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Master Thesis, Forschungsarbeit
Generative adversarial networks for medical signal processing

After its renaissance in 2012, Deep Learning (DL) has swept the scientific community by storm, dominating the publications in the fields of computer vision, natural language processing, and speech recognition. More recently, DL has been applied on medical images (such as MRI, CT, etc..) to produce several applications that assist diagnosis and treatment of patients such as tumour detection/classification, semantic segmentation of organs and medical images quality assessment. All of these applications are still subject to thorough ongoing research.

Generative Adversarial Networks
Generative Adversarial Networks (GANs) is a new branch of deep learning which was developed recently in 2015. It is being hailed by many field experts as "the next frontier in deep learning" due to its potential in unsupervised learning (learning without labelled data) and its ability to create a common framework for several applications with no hand crafted loss function. In GANs, two networks are pitted against each other and trained jointly. The generator network acts as a team of counterfeiters trying to generate fake data that resembles the input data without detection. On the other side, the discriminator network is analogous to the police, trying to detect the counterfeit data. Competition drives both networks to improve their methods and learn more about the features of the input data. GANs have been recently applied successfully in several applications including unsupervised image translation, domain adaptation, image in-painting and semi-supervised classification.

Proposed Topics
The goal of the proposed topics is to bridge the gap between GANs and medical image analysis to create novel state-of-the-art applications. Several thesis topics are possible:

- **MRI motion correction using GANs**

- **3D image-to-image translation for CT-PET/MRI-PET data**

(a) input PET   (b) output synthetic CT   (c) ground truth CT
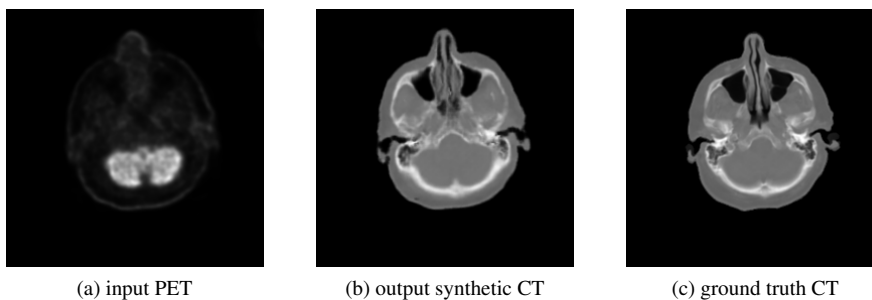
Abbildung 1: Example of image-translation from PET to equivalent CT using GANs

Please contact me for more information.

Prerequisites

- Studies in the field of electrical engineering, informatics or Medizintechnik
- Highly motivated, independent and structured way of working
- Interest in machine learning, deep learning and signal processing
- Good English (spoken and written)
- Programming expertise in Python is beneficial

Interested applicants should sent their curriculum vitae and list of grades to: karim.armanious@iss.uni-stuttgart.de