Example: Implementing GRASP with BART

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pics: A Tool for Parallel Imaging Compressed Sensing

> bart pics -R*A*:*B*:*C*:*D* -R ... [-t trj] kspace sens image

- parallel imaging and compressed sensing
- non-Cartesian k-space trajectories
- multiple regularization terms
- A: different types of regularization:
  ℓ_2, ℓ_1, total variation, ℓ_1-wavelet, (multi-scale) low-rank
- B: transforms along arbitrary dimensions (space, time, etc.)
- C: joint-thresholding along arbitrary dimensions
- D: regularization parameter

Note: Depending on the algorithm additional parameters (step size, number of iterations, etc.) must be set for optimal results.

Example: GRASP[1]

Compressed sensing parallel imaging with a specific choice of sampling and regularization:

- golden-ratio sampling[2]

```
> bart traj -G -t trj
```

- total-variation regularization in time

```
> bart pics -RT:$(bart bitmask 10):0:0.01 -t trj ksp sens out
```


1. Feng et al., Magn Reson Med 2013; 70:64-74.
2. Winkelmann S et al., IEEE Trans Med Imaging 2007; 26:68-76.

Calibration from non-Cartesian Data

- inverse non-uniform FFT

```
> bart nufft -i -t trj_calib ksp_calib ksp2
```

- calibration with ESPIRiT

```
> bart ecalib -m1 ksp2 sens
```

Reformatting the Data

- split continuous series of radial spokes

> bart reshape $(bart bitmask 1 2) spokes phases ...

- move phases into dimension 10

> bart transpose 2 10 ...