Deep Learning in Medical Imaging Focusing on MRI

--breakthroughs in artificial neural networks have propelled technological development

--ImageNet Large-Scale Visual Recognition Challenge was beaten very thoroughly by a new machine learning algorithm

Machine Learning, Artificial Neural Networks, Deep Learning

--can give computers training data and allow them to solve problems

--reinforcement learning: agents learn from their environments and can in turn make decisions based on what action they should take

--gradient descent and loss function are also discussed as in the previous work

Convolutional Neural Networks (CNNs)

--preserves spatial relationships within data

Convolutional Layers

--arranged in a grid structure possessing several feed-forward layers

-­-tensor of feature maps is created by applying the convolutional filters at all input locations

Activation Layer

--allows for almost any non-linear function to be algorithmically approximated

--generally vvery simple ReLUs; typically also called feature maps

Pooling

--produced by feeding data through one or move convolutional layers

--generally involves the use of convolutions with increased stride lengths

Dropout Regularization

--by averaging several models, generally are able to get better and more direct results

Dropout regularization: gives huge boost in performance by randomly removing neurons in a stochastic sampling process; the weights of the neural network are then accordingly readjusted

Batch normalization: layers placed on after activation layers

Machine Learning in MRI scans

--can be used to improve both radiomics and theranostics in neurosurgical imaging

--deep cascade can be created for concatenated CNNs for dynamic MR image reconstruction

--unified network for image reconstruction: automap

--QSM and MR fingerprinting

--QSM wants to understanding how magnetically susceptible certain material through estimation of parameters; has only been trained on relatively basic data

--several specific cases of MRI machine learning are detailed such as MRF construction

--Image Restoration

--denoising methods by noticing which parts of an MRI to pick out

--Super resolution: can increase the resolution through analysis of lower resolution image to find what parts of the image can be changed to increase understanding of what may appear

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