MAIA: FEDERATED IA MODEL TRAINING SYSTEM FOR RADIATION ONCOLOGY

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Federated learning

Federated learning is a form of shared AI model training that allows training without centralizing the data. Instead of sending all the data to a central server, federated learning allows training on local devices, sharing only the parameters that mathematically define each of the trained models. Instead of consolidating all data in one place, federated learning allows models to be trained directly on the local devices where the data resides. This approach allows the secure training of shared AI models, even if they are based on sensitive data protected by privacy laws (GDPR), as is the case of medical imaging and other sources of information used in Radiation Oncology.

mAIa

mAIa is designed to be used in a Radiation Oncology (RO) environment. Its objective is to promote the scientific and technological advancement of the specialty, facilitating the use of artificial intelligence (AI) tools to the novel user to train models, both local or shared with other facilities, always ensuring compliance with privacy laws.

Dataset generation

mAIa allows the creation of datasets by working directly on the files exported from the different planning systems: images, structures, plans and doses. mAIa allows fast and agile access to large volumes of data, of the order of thousands of patients, to create datasets focused on one or more structures. The creation of datasets is focused on segmentation, but also on other tasks such as predictive models based on radiomic or dosimetric characteristics. It also allows to avoid common problems such as variability in the nomenclature of the structures, both within the facility itself and between different facilities.

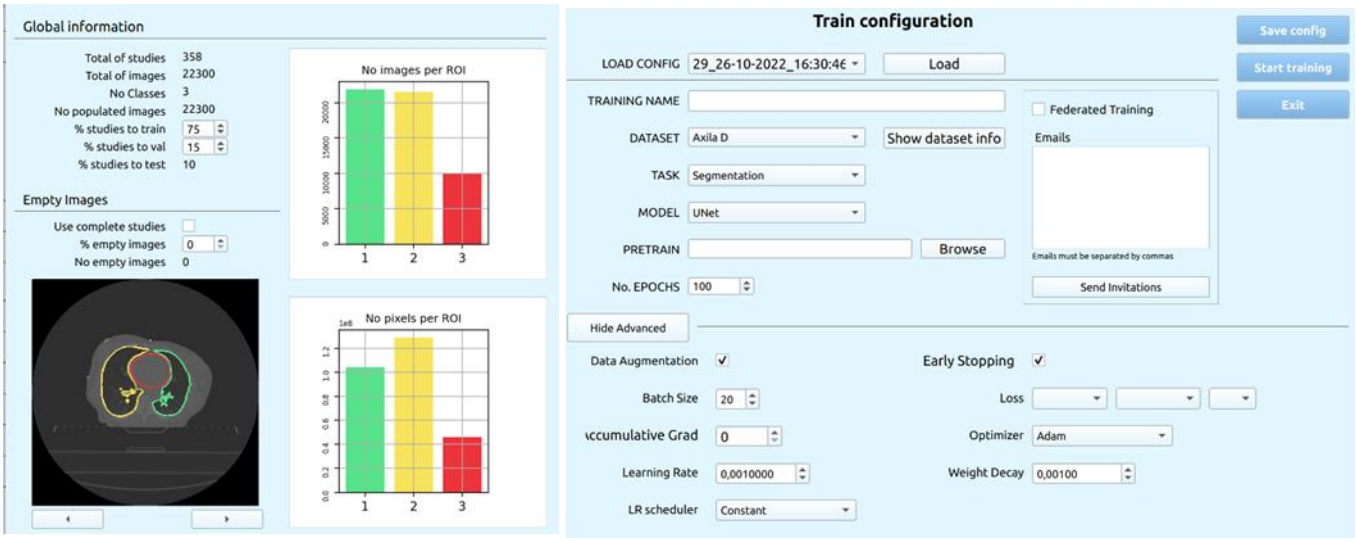

***Image 1**. a) Three organ dataset creation for a thorax training. b) Training configuration panel.*

Training models

The system incorporates different training models focused on the different tasks available, including the most common convolutional neural networks in medical imaging such as U-Net and its different variants, including 3D models such as UNet3D and other more sophisticated architectures such as the so-called transformers, or classic Machine Learning predictive models like Random Forest, SVM or KNN. All these models have a default configuration, although mAIa allows the edition of parameters, such as loss functions and schedulers, batch size, number of epochs...

Metrics and visualization

mAIa incorporates a graphical interface to evaluate the training evolution in terms of different metrics already implemented, such as the Dice coefficient and the Haussdorf distance, or indexes such as sensitivity, specificity, etc. It also allows the simultaneous evaluation of the training and validation datasets (Image 2a), and test set once the training is completed.

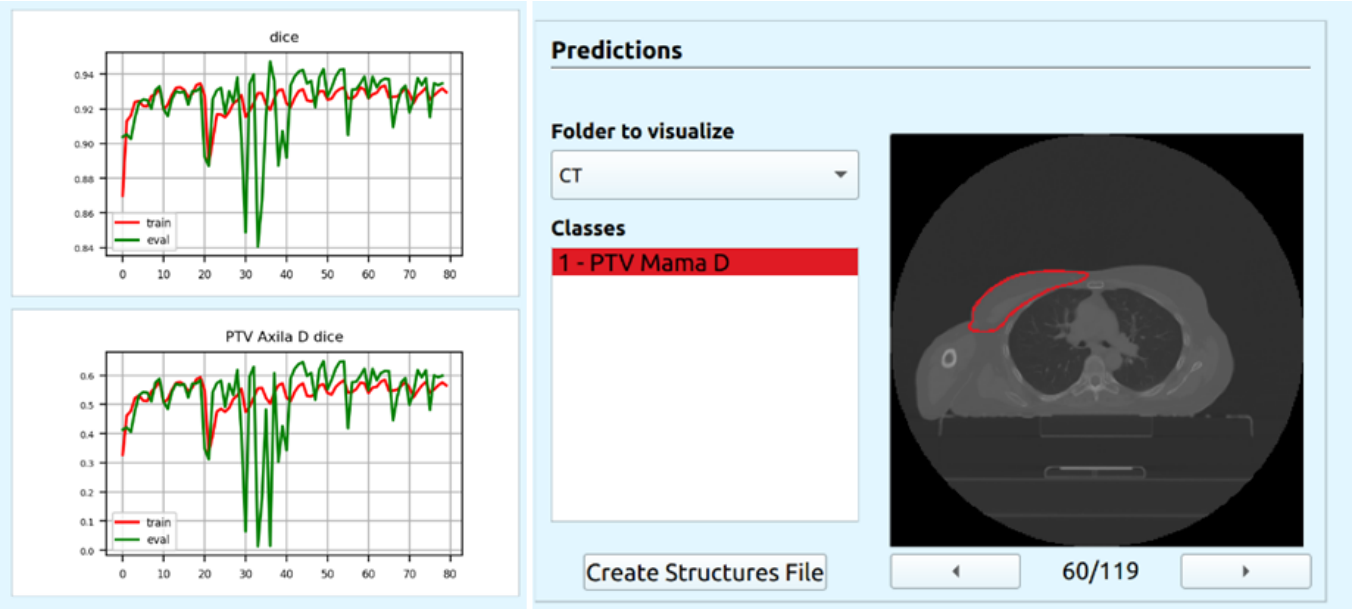

***Image 2**. a) Training dice statistics. b) Inference and Structure file creator chart.*

Future

Radiation Oncology is a specialty intimately connected to technology and data. The data generated in the usual workflow of RO departments, combined with Artificial Intelligence, has great scientific and technological potential for the future. The training of shared models between institutions significantly increases the volume of available data and decreases possible biases, resulting in more robust and accurate models. The mAIa tool is focused on facilitating this task, maintaining the privacy of the shared data and allowing simple and intuitive access for users without programming knowledge or experience in AI models.