

Segmentation made simple: A three-click user interface for automated model (pre-) training and deployment

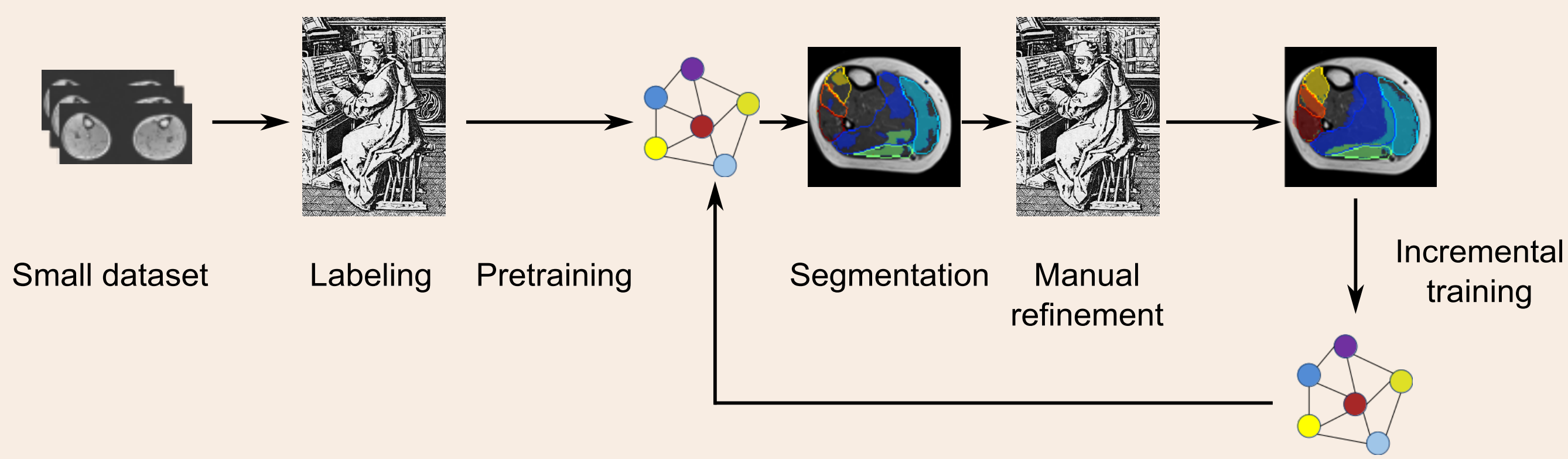
F. Santini^{1,2}, A. Agosti³, K. Sharma⁴, J. Periquito⁴, K. K. Soe⁴, K. M. Gooding⁵, A. F. Brown⁵, M. Gilchrist⁵, M. F. Gomez⁶, S. Sourbron⁴

¹ Basel Muscle MRI, Department of Biomedical Engineering, University of Basel, Basel, Switzerland; ² Department of Radiology, University Hospital Basel, Basel, Switzerland; ³ Department of Mathematics, University of Pavia, Pavia, Italy; ⁴ University of Exeter Medical School and NIHR Exeter Clinical Research Facility, Exeter, UK; ⁵ Division of Clinical Medicine, School of Medicine and Population Health, The University of Sheffield, UK; ⁶ Department of Clinical Sciences, Lund University Diabetes Centre, Lund University, Malmö, Sweden

Introduction

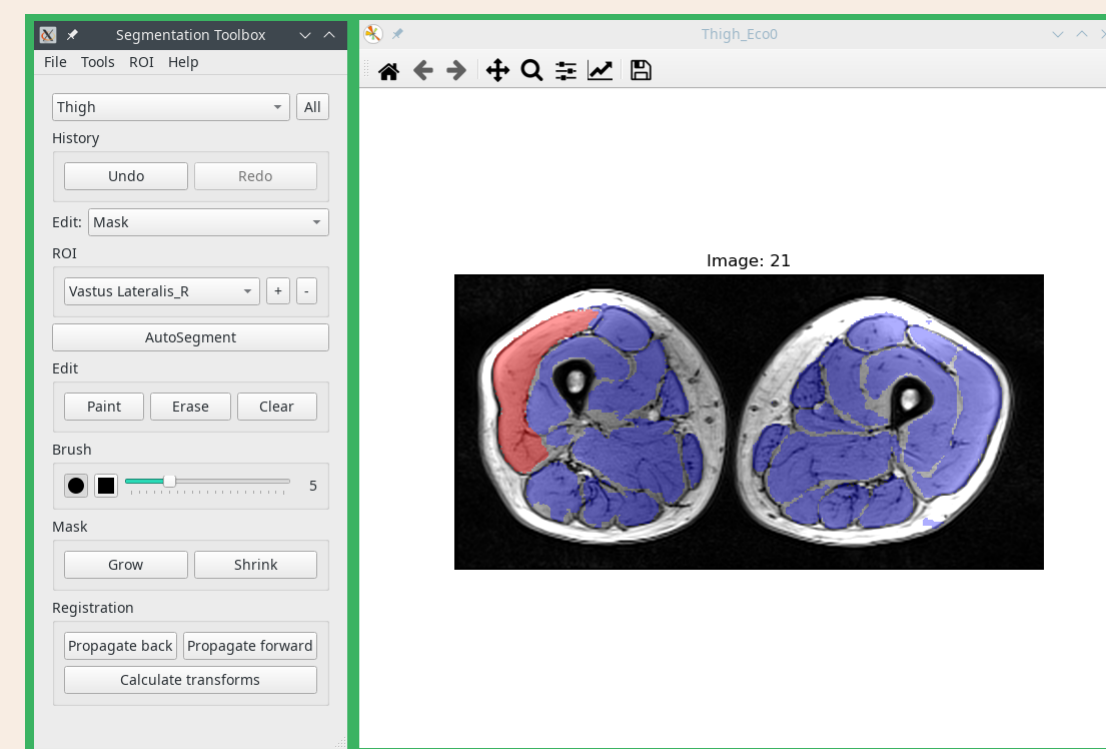
Current image segmentation methods rely on deep learning models trained on large sets of manually annotated data, to be able to handle new cases with sufficient generality.

As a solution, our group developed Dafne, an integrated segmentation solution that, by starting from a model pretrained on a reduced number of datasets, continuously refines the model performance during usage.



Dafne is a fully fledged image segmentation software, and has a modular structure, and deep-learning models can be developed as plugins.

In this work, we are presenting a simple tool for the creation and training of deep learning models that can be inserted into the Dafne ecosystem.



Installation/Usage

The "Dafne model trainer" is a Python application that can be installed via **pip**:

```
pip install dafne-models[gui]
```

once installed, the graphical interface can be simply run with:

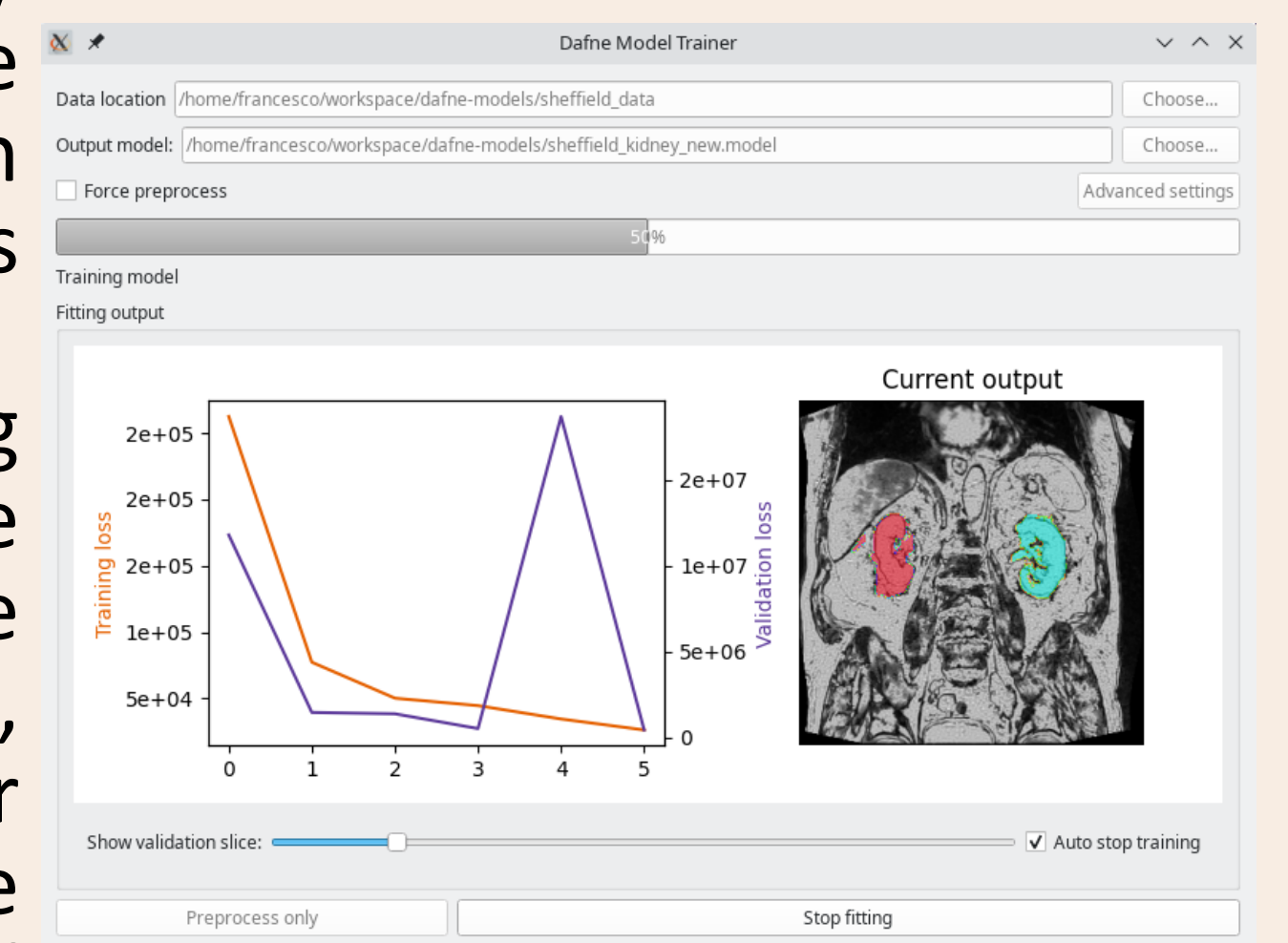
```
create_model_ui
```

The training data needs to be organized in a folder and it must be in the Dafne "numpy bundle" (npz) data format, which, for each subject, contains the original images, the training masks, and the resolution of the dataset. This format can be saved after manual segmentation from the latest version of Dafne itself. Dafne can also convert existing segmentations into this bundle format.

The usage of the software is very simple. The target model file (extension .model) is selected and then the "Preprocess and Fit" button starts the procedure.

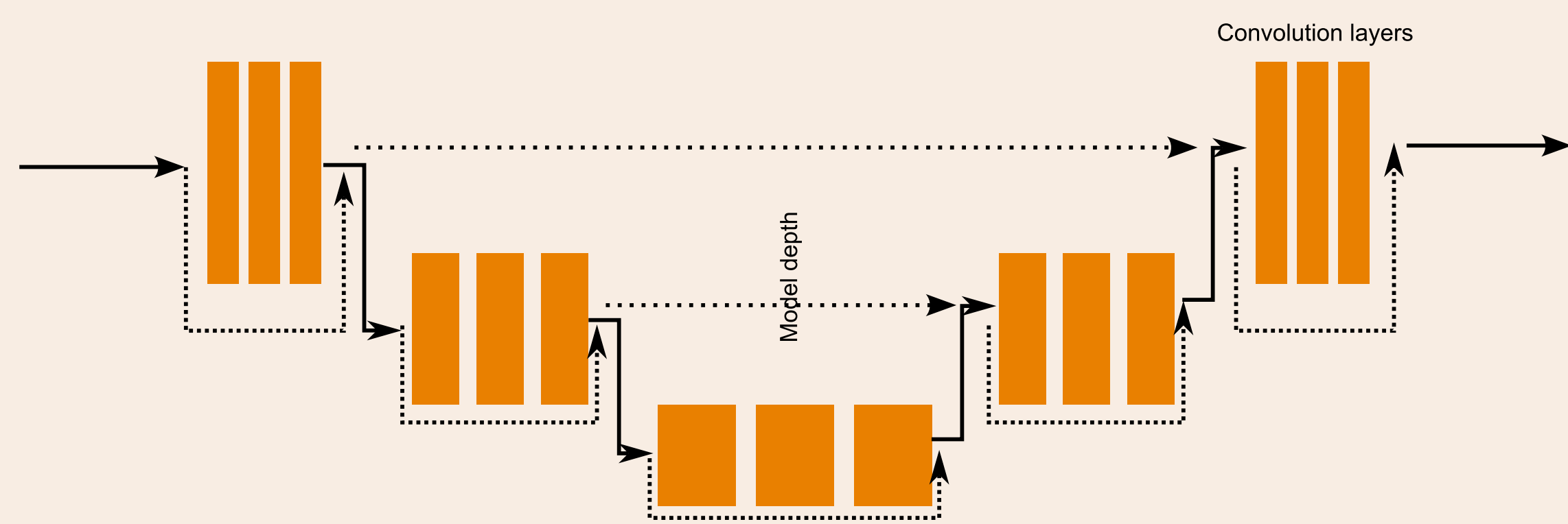
Advanced settings allow changing some hyperparameters of the underlying model. Increasing the values for Depth, Convolution Layers, and Kernel size increases the number of trainable parameters and makes the model potentially more capable of generalizing, at the cost of requiring more training data.

The fitted model can be imported into Dafne or uploaded to the central server.

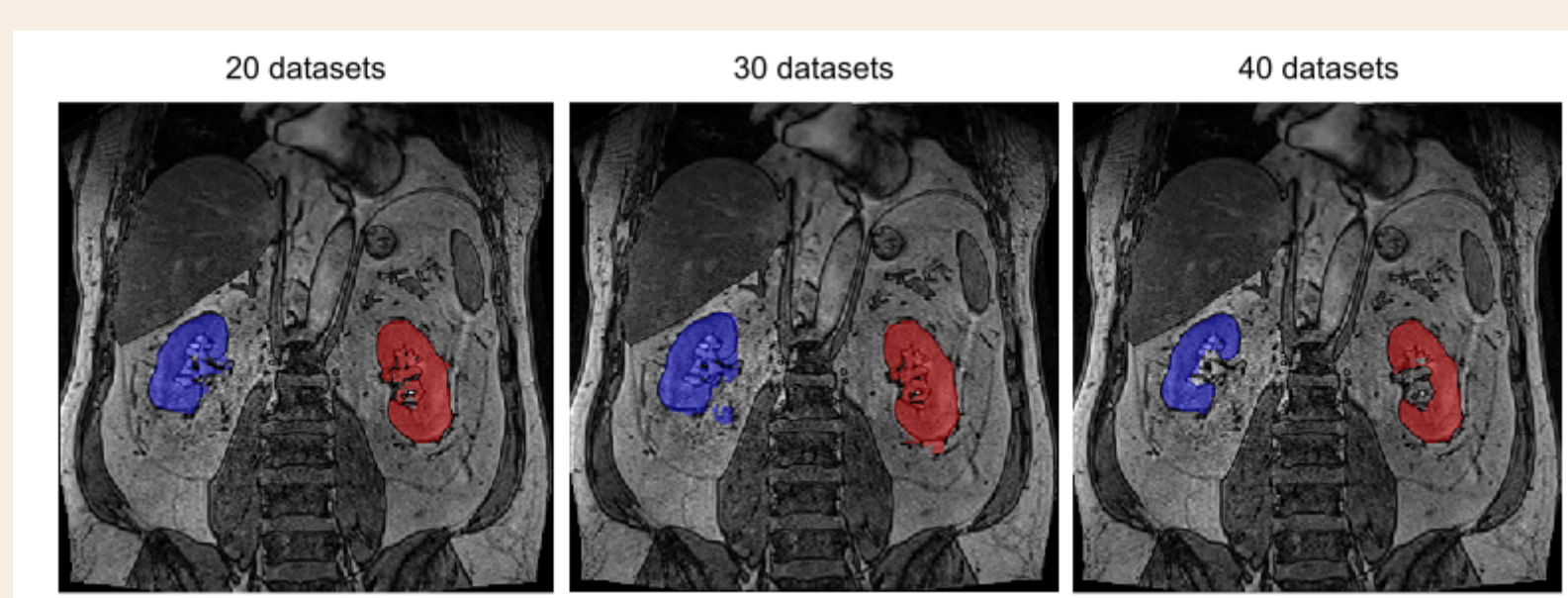


Technical details and results

The model trainer adapts a modified 2D VNet architecture to the training data, by extracting the most common voxel resolutions and image sizes, and creating the appropriate preprocessing steps to homogenize the input.



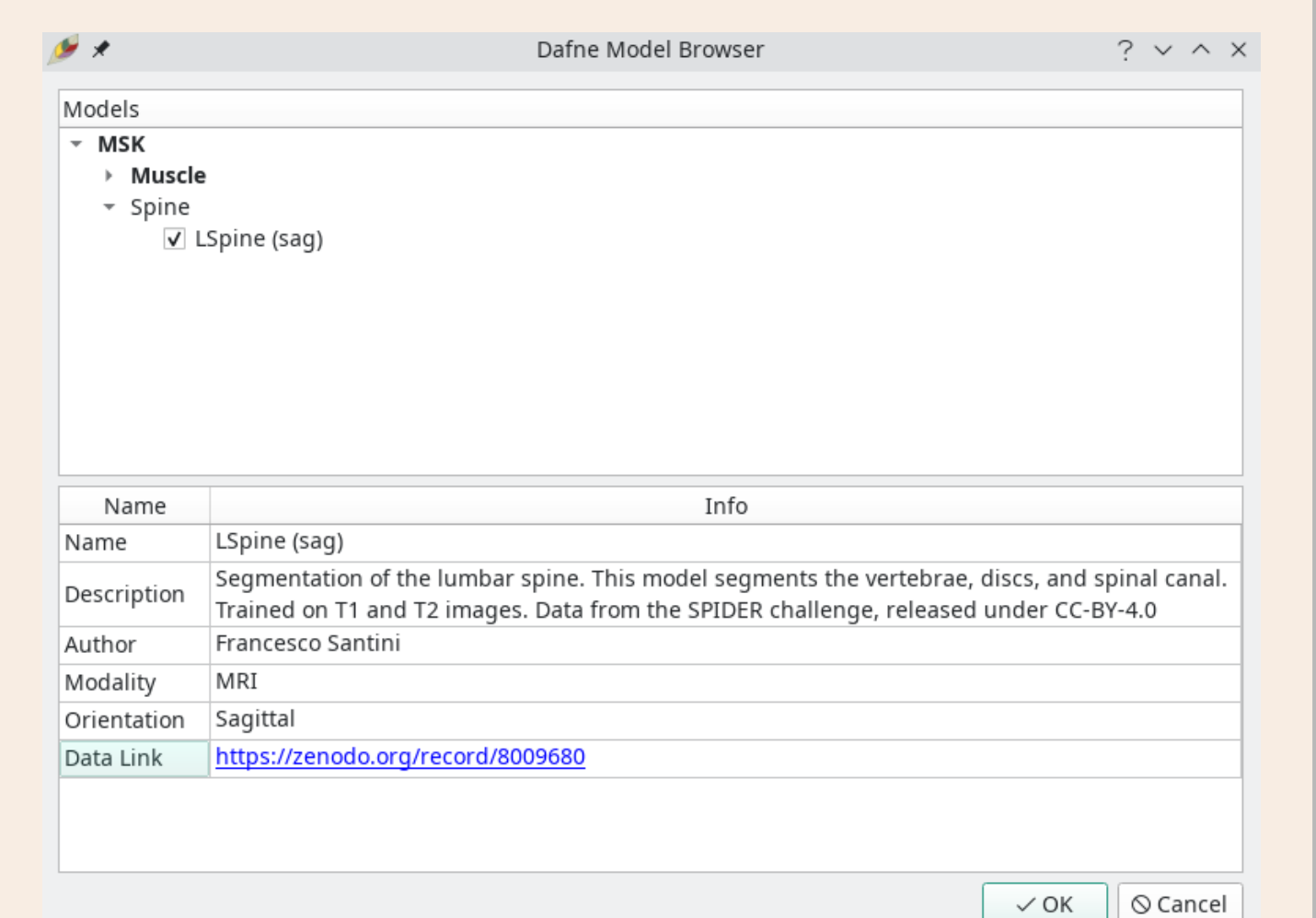
The tool was tested on MR images of the abdomen with the kidneys segmented bilaterally. Three models were trained on 20, 30, and 40 datasets, and they were imported into Dafne for qualitative evaluation.



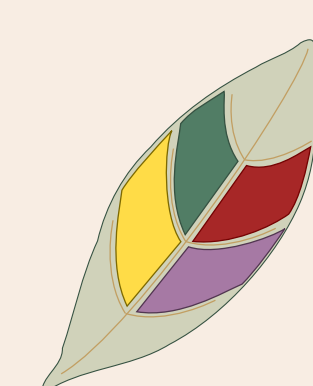
Above, a segmentation performed from inside Dafne using the three models. Quantitative, the three models were tested on 4 additional datasets and they resulted in Dice Similarity Indices of 0.76, 0.76, 0.80, respectively.

Discussion

Thanks to this model trainer, Dafne can be now easily extended to custom applications. The latest version now includes a "model browser", which allows selection of models present on the server. In parallel to the kidney model, a segmentation model of the lumbar spine is being developed and is already available.



You can download Dafne for free at <https://dafne.network/>



Dafne

Deep Anatomical Federated Network

