Training deep-learning based MR image processing with real-world images

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This project can be performed by 2 - 3 BSc students

The problem

The training of deep-learning neural networks for medical image processing requires a large amount of data. In practice, only small datasets of several tens up to a few hundred of images are usually available. In contrast, a very large number of real-world images (photographs) is freely available, but their characteristics differ significantly from those of medical images, such as MRI and CT. The question is: can these real-world images still be used to train networks dedicated to medical image processing?

The focus of this project

In this project, the focus is on training deep-learning neural networks for various magnetic resonance image processing tasks, especially noise removal, artefact reduction, and super resolution. In order to be able to use real-world images, their characteristics (appearances) first need to be adapted to those of the medical MR images. This may include adding noise and typical artefacts such as Gibbs ringing, and reducing resolution. Thereafter neural network architectures have to be chosen, which will be trained using the adapted real-world images for one or more the above-mentioned processing tasks. Finally, as proof-of-principle, the performance of the trained networks, when applied on MRI data, will be as much as possible quantitatively evaluated.

Real-world datasets

Lists of potentially useful real-world image datasets can for example be found here:

https://datagen.tech/guides/image-datasets/image-datasets/

https://www.v7labs.com/blog/computer-vision-datasets

https://imerit.net/blog/22-free-image-datasets-for-computer-vision-all-pbm/

https://www.linkedin.com/pulse/top-image-data-sets-navin-manaswi/

Reporting

A final report will be written in the form of a scientific article, using the IEEE scientific journal template. Guidelines can be found here: https://tue-image.nl/bsc-projects-beps/

Final presentation

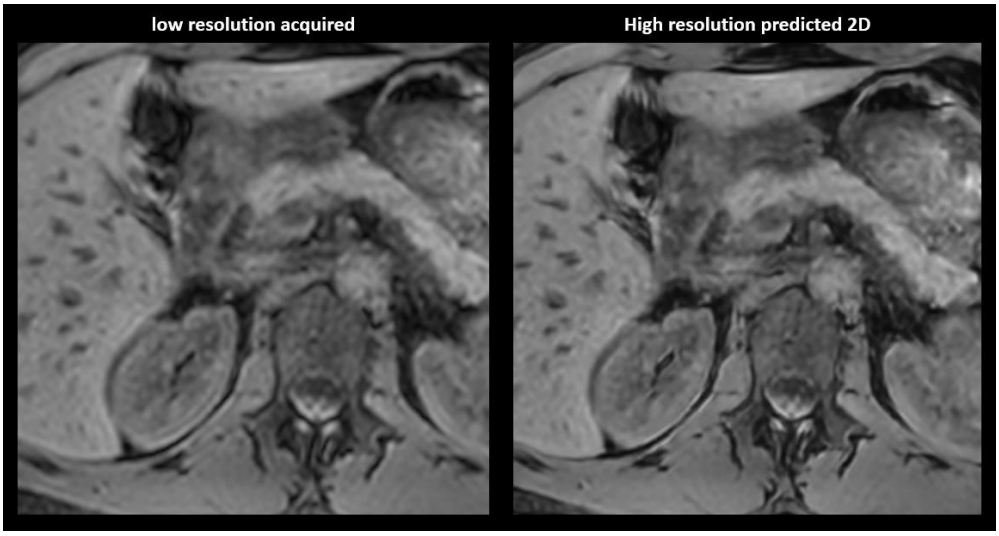
The BSc project is concluded with a 15-min presentation (incl. 3 min for questions).

Expected skills and experience

- Programming in Python

- Machine learning / deep learning: first experience with Keras/Tensorflow or (preferable) PyTorch
- Medical image analysis (courses 8DC00, 2DMM10)

Contact

Are you interest in this project? Do you want more information? Please contact: m.breeuwer@tue.nl

Example of deep-learning based MRI super resolution: