have been proposed to automatically classify liver lesions in MRI or CT, with good performance [1,2,3]. They all share a classical training procedure. Contrastive learning (CL) is a novel deep learning paradigm where pairs of cases, instead of cases taken in isolation, are leveraged to train the model. CL methods can be either trained without labels, in this case it learns global mathematical representations of the input images [4], or it can use labels during training in order to help to discriminate input images based on a specific characteristic [5]. In this study, we evaluate the potential of CL to improve the automatic classification of hepatocellular carcinoma (HCC) in CT-scans. We formulate it through a binary classification problem (HCC versus no HCC).

Methods or Background:

We work with 2-phase CT-scans (arterial/venous) in 2D, by choosing slices where concerned lesion is the largest, as well as lesion segmentations manually computed. We stack each image to obtain 512*512*4 inputs. We work with a private dataset that contains 1853 lesions in the training set (418 HCC, 1435 no-HCC), and the test set contains 551 lesions (134 HCC, 417 no-HCC). As a baseline, we train a convolutional neural network with 5 convolutional layers and 2 final dense layers, with a total number of parameters of 1,131,506. Our network architecture is detailed in figure 1.

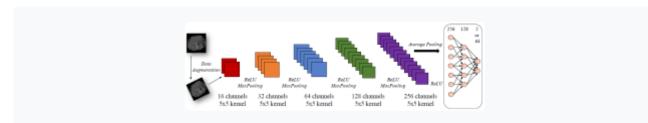
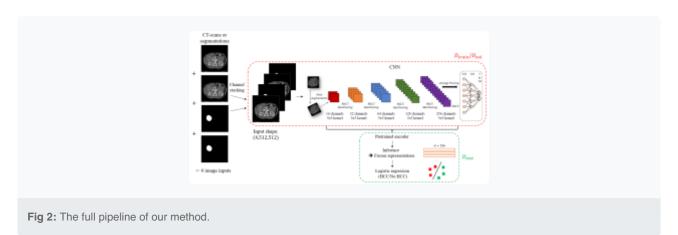


Fig 1: The deep network architecture used to train our models.

To increase performances, we propose to use a pretraining method, named Supervised Contrastive Learning (SupCon)

which is a self-supervised learning method. Our pipeline consists in a first pretraining step in which our model learns global representations of the images with the training images, and a second step in which the frozen weights are re-used to infer representations on the test set and compute a logistic regression to predict HCC probabilities. The full pipeline is detailed in figure 2.



Results or Findings:

With a classic supervised classifier, we obtain an area under the curve (AUC) of 89%, a sensitivity of 86% and a specificity of 79%. With our proposed method, we increase the AUC and sensitivity, reaching a performance AUC of 91% (+2 pts), a sensitivity of 87% (+1 pt) for the same specificity threshold of 79%. To compute sensitivity and specificity, we use the Youden threshold value on the test set [6]. The receiver operating characteristic curves of both methods are presented in figure 3.

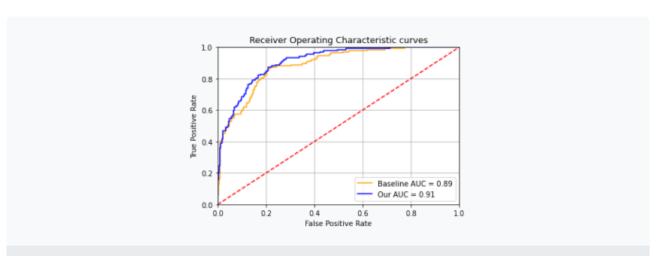


Fig 3: ROC curves for the baseline classification method and our proposed method. The red dotted line represents an arbitrary classification for HCC.

Conclusion:

We proposed to use a state-of-the-art CL method to improve the performance of HCC classification obtained with a baseline classifier. This method improves the AUC of 2% and opens perspectives for future work using other CL methods in the literature. Notably, the self-supervised learning paradigm allows to train models with unlabelled or partially labelled datasets and therefore can be easily applicable in the medical domain, due to the difficulty of obtaining large amounts of annotated scans. These preliminary results would however need to be confirmed with a prospective study.

This work was supported by Region Ile-de-France (ChoTherIA project) and ANRT (CIFRE #2021/1735).

References:

[1] Deep Learning with Convolutional Neural Network for Differentiation of Liver Masses at Dynamic Contrast-enhanced CT: A Preliminary Study, Yasaka et al., Radiology 2018

- [2] Deep learning assisted differentiation of hepatocellular carcinoma from focal liver lesions: choice of four-phase and three-phase CT imaging protocol, Shi et al., Abdominal Radiology 2020
- [3] Deep learning for liver tumor diagnosis part I: development of a convolutional neural network classifier for multi-phasic MRI, Hamm et al., European Radiology 2019
- [4] A Simple Framework fior Contrastive Learning of Visual Representations, Chen et al., ICML 2020
- [5] Supervised Contrastive Learning, Khosla et al., NeurIPS 2020
- [6] Index for rating diagnostic tests, Youden, 1950

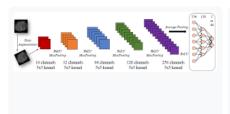


Fig 1: The deep network architecture used to train our models.

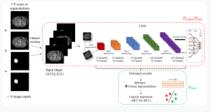


Fig 2: The full pipeline of our method.

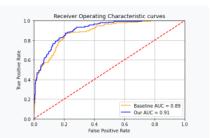


Fig 3: ROC curves for the baseline classification method and our proposed method. The red dotted line represents an arbitrary classification for HCC.