Contents

1 User Manual

Technical requirements: Python 3.5, Tensorflow 1.2

General instructions: The programs are contained in python scripts and are intended to be executed from the terminal. To execute a program, navigate to the folder that contains it or add the directory to your PATH and follow the instructions from the appropriate section below.

1.1 Modelling MR signals in the presence of nervous tissue injuries

Running the simulation The python script that contains the simulation program is `ANNdatasynth_run.py`. To run the simulation, use the command:

```
python ANNdatasynth_run.py runid neuron_no schemepath -vis
    bfloatpath -syn plypath
```

runid This parameter must be specified, and should be the filename (without extension) of the Tensorflow checkpoint that contains the parameters for the trained ANN.

neuron_no This parameter must be specified, and should match the number of neurons that the ANN in the checkpoint uses.

schemepath This parameter must be specified, and should contain the path to the directory where the experimental setup (scheme file) is located.

plypath This parameter should be specified if a straight synthesis should be run. `plypath` should contain the directory where the .ply files of the geometry models are located. Either this parameter or `bfloatpath` must be specified, but not both simultaneously.

bfloatpath This parameter should be specified, if the synthesis should be compared to another set of data. `bfloatpath` should contain the directory where the data set that should be the basis of comparison are located.

Example: A sample command that runs the simulation as described in this paper is:

```
python ANNdatasynth_run.py synth500dir30str_90neurons 90
    simulations/20170730_grad.scheme -syn
    simulations/1.5r_all/ply/
```

Output: The synthesized diffusion signals are saved as `'nn_datasynth...'.txt` in the folder of the python script.

Training a new ANN DWI model

The ANN can also be retrained to learn the prediction based on another experimental setup. The python script that contains the detection program is `ANNdatasynth_train.py`. To train a new network, use the command:

```
python ANNdetection\_train.py schemepath bfloatpath neuron_no -i
    iterations -l learningrate -s scale -pf
```

schemepath This parameter must be specified, and should contain the path to the directory where the experimental setup (scheme file) is located.

bfloatpath This parameter must be specified, and should contain the path to the directory where the diffusion signals are located. The file should be in a floating point binary format (.Bfloat).

neuron_no This parameter must be specified, and should specify the number of neurons the ANN should use in its hidden layer

iterations The default number of iterations is 100. To specify a different number, an integer can be specified here preceded by `-i`. Note that the actual number of iterations may be less if early stoppage is prompted.

learningrate The default number of iterations is 0.001. To specify a different number, a float can be specified here preceded by `-l`.

scale With this parameter, the ANN can be trained on a random subset of the provided data set. The specified value should be between 0 and 1 and the default scale is 1.0, which takes the full data set.

-pf During training, the prediction is plotted every *iterations*/20 steps. Specifying this parameter will turn off plotting. It is recommended to turn off plotting if training should run in the background.

Example: A sample command that runs the training with the reduced set as described in this paper is:

```
python ANNdatasynth_train.py simulations/20170730_grad.scheme
    simulations/1.5r_all/ 90
```

Output: The checkpoints of the trained network are saved in the `checkpoint` folder.

1.2 Detection of nervous tissue injuries

Running the detection

The python script that contains the detection program is `ANNdetection_run.py`. To run the detection, use the command:

```
python ANNdetection_run.py runid neuron_no schemepath bfloatpath
    --snr snr_value
```

runid This parameter must be specified, and should be the filename (without extension) of the Tensorflow checkpoint that contains the parameters for the trained ANN.

neuron_no This parameter must be specified, and should match the number of neurons that the ANN in the checkpoint uses.

schemepath This parameter must be specified, and should contain the path to the directory where the experimental setup (scheme file) is located.

bfloatpath This parameter must be specified, and should contain the path to the directory where the diffusion signals are located. The file should be in a floating point binary format (.Bfloat).

snr_value This parameter is optional, and can contain a signal-to-noise ratio (float). Specifying this parameter will add noise to the diffusion signals in *bfloatpath*. When specified, the value needs to be preceeded by `--snr`.

Example: A sample command that runs the detection with the reduced set as described in this paper with a SNR of 10 is:

```
python ANNdetection_run.py detect10dir5str_10neurons 10
    simulations/10dir5str.scheme simulations/10dir5str/ --snr 10
```

Output: The output of the detection is shown on screen.

Training a detection ANN

The ANN can also be retrained to learn the detection based on another experimental setup. The python script that contains the detection program is `ANNdetection_run.py`. To train a new network, use the command:

```
python ANNdetection\_train.py schemepath bfloatpath neuron_no -i
    iterations -l learningrate -nostp
```

schemepath This parameter must be specified, and should contain the path to the directory where the experimental setup (scheme file) is located.

bfloatpath This parameter must be specified, and should contain the path to the directory where the diffusion signals are located. The file should be in a floating point binary format (.Bfloat).

neuron_no This parameter must be specified, and should specify the number of neurons the ANN should use in its hidden layer

iterations The default number of iterations is 100. To specify a different number, an integer can be specified here preceded by `-i`. Note that the actual number of iterations may be less if early stoppage is prompted.

learningrate The default number of iterations is 0.001. To specify a different number, a float can be specified here preceded by `-l`.

-nostp The default setting for early stoppage is true. Early stoppage can be turned off by adding this optional parameter.

Example: A sample command that runs the training with the reduced set as described in this paper is:

```
python ANNdetection_train.py simulations/10dir5str.scheme
    simulations/10dir5str/ 10 -i 100 -l 0.01
```

Output: The checkpoints of the trained network are saved in the `checkpoints_class` folder.