**Manual for deep learning deconvolution**

**Start:**

To test the performance, sample data is available in the "Data" folder. The corresponding file names are pre-set in the GUI.

1. **Bicubic upscaling:**

Input: *.tif* image stack with 1024x1024 pixels, 8 bit. Bicubic upscaling is performed using “cv2.resize”. Result is saved in 8 bit.

1. **GAN training:**

Input Airy: .*tif* stack resulting from Bicubic upscaling, lower image quality then Gauss stack

Image input Gauss: 2048x2048, 8bit, same slice number as Airy, same image content, but with higher quality

Model name: Give model name, *.h5* format

Give epoch number: e.g. 10 for step 1, 100 for step2

Many intermediate files are created during training. They can be automatically deleted via checking “Delete intermediate files”.

Note: The graphical user interface accesses the files *.py* files in the folder. These should not be removed.

1. **Apply GAN:**

Give model name (.h5 format) and Airy Stack (*.tif*). Result is saved in 8bit in *.tif* stack format.

1. **Richardson Lucy Decon:**

Give PSF as *.tif* stack: 80x80 pix, 60 slices in z, 8bit  
Airy stack: *.tif*, 8bit

1. **Perform Evaluation:**

Give Gauss Stack (*tif*, 8bit) as basis for evaluation. Gauss is considered as “Ground truth”. RL, GAN stack (*tif*, 8bit ) must have same slice/pixel number.

**General information:**

Sometimes the message "not responding" appears, which only means that the program is in progress, not that it is broken. Especially the training can take 2 days or longer.  
Most steps can also be performed for 16-bit stacks, but this is not recommended because it increases runtime.

**Technical requirements:**

Algorithm tested in Anaconda, Python 3.9.6 64-bit

Used physical RAM: 1TB, 64 GB would be enough  
Graphiccard: NVIDIA Quadro RTX 5000  
Access to graphic card should be installed for tensorflow: Help: <https://neptune.ai/blog/installing-tensorflow-2-gpu-guide>

**Important Packages + used versions:**

Tensorflow: 2.5.0  
Pillow: 8.3.1  
Scikit-image: 0.18.2  
Scikit-learn: 0.24.2  
Numpy: 1.20.3  
Tifffile: 2021.7.30  
Opencv: 4.5.3.56  
Keras: 2.4.3  
Scipy: 1.6.2  
Matplotlib: 3.4.2  
Cudatoolkit: 11.3.1

**All installed packages + versions**

Package Version

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absl-py 0.13.0

aiohttp 3.7.4

altgraph 0.17.2

argon2-cffi 20.1.0

astor 0.8.1

astunparse 1.6.3

async-generator 1.10

async-timeout 3.0.1

attrs 21.2.0

backcall 0.2.0

bleach 4.0.0

blinker 1.4

brotlipy 0.7.0

cached-property 1.5.2

cachetools 4.2.2

certifi 2021.5.30

cffi 1.14.6

chardet 3.0.4

click 8.0.1

colorama 0.4.4

coverage 5.5

cryptography 3.4.7

cycler 0.10.0

Cython 0.29.24

decorator 5.0.9

defusedxml 0.7.1

entrypoints 0.3

flatbuffers 20210226132247

future 0.18.2

gast 0.4.0

google-auth 1.33.0

google-auth-oauthlib 0.4.1

google-pasta 0.2.0

grpcio 1.36.1

h5py 3.6.0

idna 2.10

imageio 2.9.0

imaris-ims-file-reader 0.1.6

importlib-metadata 3.10.0

ipykernel 5.3.4

ipython 7.22.0

ipython-genutils 0.2.0

jedi 0.17.2

Jinja2 3.0.1

joblib 1.0.1

jsonschema 3.2.0

jupyter-client 6.1.12

jupyter-core 4.7.1

jupyterlab-pygments 0.1.2

Keras 2.4.3

Keras-Preprocessing 1.1.2

kiwisolver 1.3.1

llvmlite 0.36.0

Markdown 3.3.4

MarkupSafe 2.0.1

matplotlib 3.4.2

mistune 0.8.4

mkl-fft 1.3.0

mkl-random 1.2.2

mkl-service 2.4.0

multidict 5.1.0

nbclient 0.5.3

nbconvert 6.1.0

nbformat 5.1.3

nest-asyncio 1.5.1

networkx 2.6.2

notebook 6.4.0

numba 0.53.1

numpy 1.20.3

oauthlib 3.1.1

opencv-contrib-python 4.5.3.56

opencv-python 4.5.3.56

opt-einsum 3.3.0

packaging 21.0

pandas 1.4.1

pandocfilters 1.4.3

parso 0.7.0

pefile 2022.5.30

pickleshare 0.7.5

Pillow 8.3.1

pip 21.2.2

prometheus-client 0.11.0

prompt-toolkit 3.0.17

protobuf 3.14.0

pyasn1 0.4.8

pyasn1-modules 0.2.8

pycparser 2.20

Pygments 2.9.0

pyinstaller 5.1

pyinstaller-hooks-contrib 2022.7

PyJWT 2.1.0

pyOpenSSL 20.0.1

pyparsing 2.4.7

pyreadline 2.1

pyrsistent 0.18.0

PySocks 1.7.1

python-dateutil 2.8.2

pytz 2022.1

PyWavelets 1.1.1

pywin32 228

pywin32-ctypes 0.2.0

pywinpty 0.5.7

PyYAML 5.4.1

pyzmq 20.0.0

requests 2.25.1

requests-oauthlib 1.3.0

rsa 4.7.2

scikit-image 0.18.2

scikit-learn 0.24.2

scipy 1.6.2

Send2Trash 1.5.0

setuptools 52.0.0.post20210125

SimpleITK 2.1.1

six 1.16.0

tensorboard 2.5.0

tensorboard-plugin-wit 1.6.0

tensorflow 2.5.0

tensorflow-estimator 2.5.0

termcolor 1.1.0

terminado 0.9.4

testpath 0.5.0

threadpoolctl 2.2.0

tifffile 2021.7.30

tornado 6.1

traitlets 5.0.5

typing-extensions 3.10.0.0

urllib3 1.26.6

wcwidth 0.2.5

webencodings 0.5.1

Werkzeug 1.0.1

wheel 0.35.1

win-inet-pton 1.1.0

wincertstore 0.2

wrapt 1.12.1

yarl 1.6.3

zipp 3.5.0