

Highlighting Reproducibility

About MRM Highlights and reproducible research practices

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Declaration of Financial Interests or Relationships

Speaker Name: Mathieu Boudreau

I have no financial interests or relationships to disclose with regard to the subject matter of this presentation.

What is MRM Highlights?

**MAGNETIC RESONANCE
IN MEDICINE**

ISMIRM

ONE
COMMUNITY
FOR CLINICIANS
AND SCIENTISTS



Three Pillars of Highlights



Monthly Interviews



Annual Magazine



ISMRM Afterparty

A brief history 2015-2019



Nikola Stikov
Polytechnique Montréal



Erika Raven
New York University School of Medicine



Atef Badji
Polytechnique Montréal



2020-2021: New Leadership

Digital Content



Mathieu Boudreau
Montreal Heart Institute



Atef Badji
Polytechnique Montréal

Magazine



Mark Chiew
University of Oxford



Maria Eugenia Caligiuri
Magna Graecia University

Current Format

- **One paper** is picked every month based on exemplary reproducible research practices.
- **Two blog posts**
 - Q&A blog post about authors and their paper.
 - *Reproducible Research Insights* blog post about their reproducible research practices.
- **Annual magazine** containing the interviews from the past year and some additional special features/interviews related to ISMRM.

EDITORIAL | [Free Access](#)

Reproducibility and the future of MRI research

Nikola Stikov✉, Joshua D. Trzasko, Matt A. Bernstein

First published: 10 August 2019 | <https://doi.org/10.1002/mrm.27939> | Citations: 7

SECTIONS



PDF



TOOLS



SHARE

Most would agree that transparency in science is an essential goal, but there are differing opinions on how open our science really should be. The questions surrounding open science and research transparency are particularly relevant for fields like magnetic resonance, in which much of the innovation over the past 50 years has been driven by intellectual property, including patents and copyrighted software, and there is a tight link between industry and academia.

Stikov, N., Trzasko, J.D. and Bernstein, M.A. (2019), *Reproducibility and the future of MRI research*. *Magn Reson Med*, 82: 1981-1983. <https://doi.org/10.1002/mrm.27939>



Mathieu Boudreau [Follow](#) Author

On the open source landscape of MRM



Being involved in several open source projects ([qMRLab](#), [AxonDeepSeg](#)) and initiatives dealing with open science in publishing ([NeuroLibre](#), [Canadian Open Neuroscience Platform](#)), I was curious to know what the current landscape of open source software/analysis sharing was in my own field - MR engineering for medical applications. I decided to investigate what the landscape of open source sharing was in one of the main journals of my field, Magnetic

<https://bit.ly/3ouFokl>

Total number of MRM papers (Jan to Nov 2019)	470
Open-source related keywords searched	open source, open-source, opensource, open science, github, git, osf, jupyter, notebook, octave, available online, released, shared, code
# of papers that matches at least one keyword	174
# of papers that actually linked to shared code and/or data	52 (~11% of total papers)
Most common coding language	MATLAB (81%)
Most common location where code is hosted	GitHub (65%)
% of papers having shared enough to potentially reproduce paper figures	12 %

Recent MRM Changes

Open Research

DATA AVAILABILITY STATEMENT

The code that supports the findings of this study is openly available in GitHub at <https://github.com/korbinian90/ROMEO.jl/tree/publication> . We plan continuous support and development of the software with the newest version available in <https://github.com/korbinian90/ROMEO> . The MRI data are available in Harvard Dataverse at <https://dataverse.harvard.edu/dataverse/ROMEO> .

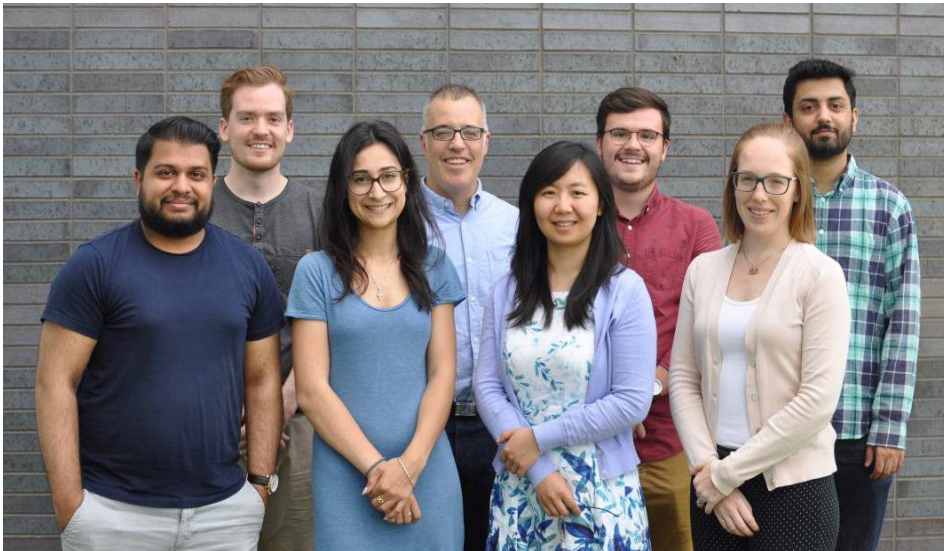
2020 Monthly Interviews

January

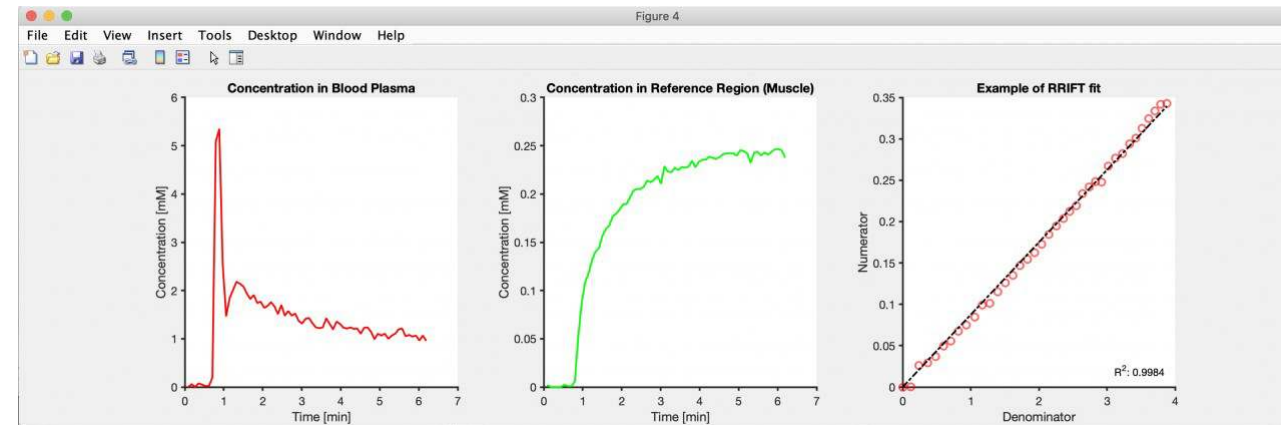
Paper

Pharmacokinetic modeling of dynamic contrast-enhanced MRI using a reference region and input function tail

Q&A with Zaki Ahmed and Ives Levesque



Reproducible Research Insights: Reproducible figures



February

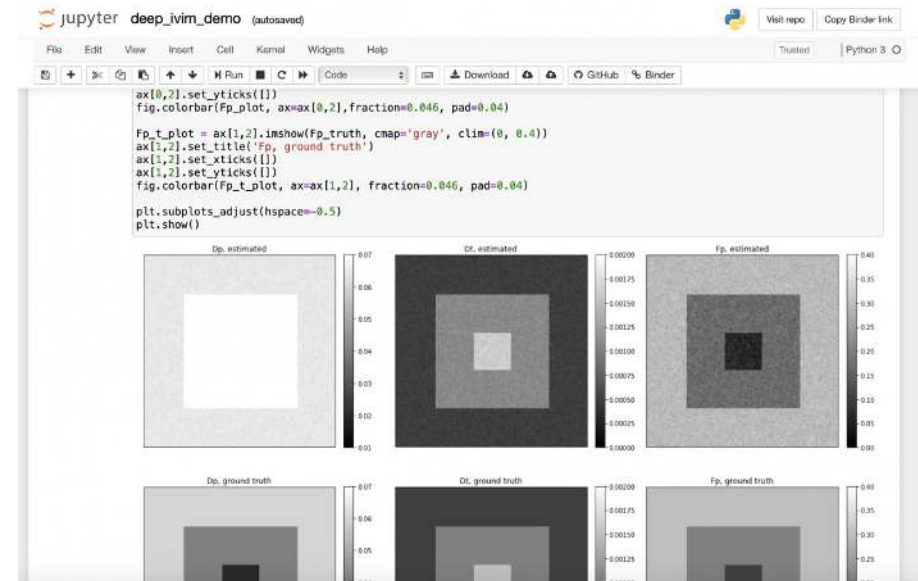
Paper

Deep learning how to fit an intravoxel incoherent motion model to diffusion-weighted MRI

Q&A with Sebastiano Barbieri, Oliver Gurney-Champion, and Harriet Thoeny



**Reproducible Research Insights:
Jupyter Notebooks**



March

Paper

Steady-state imaging with inhomogeneous magnetization transfer contrast using multiband radiofrequency pulses

Q&A with Shaihan Malik and Daniel West



Reproducible Research Insights: Documentation

ihMT_steadystate / README.md

Edit file Preview changes

```
1 # Steady-state ihMT sequences using multiband pulses
2 This software can be used for simulating the steady-state of bSSFP and SPGR MRI
3 sequences
4 when employing multi-band pulses in tissues with [inhomogeneous MT effects]
5 (https://onlinelibrary.wiley.com/doi/full/10.1002/nrm.25174)
6 and builds on prior work using non-selective multi-band RF pulses for [controlling
7 saturation of MT effects] (https://onlinelibrary.wiley.com/doi/10.1002/nrm.27442).
8
9 A paper describing the theory and experiments implemented in this repo is currently
10 under
11 review and links will be posted as soon as it is published. A related abstract was
12 presented at [ISMRM 2019 (#427)]
13 (https://cds.ismrm.org/protected/19MPresentations/abstracts/0427.html)
14
15 ==This code is distributed under the GNU General Public License v3 (see the included
16 [LICENSE](LICENSE.txt)). Please cite our work appropriately if you use it and link any
17 extensions back to this repo==
18
19 This code has been tested using Matlab R2018b. Please get in touch to report any bugs.
20
21 Shaihan Malik, King's College London, June 2019.
22 @shaihanmalik (https://twitter.com/shaihanmalik)
23
24 ## Biophysical model
```

README.md

Steady-state ihMT sequences using multiband pulses

This software can be used for simulating the steady-state of bSSFP and SPGR MRI sequences when employing multi-band pulses in tissues with inhomogeneous MT effects and builds on prior work using non-selective multi-band RF pulses for controlling saturation of MT effects.

A paper describing the theory and experiments implemented in this repo is currently under review and links will be posted as soon as it is published. A related abstract was presented at ISMRM 2019 (#427)

This code is distributed under the GNU General Public License v3 (see the included LICENSE). Please cite our work appropriately if you use it and link any extensions back to this repo.

This code has been tested using Matlab R2018b. Please get in touch to report any bugs.

Shaihan Malik, King's College London, June 2019. @shaihanmalik

Biophysical model

The code implements the model described by the following diagram:

The diagram illustrates a biophysical model with two main compartments: 'Free water' and 'Semisolid compartment'. The 'Free water' compartment contains magnetization states M_z^f , M_x^f , and M_y^f . The 'Semisolid compartment' contains 'non-dipolar' ordered states (M_z^s , M_x^s , M_y^s) and 'dipolar' ordered states (M_z^d , M_x^d , M_y^d). Transitions between these states are labeled with k and k' . A 'GR-recoupled RF' pulse is shown acting on the dipolar states.

April

Paper

Artificial neural network for myelin water imaging

Q&A with Jieun Lee and Jongho Lee

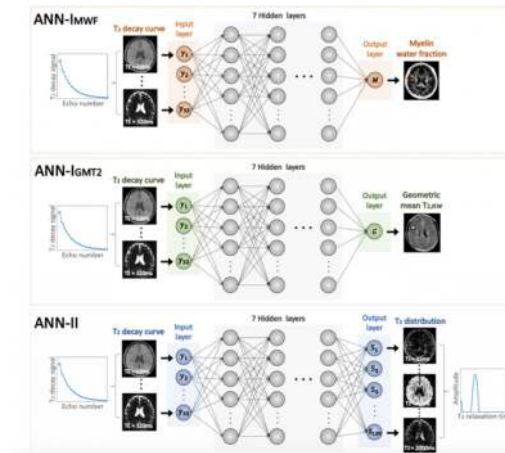


Reproducible Research Insights: Shared deep learning models

Artificial Neural Network for Myelin Water Imaging: ANN-MWI

Source code to train and test the network (.py), and data preprocessing (.m) from the manuscript "Artificial neural network for myelin water imaging", submitted to Magnetic Resonance in Medicine.

Overview

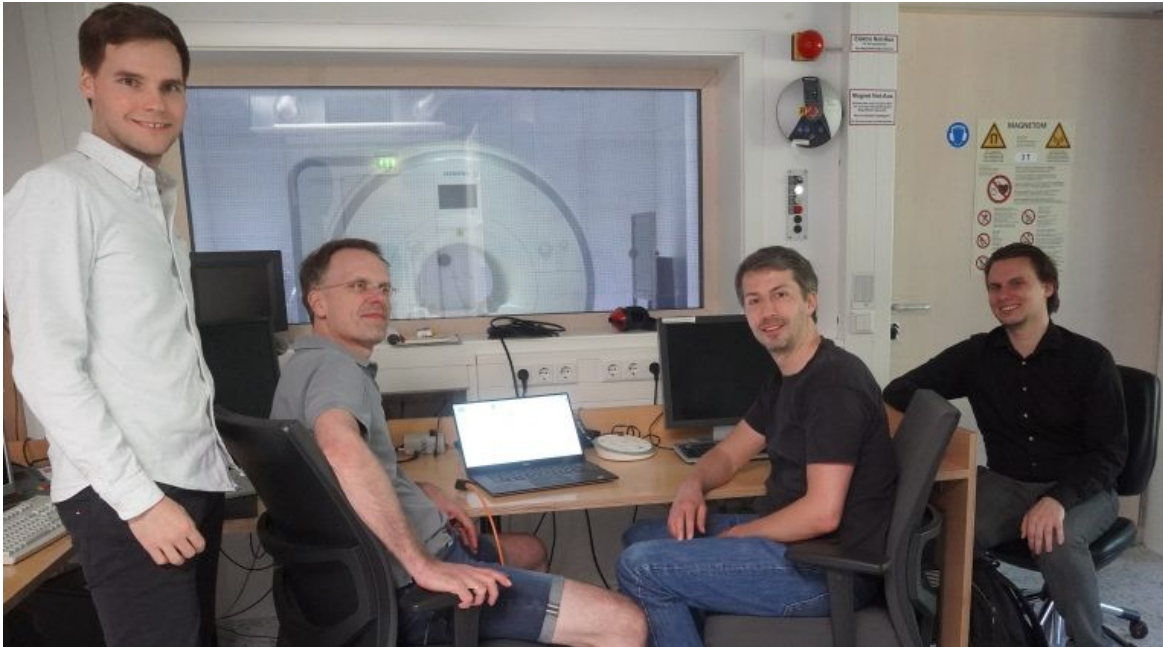


May

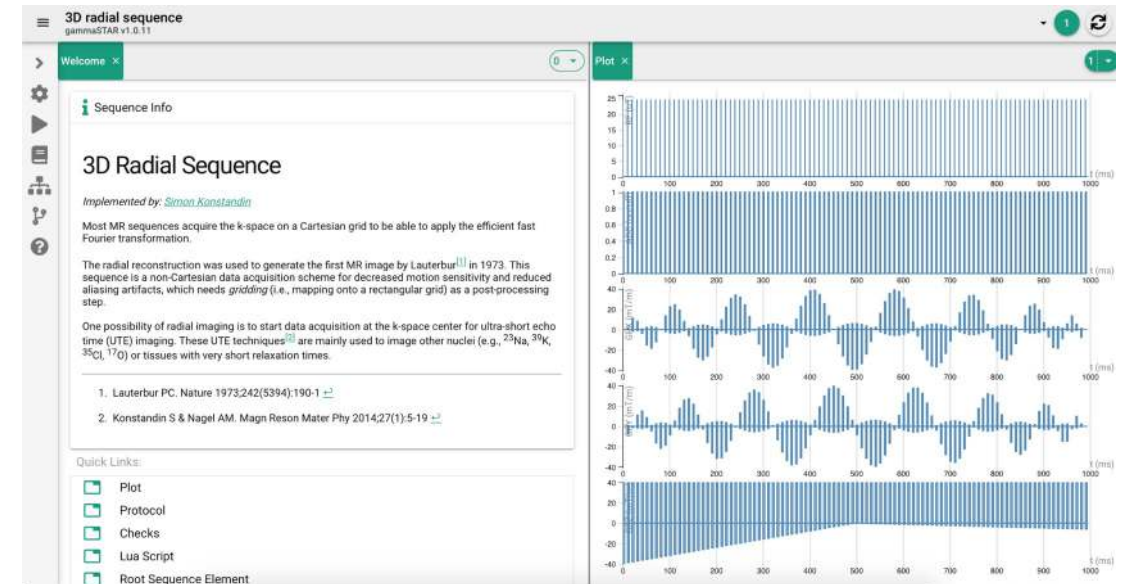
Paper

Portable and platform-independent MR pulse sequence program

Q&A with Cristoffer Cordes and Matthias Günther



Reproducible Research Insights: Docker



Contributor: Agah Karakuzu

June

Paper

FatSegNet: a fully automated deep learning pipeline for adipose tissue segmentation on abdominal Dixon MRI

Q&A with Santiago Estrada and Martin Reuter



Reproducible Research Insights: Dockerfiles

```
33 lines (22 sloc) 766 Bytes
1  ## start with the Docker 'base Tensorflow1.4 for python3' Debian-based image
2
3  #FROM tensorflow/tensorflow:1.6.0-py3
4  FROM tensorflow/tensorflow:1.6.0-gpu-py3
5  #FROM tensorflow/tensorflow:latest-gpu-py3
6  ##Install custom libraries
7
8  RUN apt-get update && apt-get install -y --no-install-recommends \
9      python3-tk
10
11 # install dependencies from python packages
12 RUN pip3 --no-cache-dir install \
13     pandas==0.21.0 \
14     scikit-learn==0.19.1 \
15     scipy==1.1.0 \
16     scikit-image==0.15.0 \
17     SimpleITK==1.1.0 \
18     nibabel==2.2.1 \
19     keras==2.2.4 \
20     numpy==1.15.4
21
22
23
24
25
26 ## Copying application code (present working directory) and configuration to docker image
27 COPY ./tool /tool
28 WORKDIR "/tool"
29 RUN bash /tool/bash_profile
30
31
32 ENTRYPOINT ["python3","./run_FatSegNet.py"]
33
```

Contributor: Emilie McKinnon

July

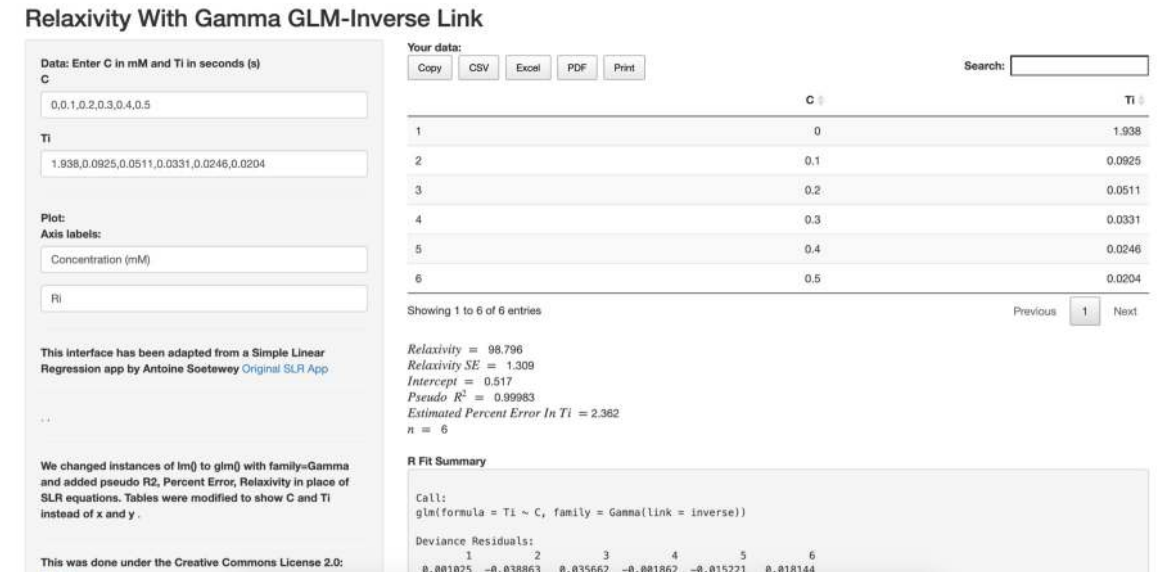
Paper

A novel gamma GLM approach to MRI relaxometry comparisons

Q&A with Rohan Kapre and Angelique Y. Louie



Reproducible Research Insights: RShiny Dashboard



Contributor: Mathieu Boudreau

August

Paper

Myelin water fraction estimation using small-tip fast recovery MRI

**Q&A with Steven Whitaker, Jon-Fredrik Nielsen
and Jeff Fessler**



**Reproducible Research Insights:
Reproducible figures & Julia**



Contributor: Jessica McKay

September

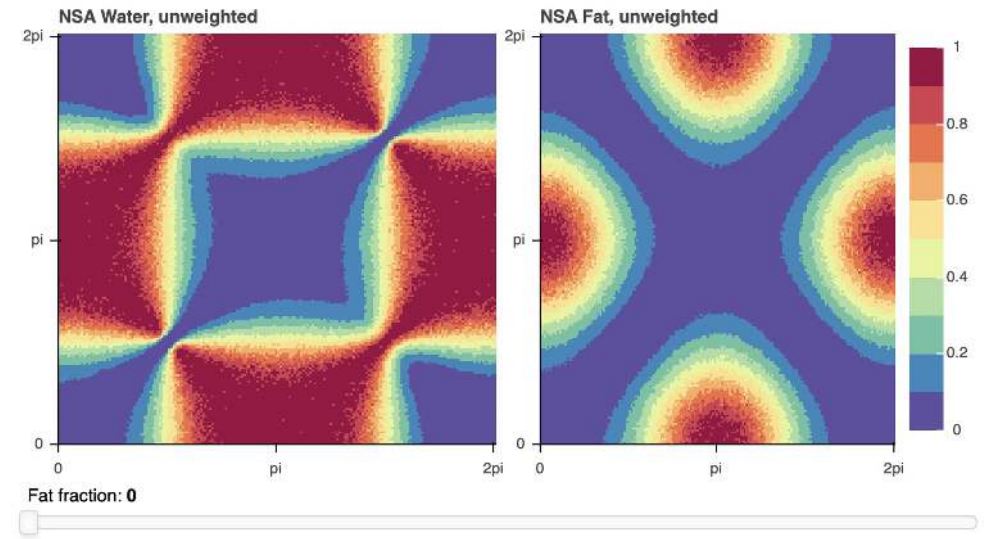
Paper

RARE two-point Dixon with dual bandwidths

Q&A with Henric Rydén and Stefan Skare



Reproducible Research Insights: Interactive figures & Bokeh



October

Paper

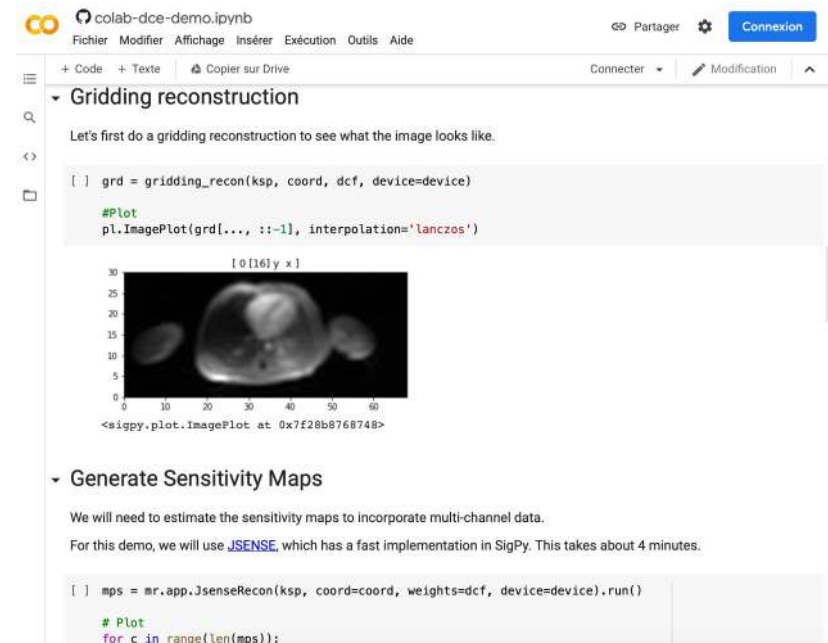
Extreme MRI: Large-scale volumetric dynamic imaging from continuous non-gated acquisitions

Q&A with Frank Ong and Miki Lustig



Contributor: Nikola Stikov

Reproducible Research Insights: Google Colab



November

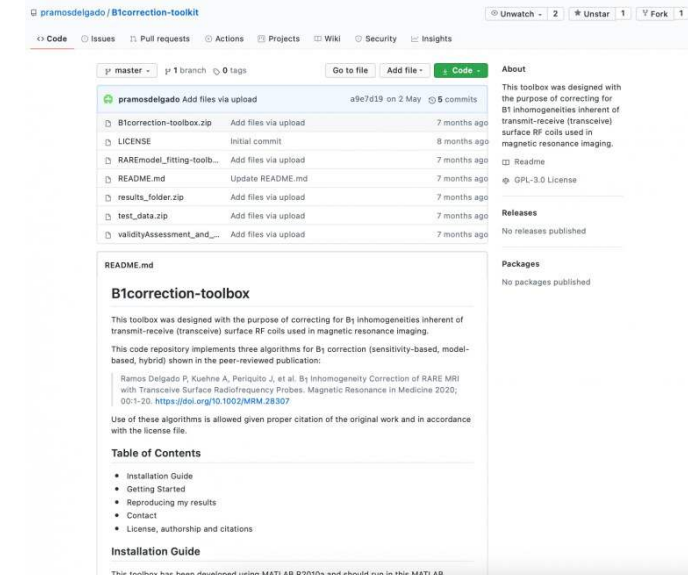
Paper

B1 inhomogeneity correction of RARE MRI with transceive surface radiofrequency probes

Q&A with Paula Ramos Delgado and Thoralf Niendorf



Reproducible Research Insights: Good documentation



2021 MRM Highlights Magazine



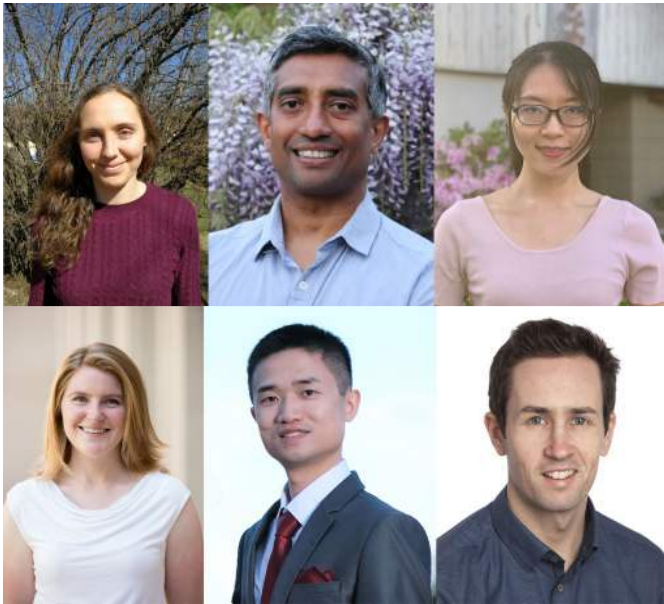
**Presidential
Interview**



**Equity, Diversity
and Inclusion**



Mark Henkelman



**Young Investigator Awards
finalists**



**Canadian
Researcher
Profiles**

Do I **need** to....

- be a software engineer?
- have advanced coding skills?
- have well-organized documentation?
- have fancy things in my tests?
- have scripts that reproduce all my data analysis?

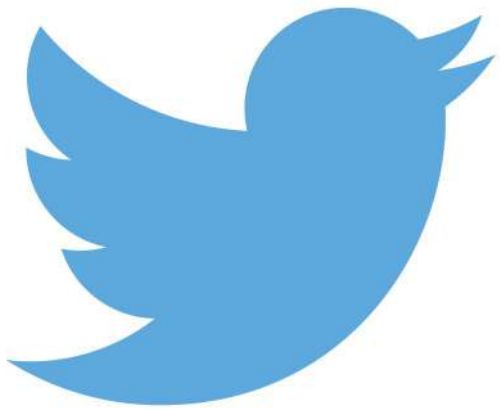
...to share code with my papers?

On Reproducibility

Recurring questions we ask authors that we highlight

- **Why did you choose** to share your code/data?
- What is your **lab or institutional policy** on code/data sharing?
- **At what stage** did you decide to share your code/data?
- **How can we encourage researchers** in the MRI community to contribute more open-source code along with their research papers?
- Are there any **other reproducible research habits** that you haven't used for this paper but might be interested in trying in the future?

Where to find us



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Where to find us

MRM Author-Reader Dialog Forum



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Categories

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MRM Papers Author-reader discussions on papers published in Magnetic Resonance in Medicine. Volume 85(6) - June 2021 Volume 85(5) - May 2021 Volume 85(4) - April 2021 Volume 85(3) - March 2021 Volume 85(2) - February 2021 Volume 85(1) - January 2021 Volume 86(1)	59	 Code of Conduct 1 Site Feedback Jan 22
MRM Highlights Monthly MRM Highlights author Q&As and reproducible research insights blog posts.	9	 MRM Highlights Magazine – Volume 6 0 MRM Highlights Magazine 4d
MRM Highlights Magazine Annual MRM Highlights magazine published during the ISMRM meeting.	1	 Parallel transmit optimized 3D composite adiabatic spectral-spatial pulse for spectroscopy 0 Volume 86(1) 6d
		 Unshielded bent folded-end dipole 9.4 T human head transceiver array decoupled using modified passive dipoles 0 Volume 86(1) 6d

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Recent Contributors



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Pinar S. Özbay



Emilie McKinnon



Stefano Mandija

The MR-Pub Competition

Call for submission of interactive code demos



**Show us your work &
win awards!**

Deadline - May 30

Details here:

<https://ismrm.github.io/mrpub/>