Open-source software

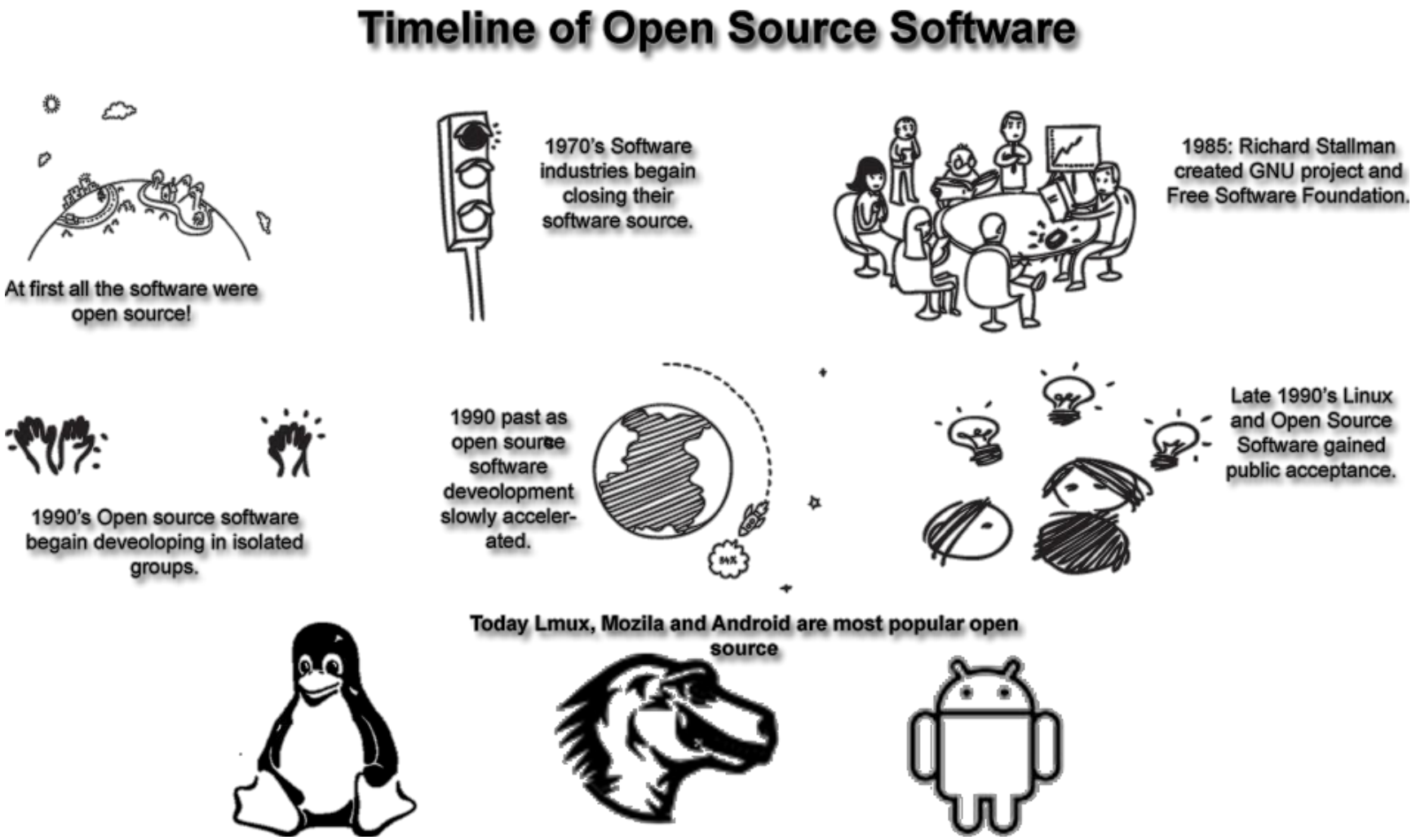
Carlos Castillo Passi

What is open-source software

- Open-source software is distributed with its **source code**, making it **available** for use, **modification**, and **distribution** with its original rights.

open source initiative®

History of open-source software



https://mason.gmu.edu/~mshahada/OpenSourceSoftware/hist.html

Richard Stallman

- GNU project
- GNU General Public License

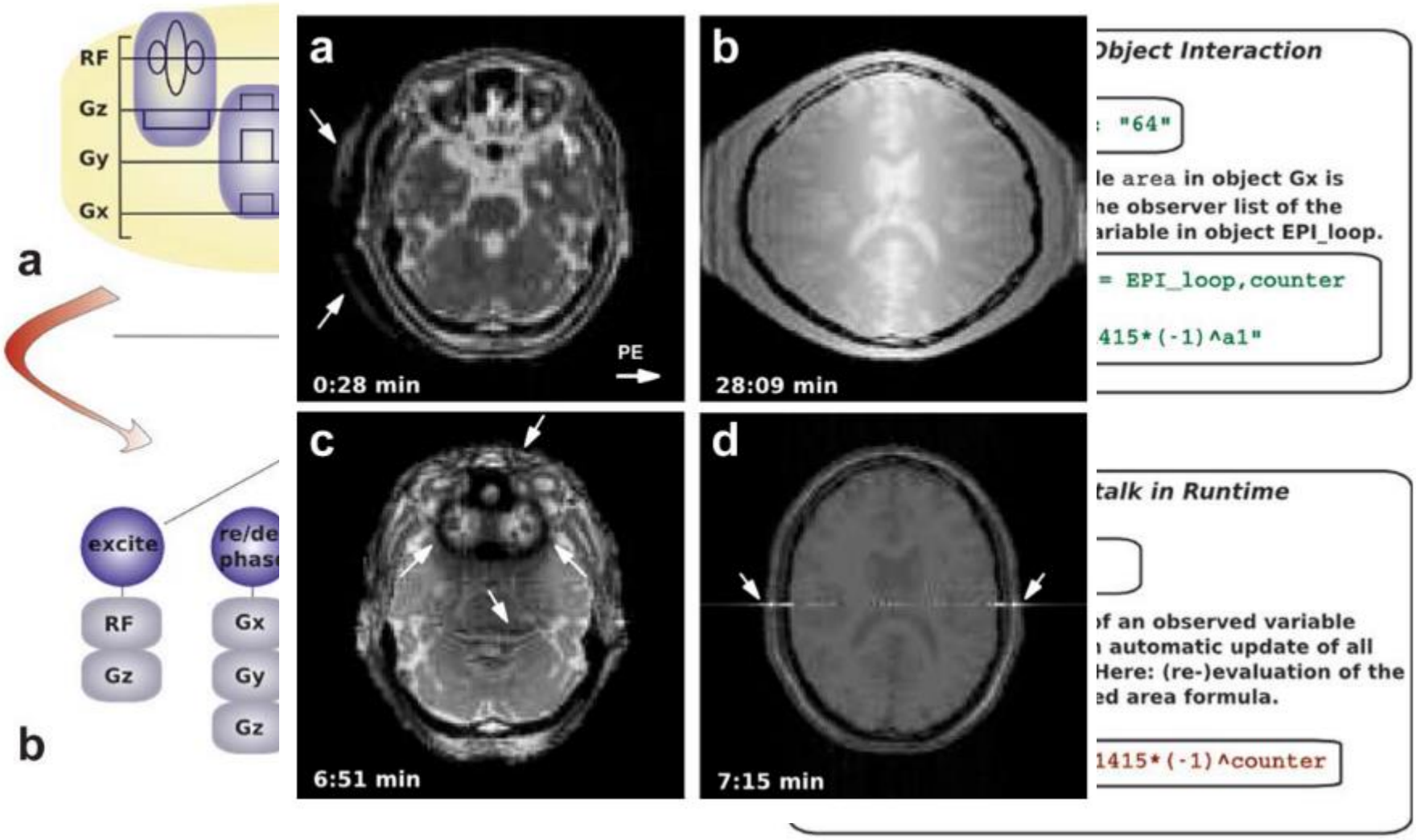
Replication crisis

		Data	
		Same	Different
Analysis	Same	Reproducible	Replicable
	Different	Robust	Generalisable

Python (1991)

The designer of Python, Guido van Rossum, at OSCON 2006

JEMRIS (2010)


RF
Gz
Gy
Gx
a
excite
RF
Gz
Gx
Gy
Gz
b
a
0:28 min
PE
b
28:09 min
c
6:51 min
d
7:15 min
Object Interaction
"64"
area in object Gx is
observer list of the
variable in object EPI_loop.
= EPI_loop,counter
415*(-1)^a1"
talk in Runtime
of an observed variable
automatic update of all
Here: (re-)evaluation of the
area formula.
1415*(-1)^counter

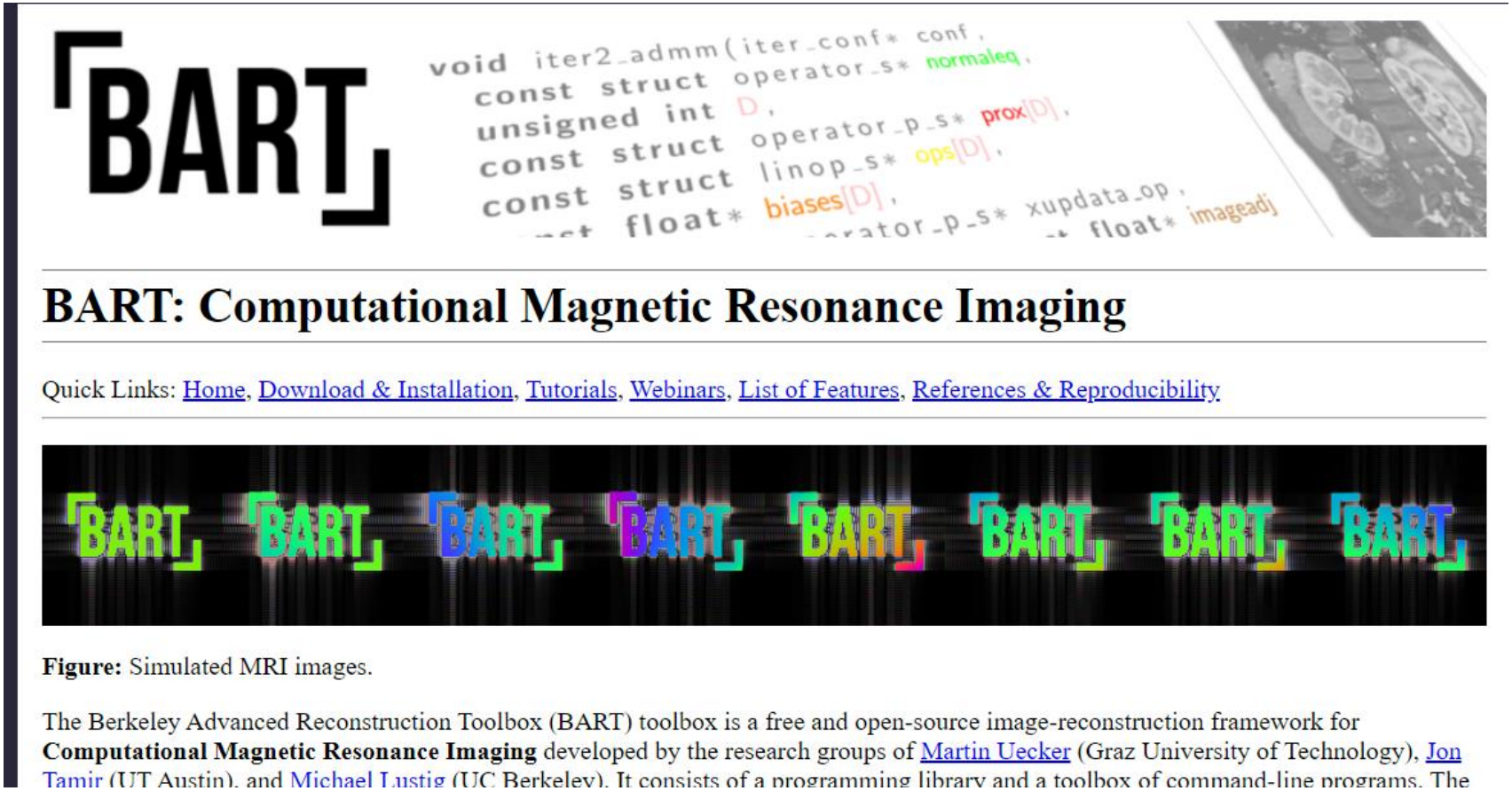
Julia programming language (2012)

julia

Massachusetts Institute of Technology

Stefan Karpinski, Viral B. Shah, Jeff Bezanson, and Alan Edelman

BART (2014)



BART: Computational Magnetic Resonance Imaging

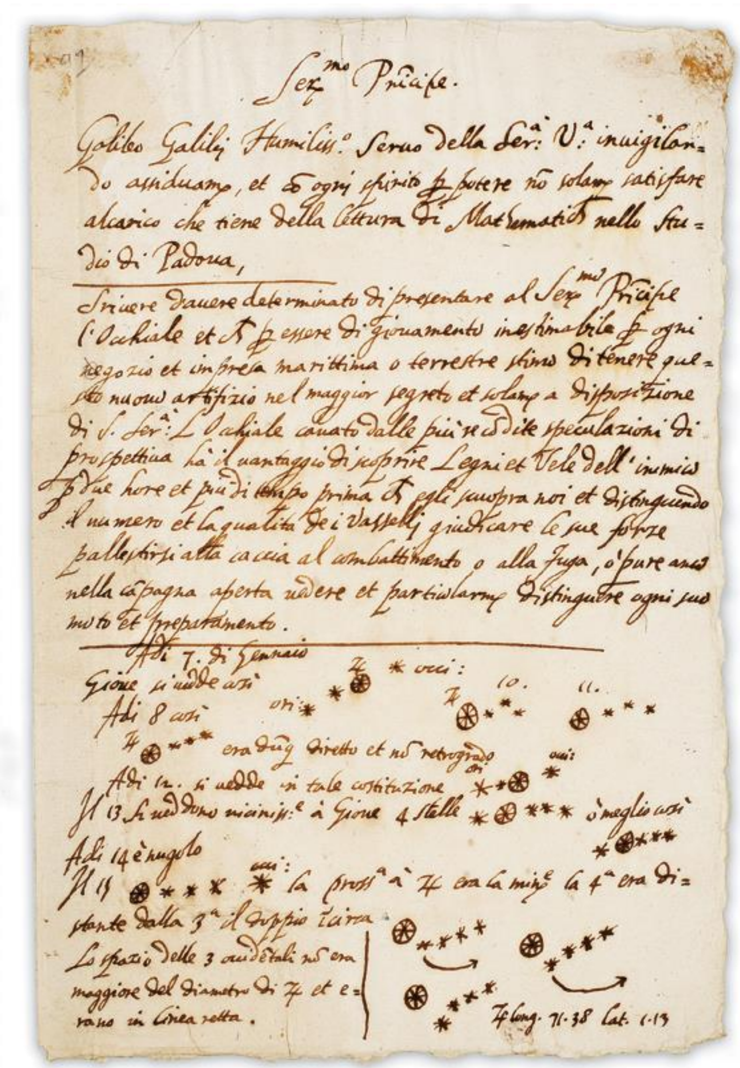
Quick Links: Home, Download & Installation, Tutorials, Webinars, List of Features, References & Reproducibility

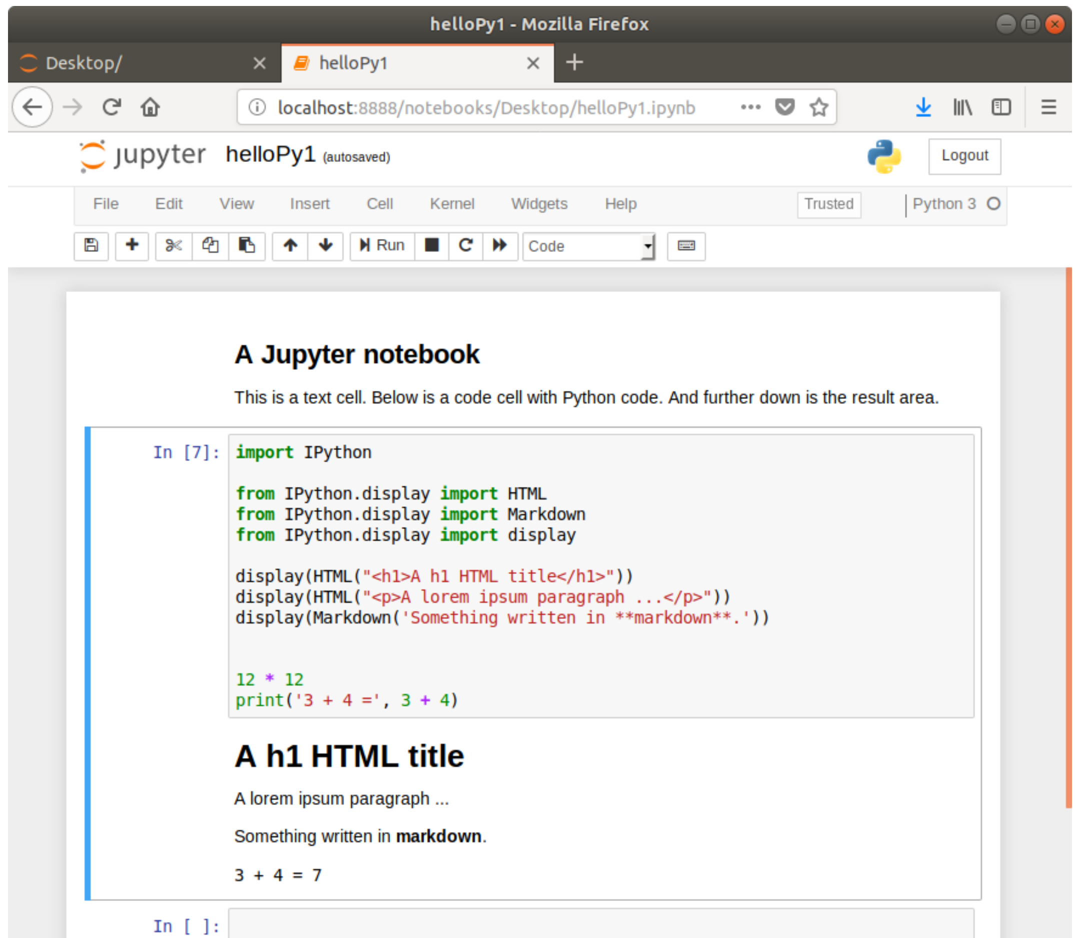
Figure: Simulated MRI images.

The Berkeley Advanced Reconstruction Toolbox (BART) toolbox is a free and open-source image-reconstruction framework for **Computational Magnetic Resonance Imaging** developed by the research groups of Martin Uecker (Graz University of Technology), Jon Tamir (UT Austin), and Michael Lustig (UC Berkeley). It consists of a programming library and a toolbox of command-line programs. The

Martin Uecker (Graz University of Technology),
Jon Tamir (UT Austin), and
Michael Lustig (UC Berkeley)

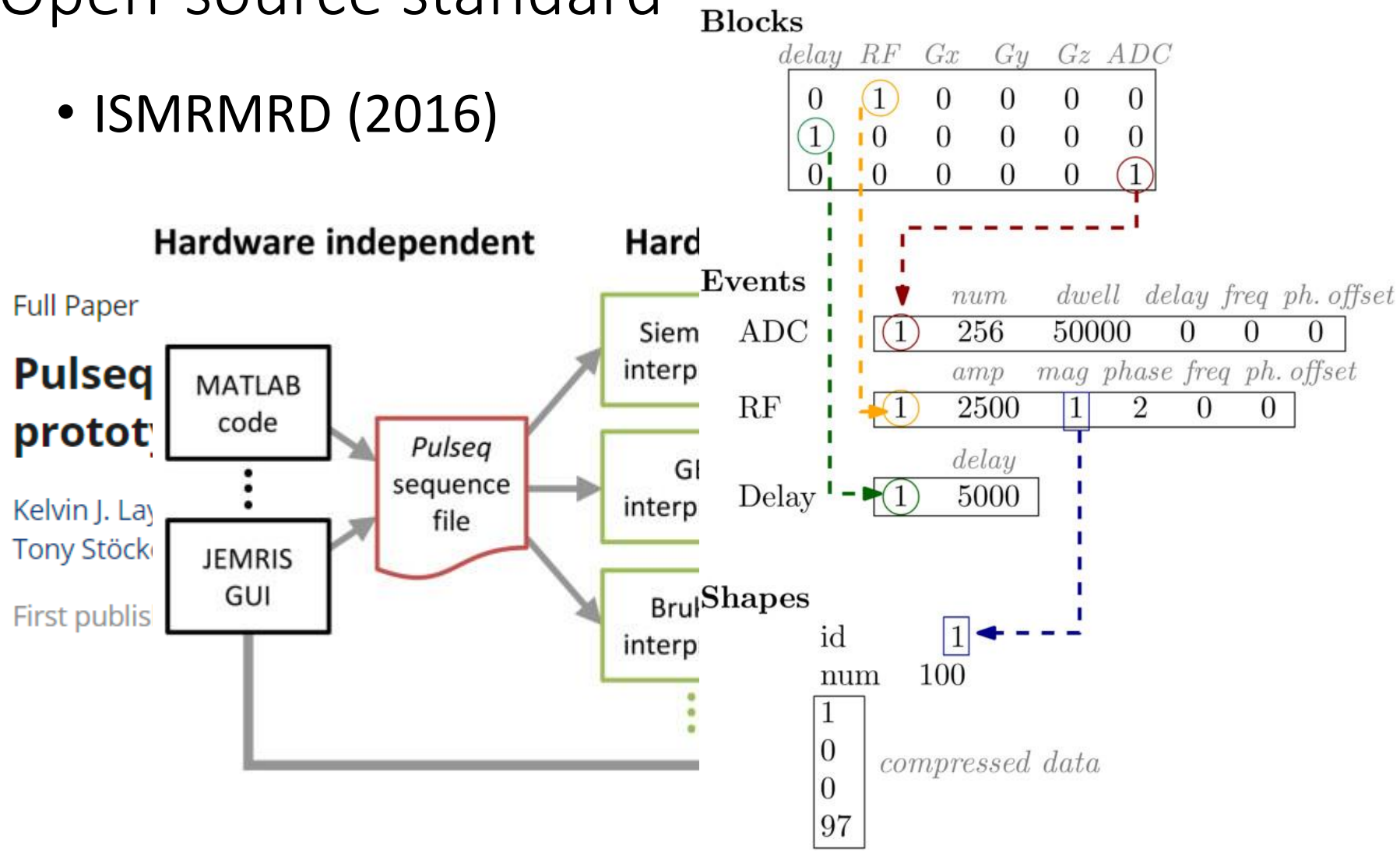
Jupyter notebooks (2015)





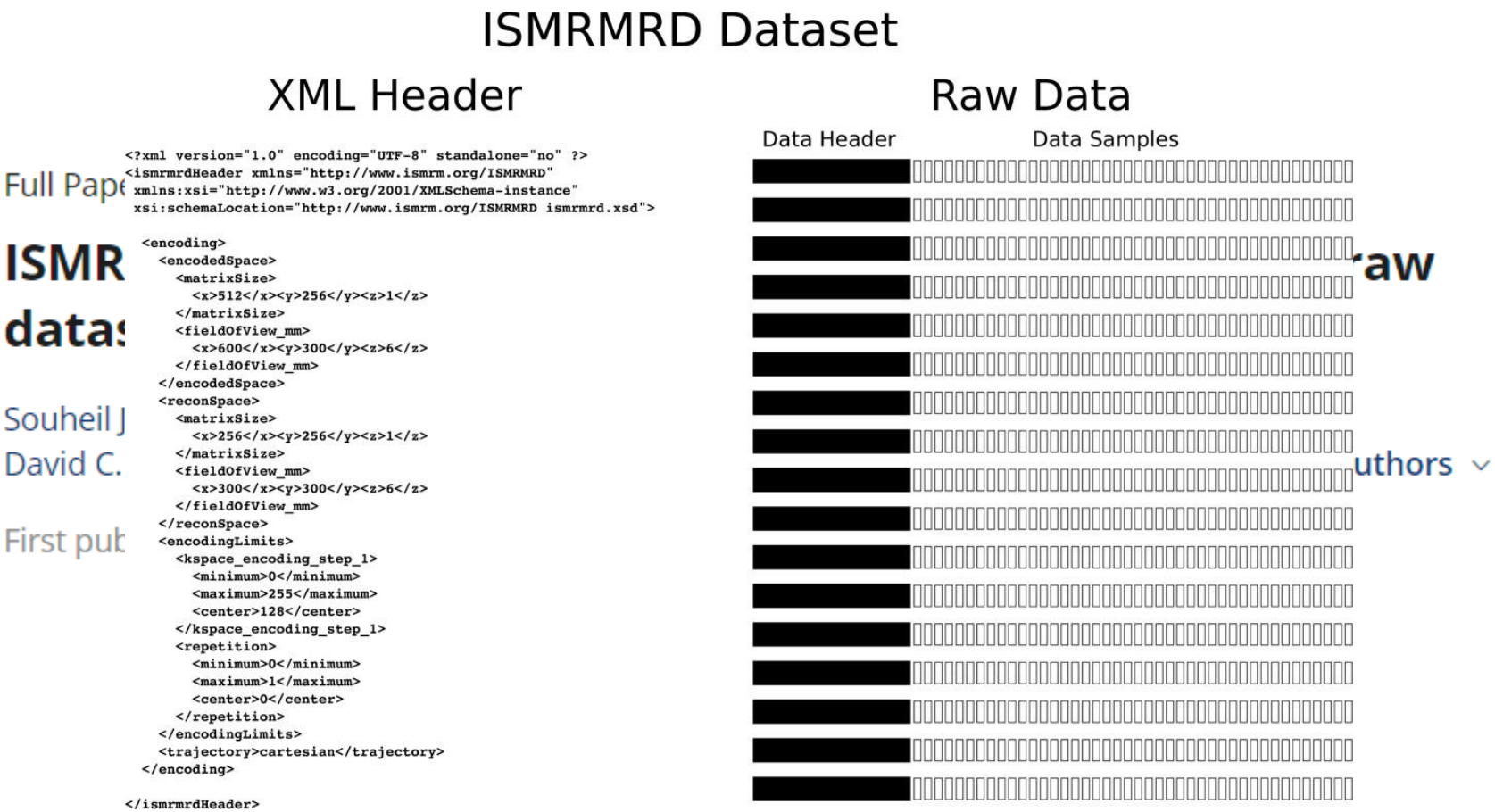
Open-source standard

- ISMRMRD (2016)



Open-source standard

- ISMRMRD (2017)



MR-Hub (2019)

Many members of the ISMRM community develop customized software tools to solve problems in various
n and data processing. The MR-Hub offers a platform
with the rest of the community - hopefully making
to solve their own problems more rapidly by building
he ISMRM community to follow the spirit of
behind their publications available to share.

Study Group of the ISMRM - and we encourage
ients to get involved. The GitHub repository for
/ismrm/mrhub - where you can also find instructions
o the repository.

d-sourced information related to open science and

to coincide with ISMRM 2019 in Montreal.

Categories:
All Categories (44)

Search MR-Hub

Sort by name | Sort by date added | Sort by date last updated | Sort by citations

DIPY

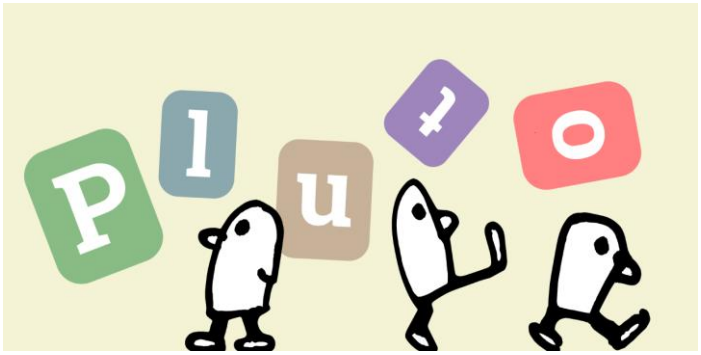
DIPY

Scientific computing software and community-driven medical imaging organization

Category: Multipurpose
Principal developers: Eleftherios Garyfallidis, Matthew Brett, Bagrat Amirbekian, Ariel Rokem, Stefan van der Walt, Maxime Descoteaux, Ian Nimmo-Smith and DIPY Contributors
Keywords: DTI, DKI, dMRI, diffusion MRI, neuroimaging, tractography, Diffusion Imaging

Date added to MR-Hub: 2020-01-27
Date software last updated: 2023-10-19
No. of citations: 868
(main associated paper on Semantic Scholar)

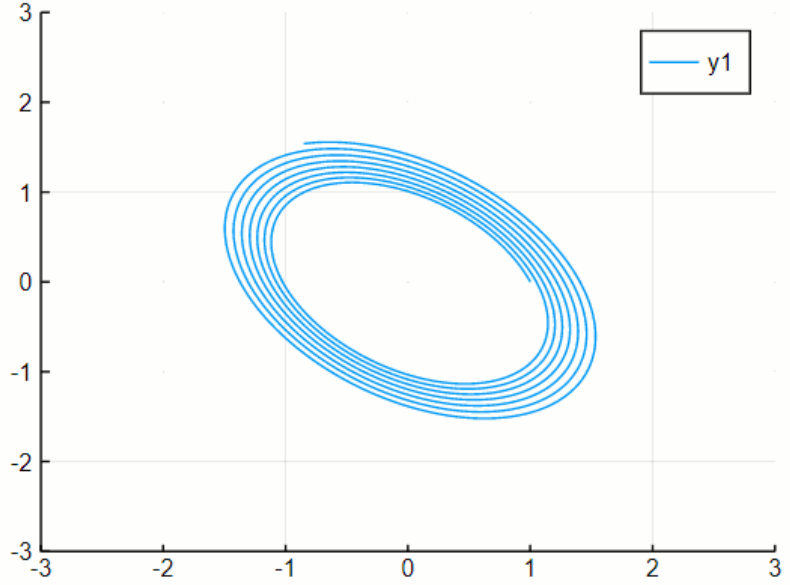
Pluto.jl (2020)



Massachusetts Institute of Technology

```
2×2 Array{Float64,2}:
 -0.4  -1.0
  1.0   0.41
```

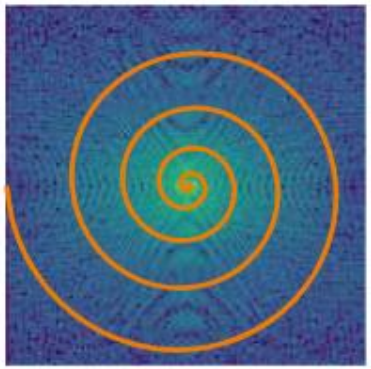
```
A = [ -.4 -1
       1  .41]
```




```
let
  x, y = integrate_ODE(A, 50.0)
  plot(x, y, xlims=(-3,3), ylims=(-3,3), size=
(400,300))
end
```

Each notebook also contains the package versions used

MRIReco.jl (2021)



Phantom

```
# create image
N = 128
x = shepp_logan(N)
```

Simulation

```
# create coil sensitivities
smaps = birdcageSensitivity(N,8,3.0)

# simulation parameters
params = Dict{Symbol, Any}()
params[:simulation] = "fast"
params[:trajName] = "SpiralVarDens"
params[:numProfiles] = 1
params[:windings] = 16
params[:numSamplingPerProfile] = 2048
params[:senseMaps] = smaps

# do simulation
acqData = simulation(x, params)
```

Reconstruction

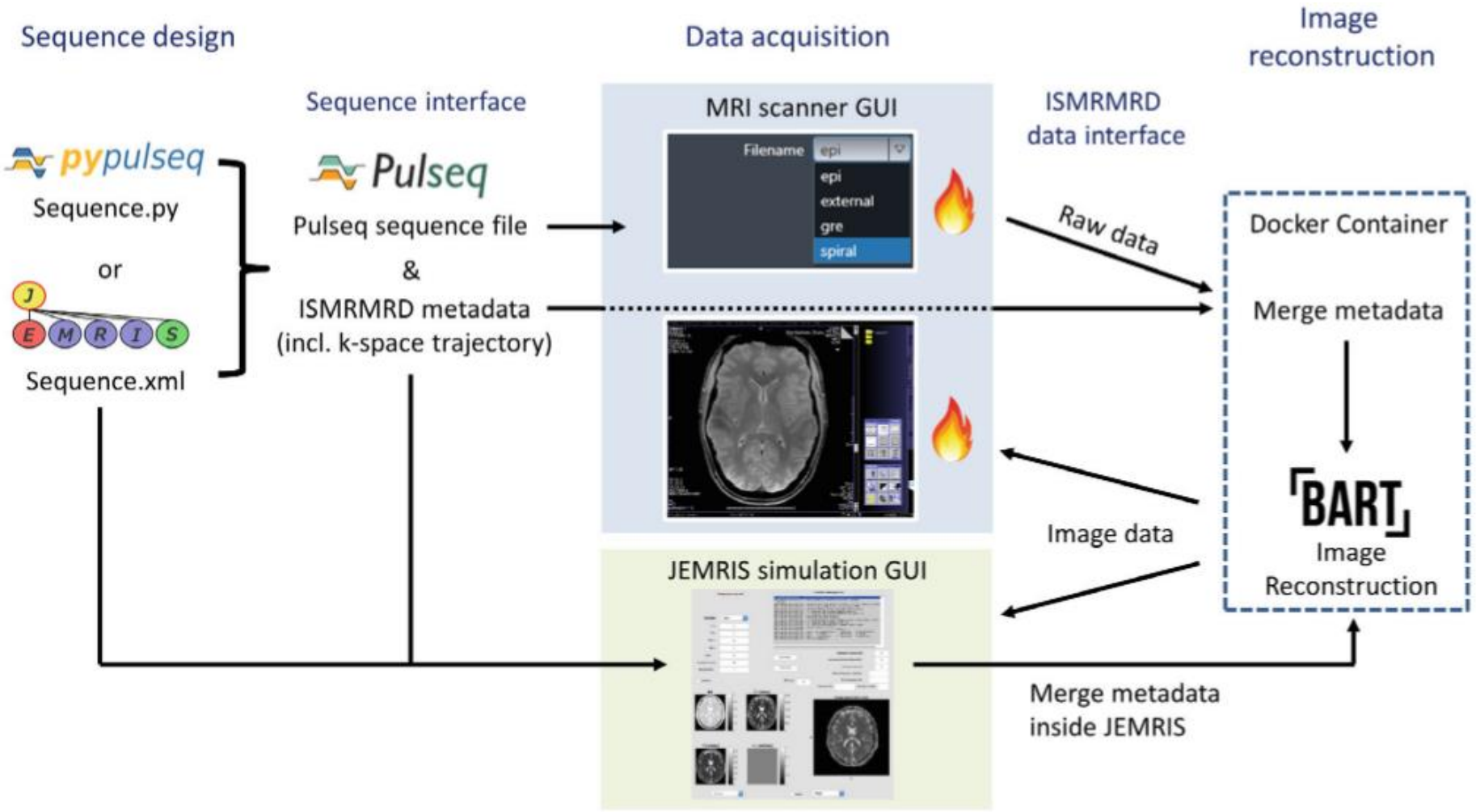
```
# reconstruction parameters
params[:reco] = "multiCoil"
params[:reconSize] = (N,N)
params[:regularization] = "TV"
params[:λ] = 2.0e-3
params[:solver] = "admm"
params[:iterationsInner] = 10
params[:iterations] = 30
params[:ρ] = 1.0e-1
params[:absTol] = 1.0e-5
params[:relTol] = 1.0e-4

# do reconstruction
y = reconstruction(acqData, params)
```

ISMRM REPRODUCIBLE RESEARCH (2021)

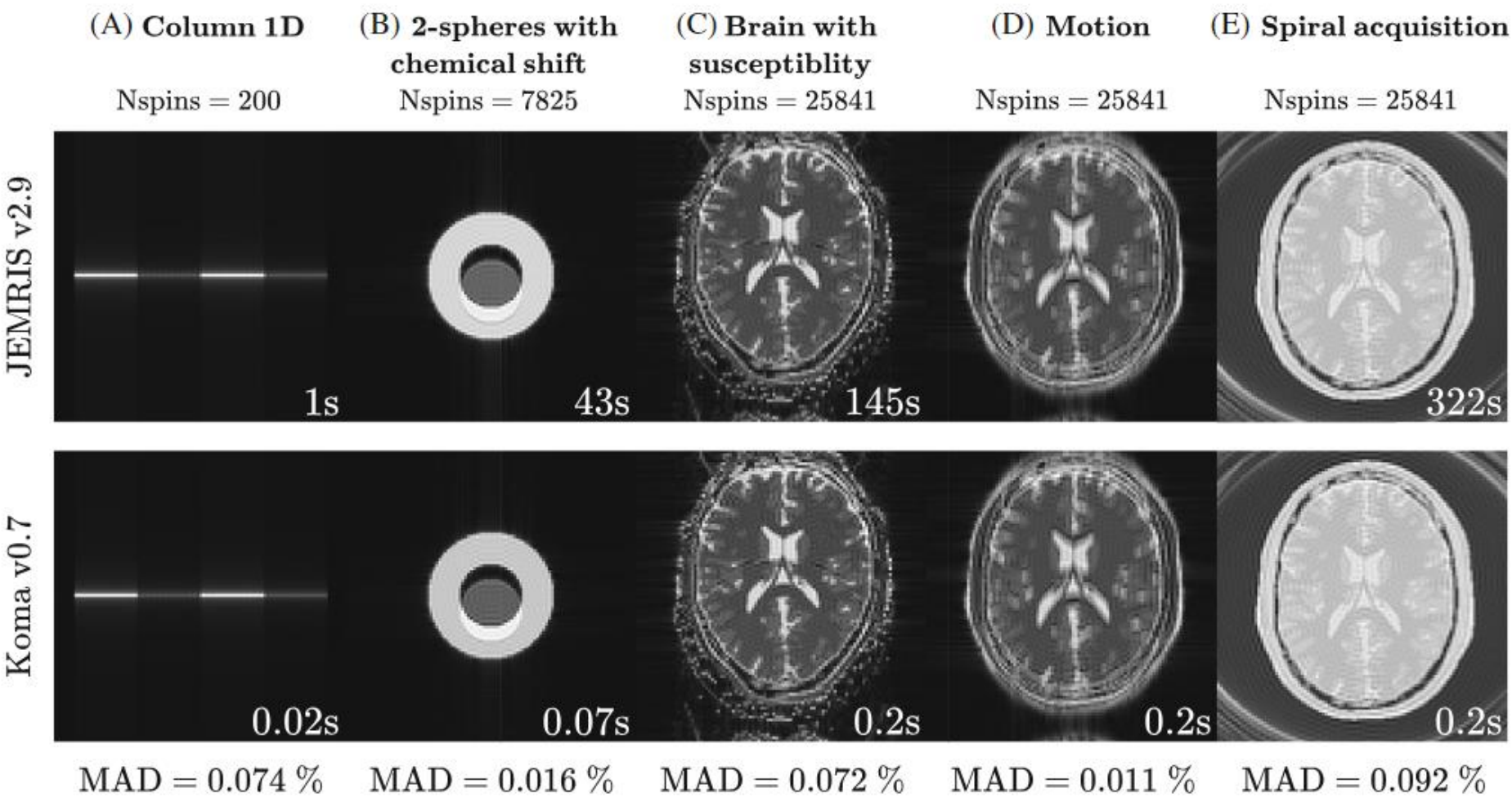
ISMRM | Reproducible Research STUDY GROUP

Open-source MRI pipeline (2022)



KomaMRI.jl (2023)

Pulseq



Your Contribution (202X)

- Be a part of the MRI open-source software history!