Subsample

August 23, 2021

[1]:
```
%matplotlib inline

import h5py
import numpy as np
from matplotlib import pyplot as plt

import fastmri
from fastmri.data import transforms as T

import random
```

[2]:
```
# parameters
slice_idx = 7  # choose which slice in a volume to plot
file_name = "file_brain_AXFLAIR_200_6002447.h5"
gt_file_before_recon_name = './undersampling/' + file_name
file_after_subsampling_name = './undersampling/r_sub4_' + file_name
```

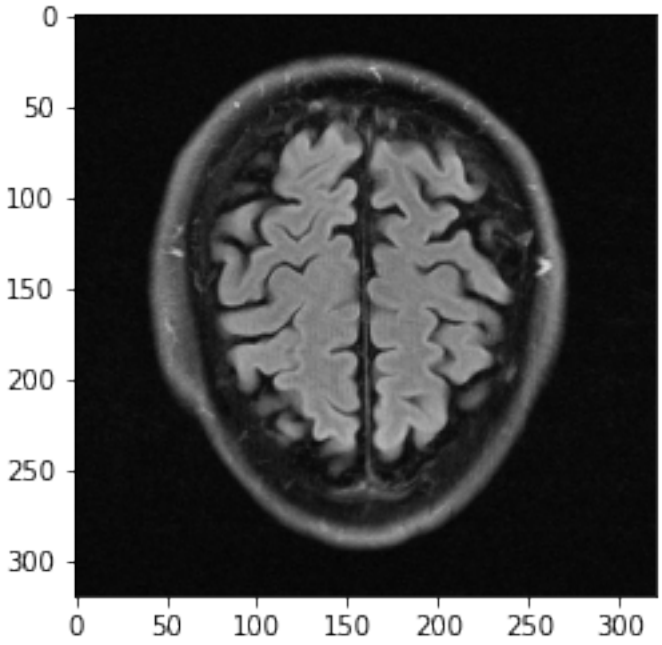
0.1 Ground Truth .h5 Basic Format

[3]:
```
# ground truth img
# get raw img matrix
gt_hf = h5py.File(gt_file_before_recon_name, 'r')
print('Keys:', list(gt_hf.keys()))  # Keys: ['ismrmrd_header', 'kspace',␣
↪'reconstruction_rss']
print('Attrs:', dict(gt_hf.attrs))  # Attrs: ['acquisition', 'max', 'norm',␣
↪'patient_id']
print(gt_hf['kspace'][()].shape)  # (number of slices, number of coils, height,␣
↪width)
```

```
Keys: ['ismrmrd_header', 'kspace', 'reconstruction_rss']
Attrs: {'acquisition': 'AXFLAIR', 'max': 0.00041413615952341293, 'norm':
0.08723472457184536, 'patient_id':
'30c14259008242f60e5214a793bad574fbf48a7140f76ec3152eef31e090486d'}
(16, 16, 640, 320)
```

[4]:
```
# .h5 contains rss that has already been calculated; same as the cell below
# plot ground truth img (rss)
```

```
gt_slice_img_rss_test = gt_hf['reconstruction_rss'][()][slice_idx]
fig = plt.figure()
plt.subplot(1,1,1)
plt.imshow(np.abs(gt_slice_img_rss_test), cmap='gray');
```



0.2 Subsample Validation Data (equispaced)

[5]:
```
# # subsampling

# from fastmri.data.subsample import EquispacedMaskFunc

# mask_func = EquispacedMaskFunc(center_fractions=[0.04], accelerations=[8])  #␣
 ↪Create the mask function object
# gt_volume_kspace = gt_hf['kspace'][()]
# undersample_all_slices_lst = []

# for slice_i in range(gt_volume_kspace.shape[0]):
#     gt_single_slice = T.to_tensor(gt_volume_kspace[slice_i]) # fetch one␣
 ↪slice of the sample
#     masked_kspace_single_slice, mask = T.apply_mask(gt_single_slice,␣
 ↪mask_func, seed=1)
#     # Apply the mask to k-space
#     # torch.Size([16, 640, 320, 2]) (number of slices, height, width, 2:real␣
 ↪part + imaginary part)
```

```
#     masked_kspace_single_slice_complex = masked_kspace_single_slice[..., 0] +␣
 ↪\
#                                          masked_kspace_single_slice[..., 1] *␣
 ↪1j
#     undersample_all_slices_lst.append(masked_kspace_single_slice_complex.
 ↪numpy())

# undersample_all_slices_nparray = np.array(undersample_all_slices_lst)
# print(undersample_all_slices_nparray.shape) # should be the same as the␣
 ↪gt_before_recon: (16, 16, 640, 320)
```

[6]:
```
# # create subsampled .h5
# f = h5py.File(file_after_subsampling_name,'w')
# f.create_dataset('ismrmrd_header', data=gt_hf['ismrmrd_header'][()])
# f.create_dataset('kspace', dtype=np.complex64,␣
 ↪data=undersample_all_slices_nparray)
# f.create_dataset('mask', dtype=np.float32, data=mask)
# f.attrs['acceleration'] = 8
# f.attrs['acquisition'] = gt_hf.attrs['acquisition']

# num_cols = gt_hf['kspace'][()].shape[-1]
# center_fraction, acceleration = 0.04, 8
# num_low_freqs = int(round(num_cols * center_fraction))
# f.attrs['num_low_frequency'] = num_low_freqs

# f.attrs['patient_id'] = gt_hf.attrs['patient_id']
# f.close()
```

[7]:
```
# # check the format of test data
# test = h5py.File(file_after_subsampling_name, 'r')
# print('Keys:', list(test.keys()))
# print('Attrs:', dict(test.attrs))
# test_kspace = test['kspace'][()]
# print(test_kspace.shape)
# print(test_kspace.dtype)
# print(test['mask'][()].dtype)
# test.close()
```

0.3 Subsample Validation Data (random)

[8]:
```
# subsampling
from fastmri.data.subsample import RandomMaskFunc

mask_func = RandomMaskFunc(center_fractions=[0.04], accelerations=[8])  #␣
 ↪Create the mask function object
gt_volume_kspace = gt_hf['kspace'][()]
```

```
undersample_all_slices_lst = []

for slice_i in range(gt_volume_kspace.shape[0]):
    gt_single_slice = T.to_tensor(gt_volume_kspace[slice_i]) # fetch one slice␣
 ↪of the sample
    masked_kspace_single_slice, mask = T.apply_mask(gt_single_slice, mask_func,␣
 ↪seed=random.randint(1, 1000))
    # Apply the mask to k-space
    # torch.Size([16, 640, 320, 2]) (number of slices, height, width, 2:real␣
 ↪part + imaginary part)
    masked_kspace_single_slice_complex = masked_kspace_single_slice[..., 0] + \
                                         masked_kspace_single_slice[..., 1] * 1j
    undersample_all_slices_lst.append(masked_kspace_single_slice_complex.
 ↪numpy())

undersample_all_slices_nparray = np.array(undersample_all_slices_lst)
print(undersample_all_slices_nparray.shape) # should be the same as the␣
 ↪gt_before_recon: (16, 16, 640, 320)
```

```
(16, 16, 640, 320)
```

[9]:
```
# create subsampled .h5
f = h5py.File(file_after_subsampling_name,'w')
f.create_dataset('ismrmrd_header', data=gt_hf['ismrmrd_header'][()])
f.create_dataset('kspace', dtype=np.complex64,␣
 ↪data=undersample_all_slices_nparray)
f.create_dataset('mask', dtype=np.float32, data=mask)
f.attrs['acceleration'] = 4
f.attrs['acquisition'] = gt_hf.attrs['acquisition']

num_cols = gt_hf['kspace'][()].shape[-1]
center_fraction, acceleration = 0.08, 4
num_low_freqs = int(round(num_cols * center_fraction))
f.attrs['num_low_frequency'] = num_low_freqs

f.attrs['patient_id'] = gt_hf.attrs['patient_id']
f.close()
```

[10]:
```
# check the format of test data
test = h5py.File(file_after_subsampling_name, 'r')
print('Keys:', list(test.keys()))
print('Attrs:', dict(test.attrs))
test_kspace = test['kspace'][()]
print(test_kspace.shape)
print(test_kspace.dtype)
print(test['mask'][()].dtype)
test.close()
```

```
Keys: ['ismrmrd_header', 'kspace', 'mask']
Attrs: {'acceleration': 4, 'acquisition': 'AXFLAIR', 'num_low_frequency': 26,
'patient_id':
'30c14259008242f60e5214a793bad574fbf48a7140f76ec3152eef31e090486d'}
(16, 16, 640, 320)
complex64
float32
```