

Sparse MRI

UNDERSTANDING IN MRI
COMPRESSED SENSING

Assignment

READ LUSTIG "SPARSE MRI" PAPER

SO FAR IN THIS CLASS WE'VE LOOKED AT MANY DIFFERENT WAYS TO SPEED UP MRI

* NON-CARTESIAN ACQUISITIONS

COLLECT MORE DATA, FASTER

* PARALLEL ACQUISITIONS

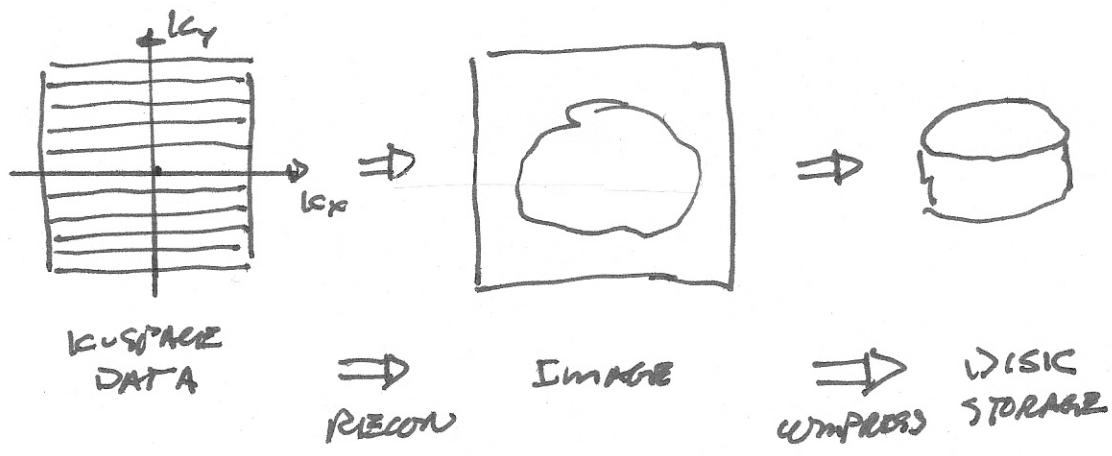
ADD RF ENCODING, REDUCE GRADIENT ENCODING

* COMPRESSED SENSING

JUST COLLECT LESS DATA, MAKE IT UP IN RECON

ALL OF THESE CAN BE COMBINED!

BASIC COMPRESSED SENSING IDEA



COMPRESSED IMAGE HAS ~10% OR LESS DATA THAN K-SPACE DATA

WHY COLLECT THE OTHER 90%?

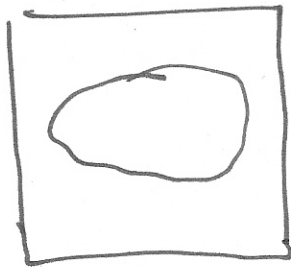
HOW CAN WE DO THIS?

FUNDAMENTALLY WE WANT TO UNDERSAMPLE

THIS PRODUCES ALIASING

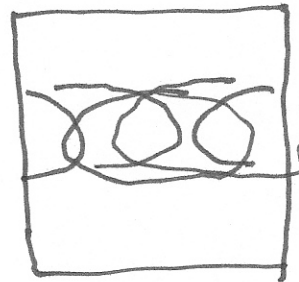
WE NEED TO BE ABLE TO TELL SIGNAL FROM ALIASING

CONSIDER PARALLEL IMAGING



FULL IMAGE

UNDERSAMPLE
UNIFORMLY

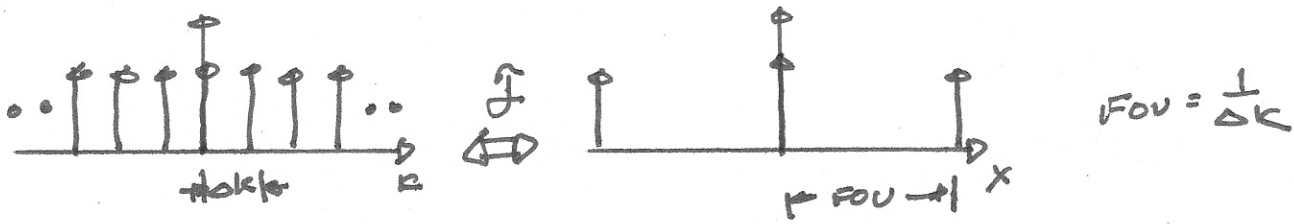


UNDERSAMPLED
IMAGE

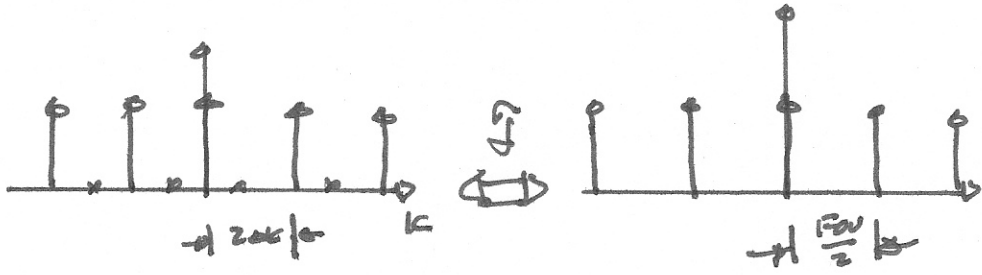
ALL GHOSTS ARE EQUALLY LIKELY

WE NEED COIL SENSITIVITIES TO SORT IT OUT.

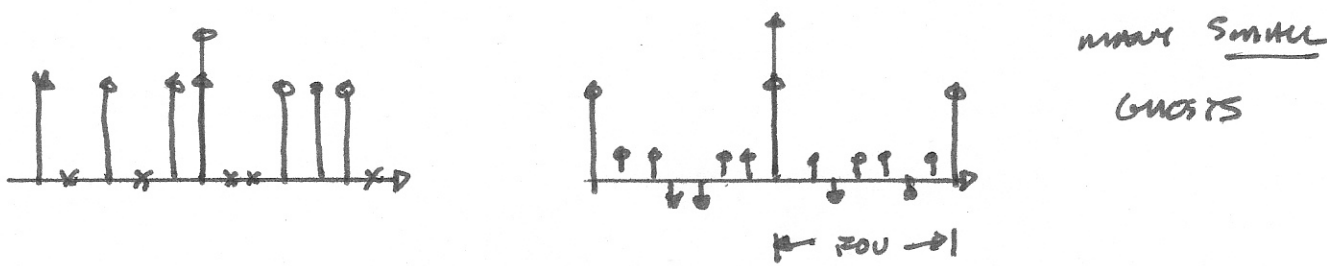
UNIFORM SAMPLING



UNIFORM UNDERSAMPLING x 2

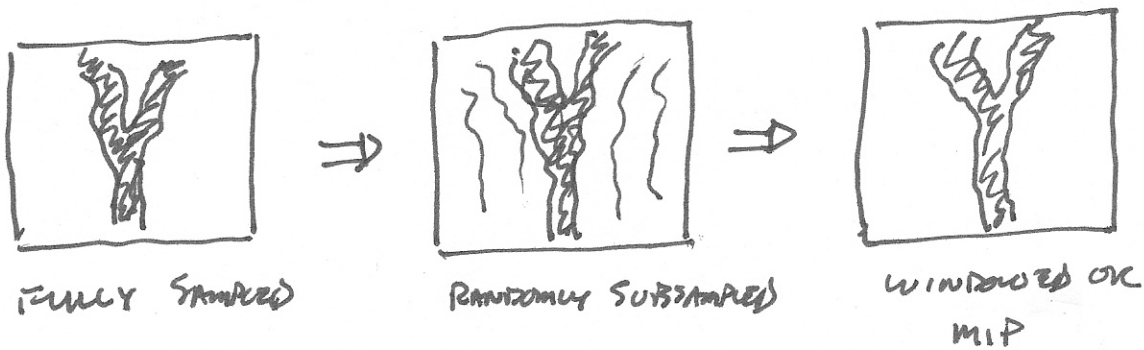


"RANDOM" UNDERSAMPLING x 2



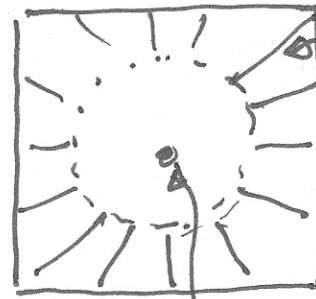
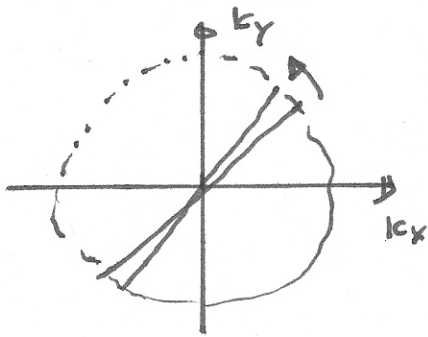
FOR HIGH CONTRAST OBJECTS THIS MAY BE OK

WIDELY EXPLOITED IN ANGIOGRAPHY



PARTICULARLY USEFUL FOR PROJECTION RECONSTRUCTION

DATA SETS



VIEW
STREAMS
AMPLITUDE $\frac{1}{N}$
RADIUS $\frac{FOV}{R}$

IMPULSE

PR IS OFTEN AGGRESSIVELY UNDERSAMPLED

FULLY SAMPLED 256×256 REQUIRES $256 \times \frac{\pi}{2} \approx 402$ PROJECTIONS

UNDERSAMPLED SET MAY USE 32 OR 64 PROJECTIONS

ARTIFACTS LOOK LIKE NOISE

BASIS FOR HYPR ALGORITHMS

HIGHLY CONSTRAINED BASIC PROJECTION

WE'LL FOCUS HERE ON ANOTHER APPROACH

SPARSE MRI

COMPRESSED SENSING

<GO TO SLIDES HERE>