Technology Offer

Faster Processing: Neural Network for MR Imaging Parameter Prediction
Ref.-No.: 0107-6054-BC

The invention relates to a new method for processing magnetic resonance (MR) data based on a neural network (NN). After training, the NN quickly delivers high quality CEST images with low computational effort. Additionally, it provides uncertainty data aiding to judge the images appropriately.

Typically, sophisticated MR contrasts are calculated based on complex mathematical models, which is computationally expensive, and it requires long processing durations. Besides that, the results are highly sensitive to fit parameter variations making even state-of-the-art methods unreliable.

As a new concept, a neural network according to the invention uses multiple MR data sets for training. Afterwards the NN predicts the Lorentzian parameters from which the MR contrasts are calculated as well as their uncertainty. Raw Z-spectra are the input for these predictions that are generated in approximately one second.

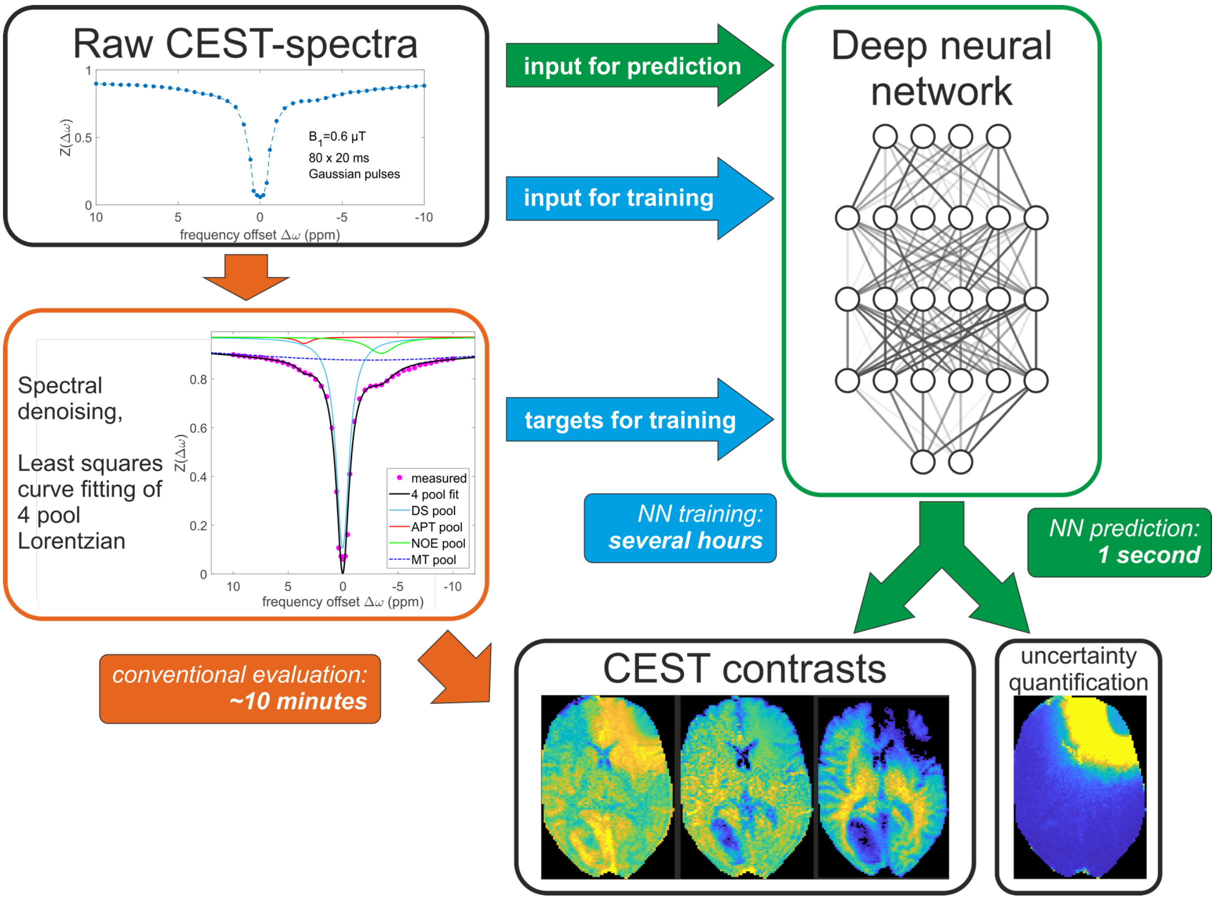

Fig. 1: Schematic of the presented data processing procedure. A deep neural network is used to shortcut CEST-spectra evaluation (orange arrows and boxes) by training with previously evaluated data (blue arrows and box). The trained network directly maps from raw Z-spectra to Lorentzian parameters, yielding CEST contrast maps (green). Additionally, the neural network architecture provides uncertainty quantification that indicates if predictions are trustworthy.

Max-Planck-Innovation GmbH
Amalienstr. 33
80799 München
www.max-planck-innovation.de

Advantages

- Quick processing
- Additional uncertainty predictions
- Insensitive to model properties
- Fully compatible with existing MRI setups
- Reliable
- Inexpensive

Applications

- MR imaging
- Medical investigations
- Material investigations

Background

For various applications and especially in medical diagnostics, MR Imaging is a common and often used tool. The calculation of the relevant images however is mainly based on complex modelling and is therefore a lengthy and computationally expensive process. Besides that, these calculations can lack robustness, as they are sensitive to slight fit algorithm parameter variations. Furthermore, state-of-the-art modelling methods only provide fit results but lack information about contrast uncertainties.

Technology

A new method based on a neural network has been developed to overcome the aforementioned shortcomings and to achieve quicker processing of MR data.
The method according to the invention uses a deep learning approach to train the neural network with previously evaluated data. Thereby a plurality of MR data and the related parameter maps of the used reference samples form the required training dictionary. After the learning procedure the trained neural network can be applied onto unknown samples. It uses the raw Z-spectra as an input and maps them onto vectors of 10 elements representing the free parameters of the Lorentzian model from which the CEST contrasts can be generated as shown in figure 1. The neural network can perform these calculations rapidly and consistently.
Besides the vectors of the free parameters, the neural network is also capable of estimating the uncertainty of each parameter as additional output vectors. These parameters can be directly translated into an additional uncertainty map and provided as additional information. The uncertainty maps allow radiographers to interpret the generated CEST maps with high confidence and are therefore another significant advantage over common methods.

Patent Information

EPO *(EP2018191698)*, USPTO *(US20200072931)*

Publications

F. Glang *et al.* "*DeepCEST 3T: Robust MRI parameter determination and uncertainty quantification with neural networks—application to CEST imaging of the human brain at 3T*", Magn Reson Med. (2019)

Contact

Dr. Bernd Ctortecka
Senior Patent- & License Manager
Physicist
Phone: +49 (0)89 / 29 09 19 - 20
eMail: ctortecka@max-planck-innovation.de

Max-Planck-Innovation GmbH
Amalienstr. 33
80799 München
www.max-planck-innovation.de