POLYTECHNIQUE MONTRÉAL

LE GÉNIE EN PREMIÈRE CLASSE

INSTITUT DE CARDIOLOGIE DE MONTRÉAL

NeuroPoly

NeuroLibre: Taking papers to their logical conclusion

Nikola Stikov

École Polytechnique/Montreal Heart Institute
University of Montreal

Center for Advanced Interdisciplinary Research
University Ss Cyril and Methodius

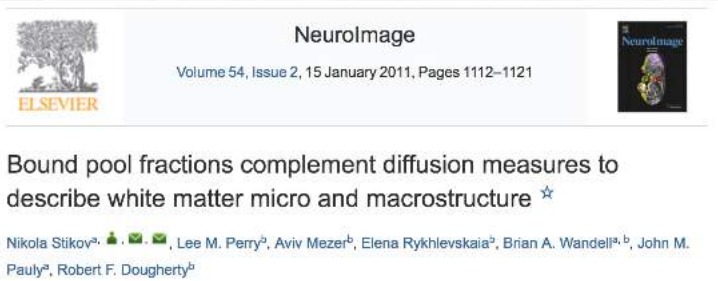
My path

Stanford | Magnetic Resonance Systems Research Laboratory

OVERVIEW PUBLICATIONS PEOPLE ALUMNI PICTURES FINDING US PRIVATE

$$SNR \propto \sqrt{Time}$$

My publishing timeline

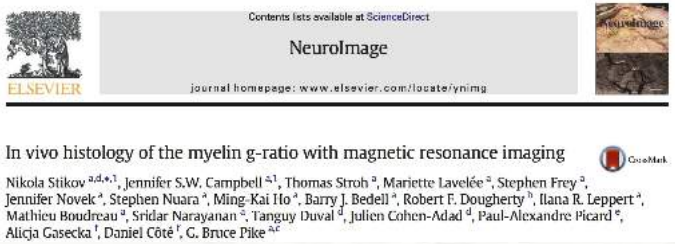


NeuroImage

Volume 54, Issue 2, 15 January 2011, Pages 1112–1121

Bound pool fractions complement diffusion measures to describe white matter micro and macrostructure ☆

Nikola Stikov[a], Lee M. Perry[a], Aviv Mezer[b], Elena Rykhlevskaia[a], Brian A. Wandell[a, b], John M. Pauly[a], Robert F. Dougherty[b]



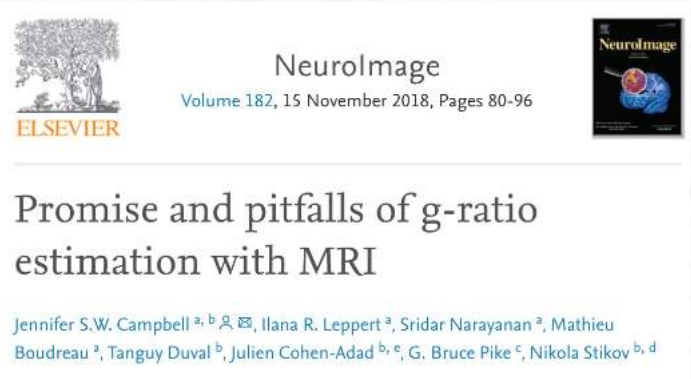
Contents lists available at ScienceDirect

NeuroImage

journal homepage: www.elsevier.com/locate/ynimg

In vivo histology of the myelin g-ratio with magnetic resonance imaging

Nikola Stikov [a,d,*,1], Jennifer S.W. Campbell [a,1], Thomas Stroh [a], Mariette Lavelée [a], Stephen Frey [a], Jennifer Novek [a], Stephen Nuara [a], Ming-Kai Ho [a], Barry J. Bedell [a], Robert F. Dougherty [b], Ilana R. Leppert [a], Mathieu Boudreau [a], Sridar Narayanan [a], Tanguy Duval [d], Julien Cohen-Adad [d], Paul-Alexandre Picard [e], Alicja Gasecka [f], Daniel Côté [f], G. Bruce Pike [a,c]

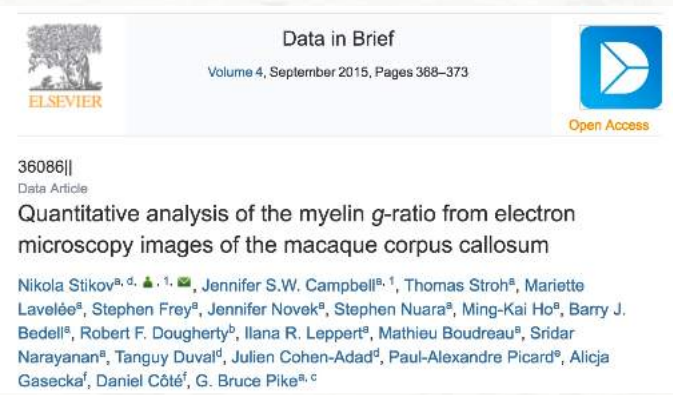


NeuroImage

Volume 182, 15 November 2018, Pages 80-96

Promise and pitfalls of g-ratio estimation with MRI

Jennifer S.W. Campbell [a, b], Ilana R. Leppert [a], Sridar Narayanan [a], Mathieu Boudreau [a], Tanguy Duval [b], Julien Cohen-Adad [b, e], G. Bruce Pike [c], Nikola Stikov [b, d]



Data in Brief

Volume 4, September 2015, Pages 368–373

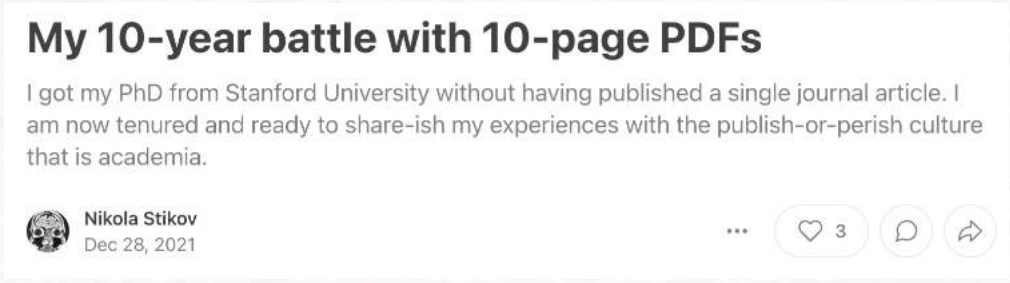
Open Access

36086||

Data Article

Quantitative analysis of the myelin *g*-ratio from electron microscopy images of the macaque corpus callosum

Nikola Stikov[a, d], Jennifer S.W. Campbell[a, 1], Thomas Stroh[a], Mariette Lavelée[a], Stephen Frey[a], Jennifer Novek[a], Stephen Nuara[a], Ming-Kai Ho[a], Barry J. Bedell[a], Robert F. Dougherty[b], Ilana R. Leppert[a], Mathieu Boudreau[a], Sridar Narayanan[a], Tanguy Duval[d], Julien Cohen-Adad[d], Paul-Alexandre Picard[e], Alicja Gasecka[f], Daniel Côté[f], G. Bruce Pike[a, c]



My 10-year battle with 10-page PDFs

I got my PhD from Stanford University without having published a single journal article. I am now tenured and ready to share-ish my experiences with the publish-or-perish culture that is academia.

Nikola Stikov
Dec 28, 2021

3

https://qantarot.substack.com/p/10-page-pdfs

Science communication

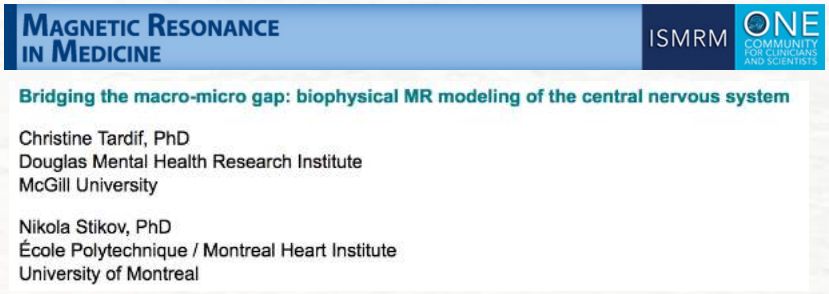
www.humanbrainmapping.org/blog

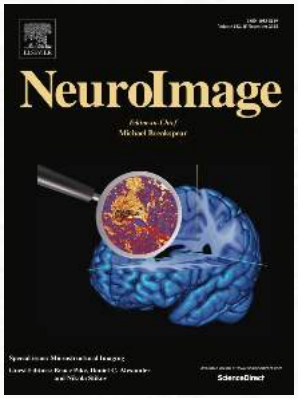
www.ismrm.org/mrm

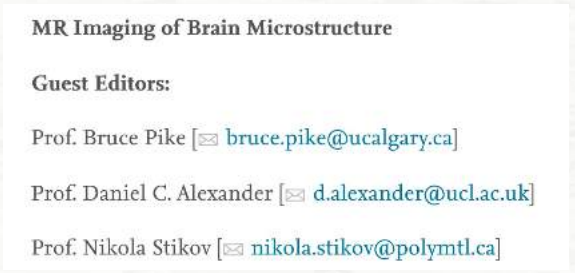
blog.ismrm.org

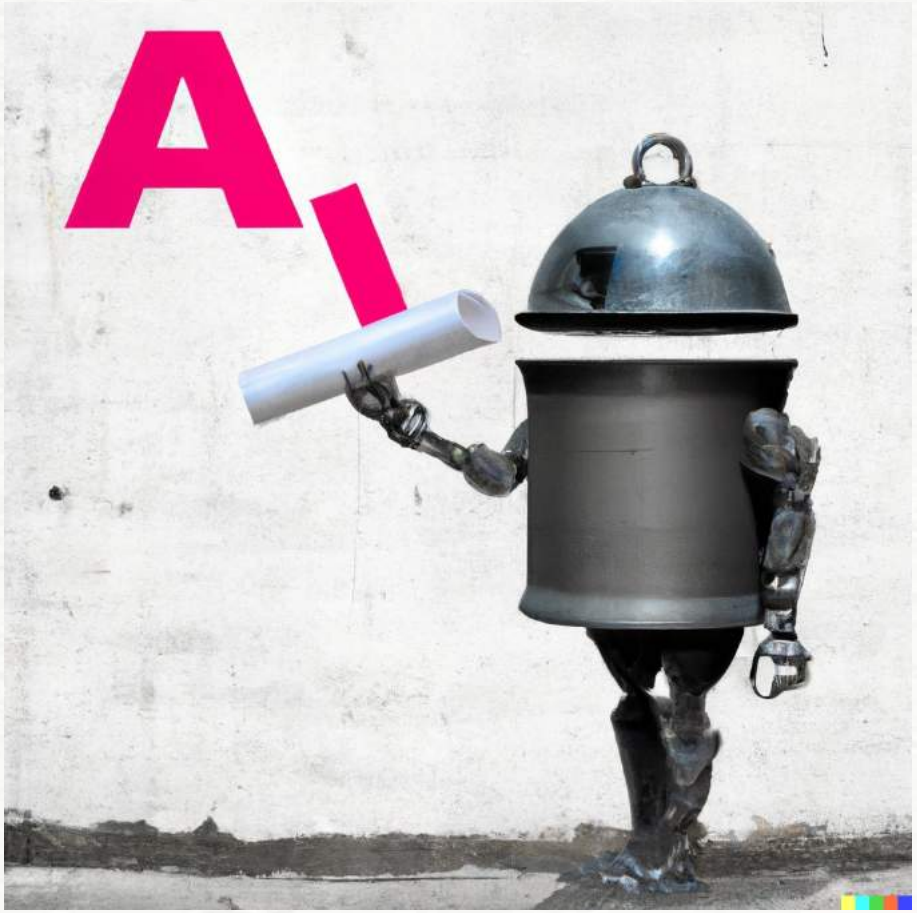
naukazadeca.mk

qantarot.substack.com









Prompt: Artificial intelligence swallowing an academic article, Banksy style. AI image generated by DALL-E

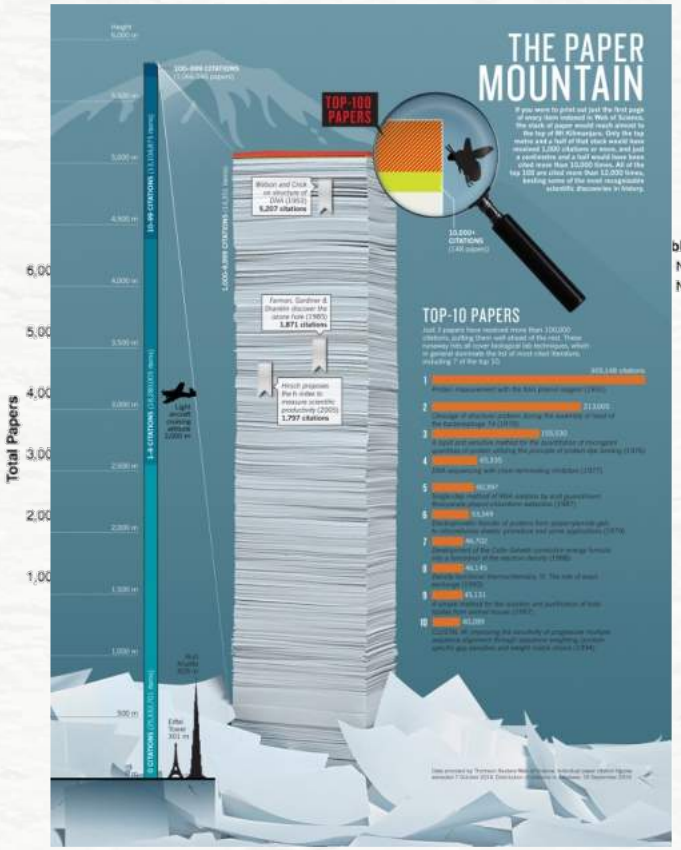
SHARE-ISH

ChatGPT and Galactica are taking scientific papers to their logical conclusion

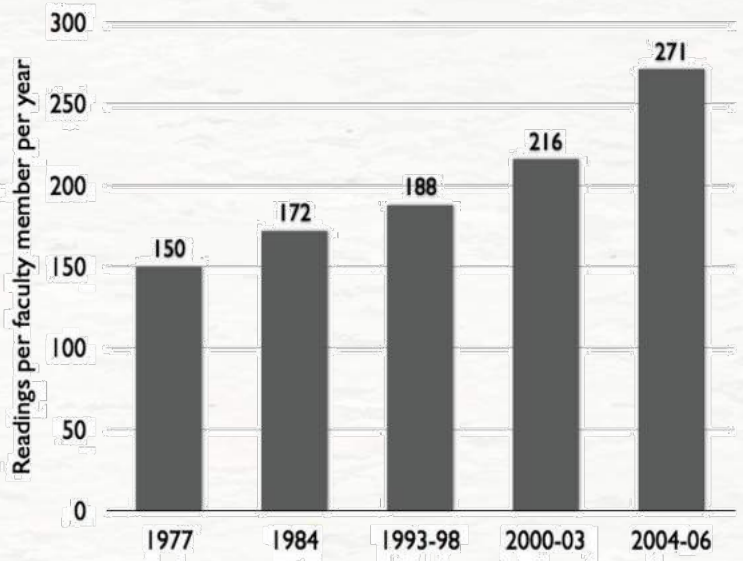
> "... taken to its logical conclusion, every story is sad, because at the end everyone dies."
> — Margaret Atwood, The Blind Assassin

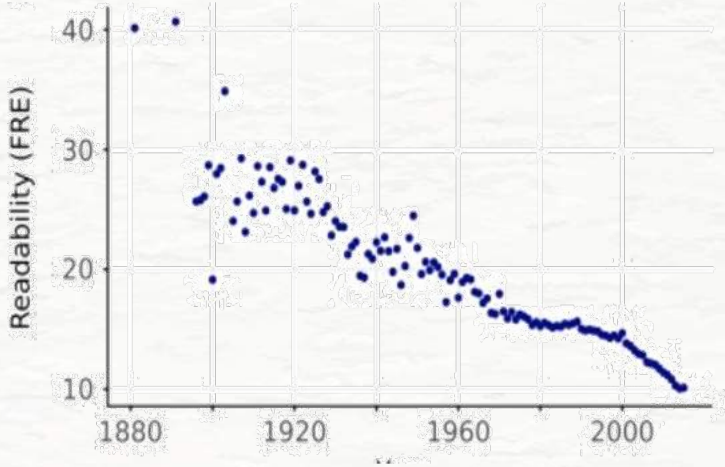
https://qantarot.substack.com/p/chatgpt-and-galactica-are-taking

The PDF crisis



https://www.nature.com/news/the-top-100-papers-1.16224
https://www.stm-assoc.org/2015_02_20_STM_Report_2015.pdf





https://elifesciences.org/articles/27725
https://academic.oup.com/gigascience/article/8/6/giz053/5506490

Research Debt

https://distill.pub/2017/research-debt/

The Scientific Paper Is Obsolete

Here's what's next.

https://www.theatlantic.com/science/archive/2018/04/the-scientific-paper-is-obsolete/556676/

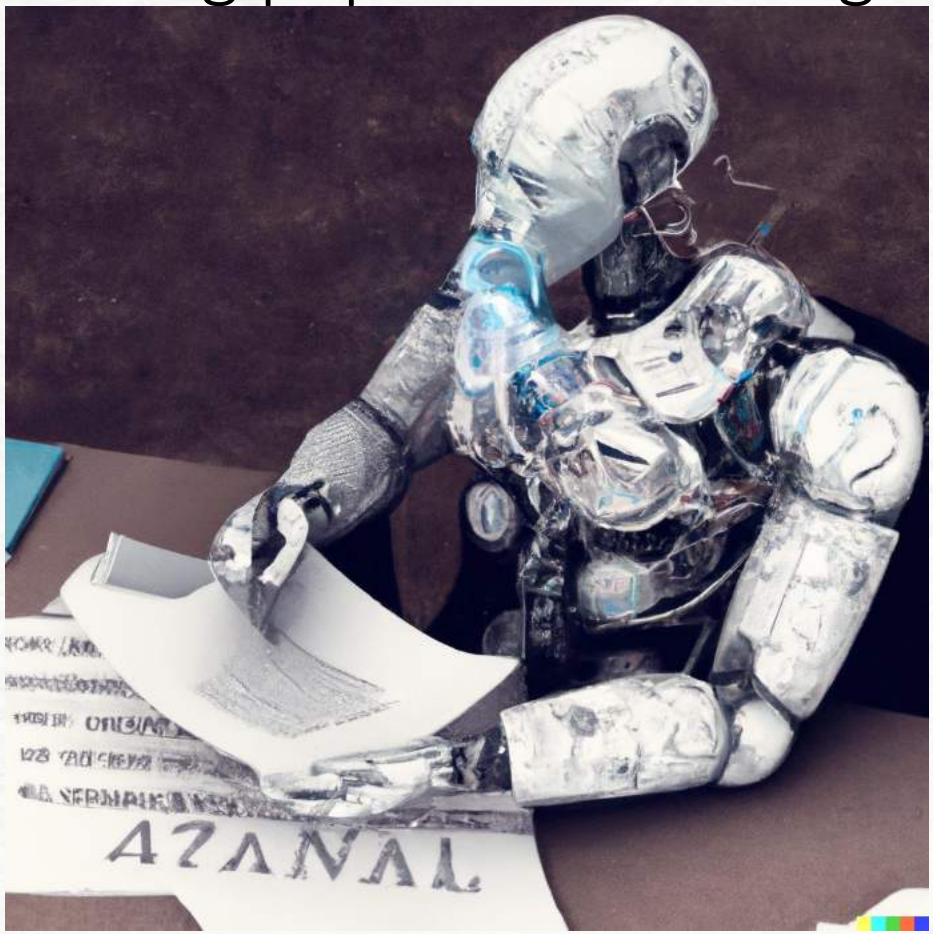
The Business of Extracting Knowledge from Academic Publications

December 7, 2021. Send your thoughts via twitter or mail

Close to nothing of what makes science actually work is published as text on the web

https://markusstrasser.org/extracting-knowledge-from-literature/

Taking papers to their logical conclusion



Prompt: Artificial intelligence eating a word salad and outputting an academic paper, digital art. AI image generated by DALL-E

Papers with Code
@paperswithcode

🪐 Introducing Galactica. A large language model for science.

Can summarize academic literature, solve math problems, generate Wiki articles, write scientific code, annotate molecules and proteins, and more.

Explore and get weights: galactica.org

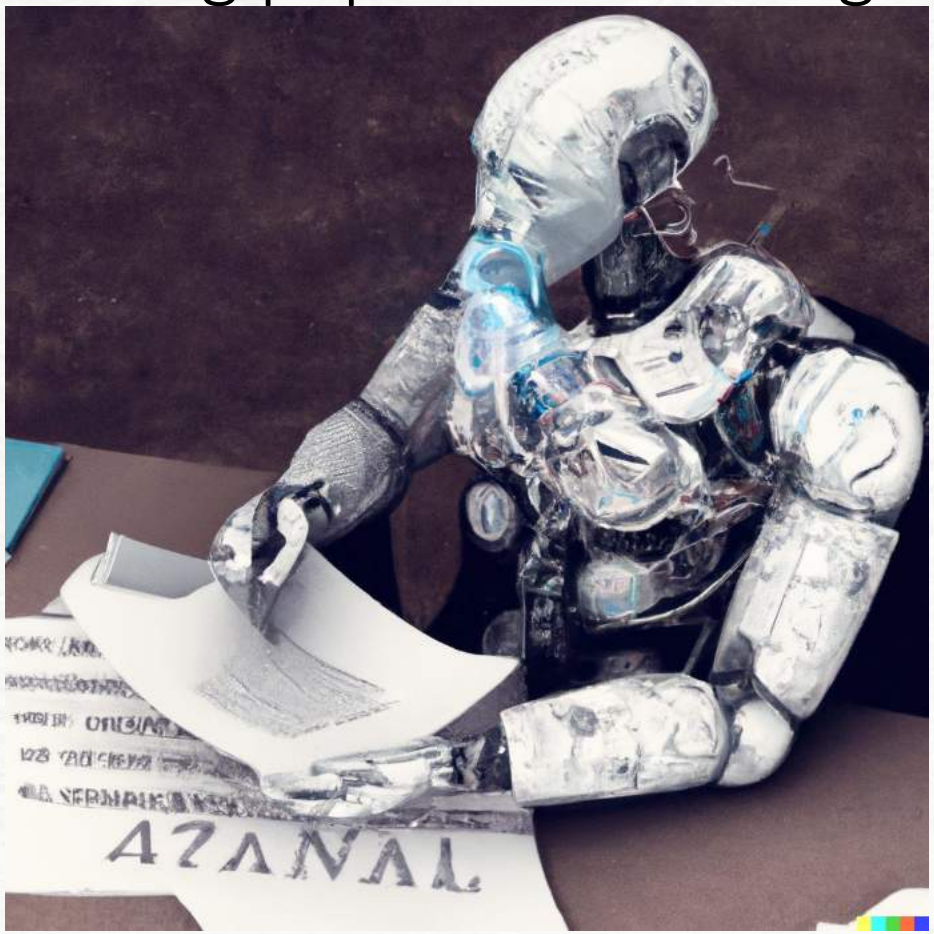
https://twitter.com/paperswithcode/status/1592546933679476736

Yann LeCun @ylecun · Nov 15
This tool is to paper writing as driving assistance is to driving.
It won't write papers automatically for you, but it will greatly reduce your cognitive load while you write them.

> **Yann LeCun** @ylecun · Nov 15
> A Large Language Model trained on scientific papers.
> Type a text and galactica.ai will generate a paper with relevant references, formulas, and everything.
>
> Amazing work by @MetaAI / @paperswithcode
> Show this thread

https://twitter.com/ylecun/status/1592677381818691584

Taking papers to their logical conclusion



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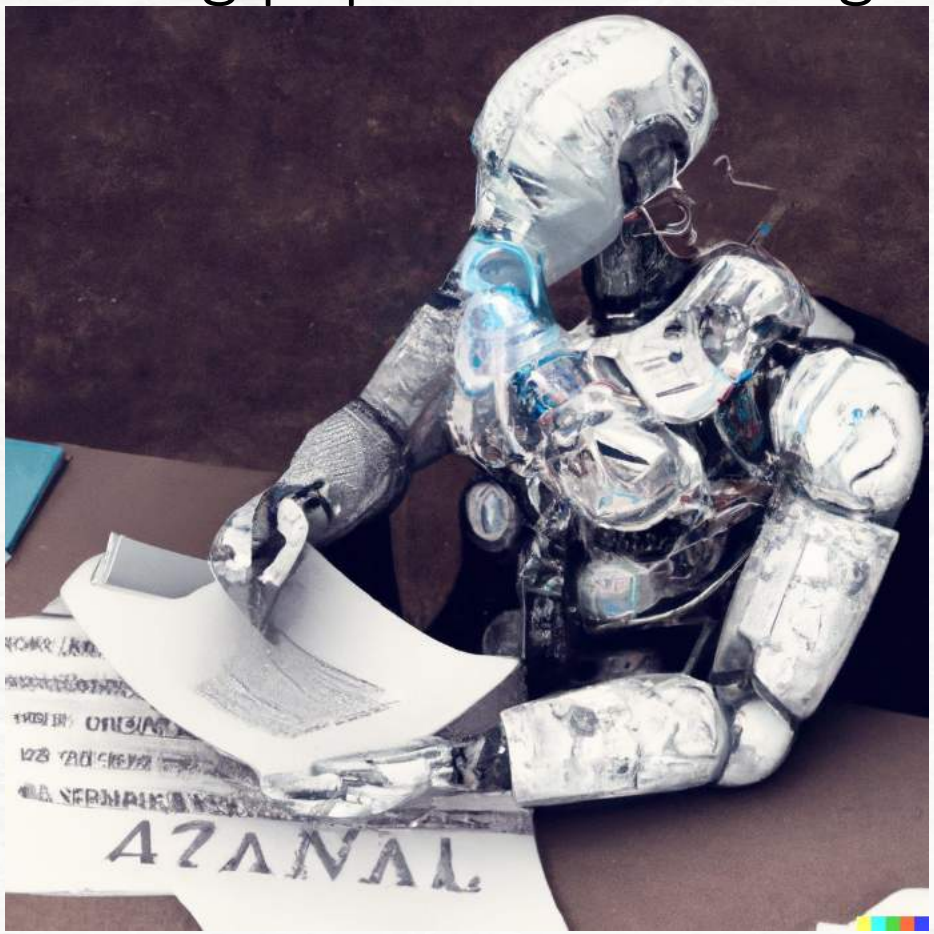
Michael Black
@Michael_J_Black

I asked #Galactica about some things I know about and I'm troubled. In all cases, it was wrong or biased but sounded right and authoritative. I think it's dangerous. Here are a few of my experiments and my analysis of my concerns. (1/9)

https://twitter.com/Michael_J_Black/status/1593133722316189696

Taking papers to their logical conclusion



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Vendor neutral MRI pulse sequences for qMRI

The vendor neutral MRI pulse sequences were developed by researchers at the National Institute of Standards and Technology (NIST) and the National Institutes of Health (NIH) as part of the Quantitative Imaging Network (QIN).

The sequences are designed to be compatible with both 1.5 T and 3 T scanners from multiple vendors and to facilitate the measurement of relaxation times and proton density (T1, T2, and PD) in the brain.

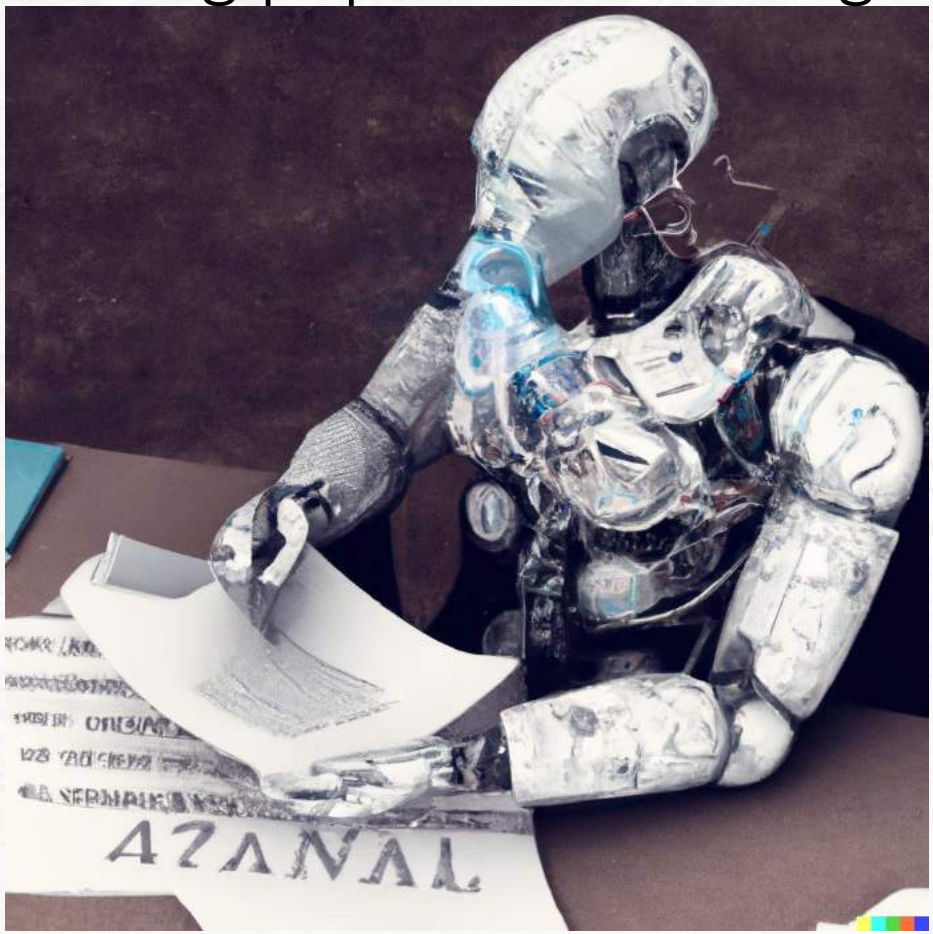
The pulse sequences and processing software are available for free download and use.

The sequences and processing software were designed to be used with phantoms, but can also be used for in vivo studies.

This sequence repository can be used for both research and educational purposes.

For more information on the sequences, please refer to the pulse sequence references listed below.

Taking papers to their logical conclusion



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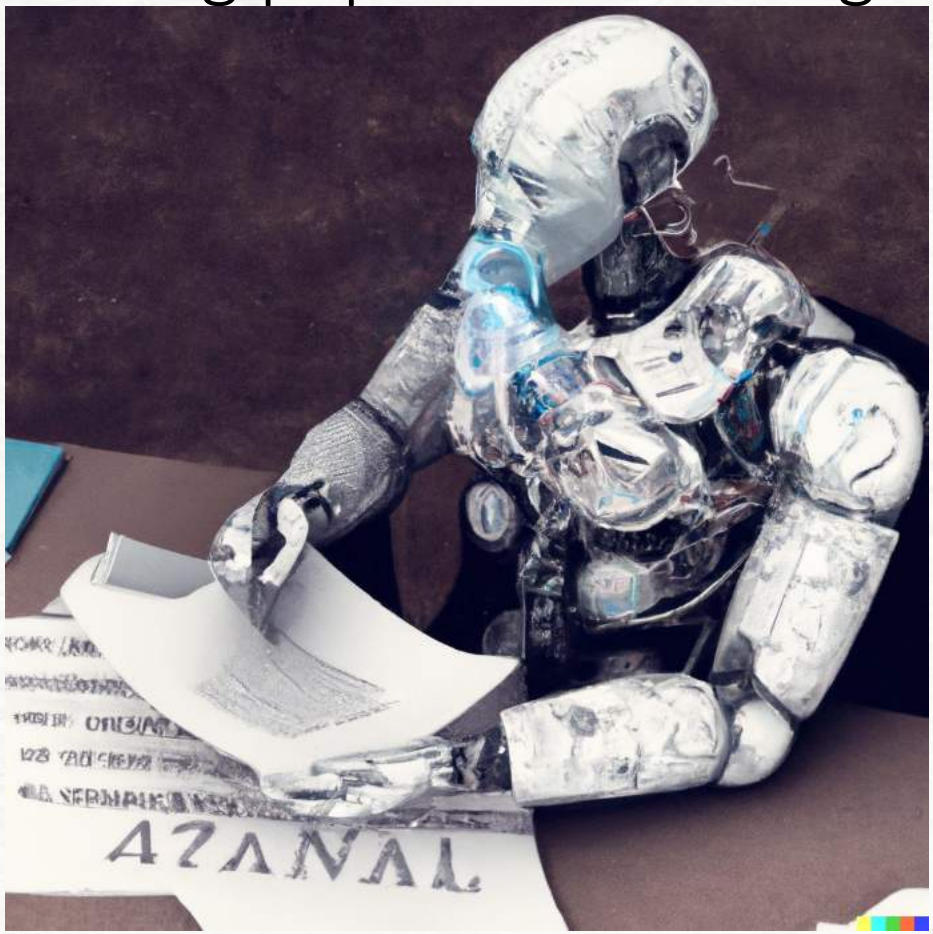
https://twitter.com/paperswithcode/status/1592546933679476736

Bojan Tunguz
@tunguz

I believe that scientific papers are vestiges of the bygone era, especially in the fields of DS/ML/AI. IMHO, ML researchers should skip paper/arXiv altogether. Just publish the code and your data. Explain what code does. Publish a few benchmarking scripts. That's it.

Taking papers to their logical conclusion



Prompt: Artificial intelligence eating a word salad and outputting an academic paper, digital art. AI image generated by DALL-E

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Can summarize academic literature, solve math problems, generate Wiki articles, write scientific code, annotate molecules and proteins, and more.

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https://twitter.com/paperswithcode/status/1592546933679476736

vitalik.eth
@VitalikButerin

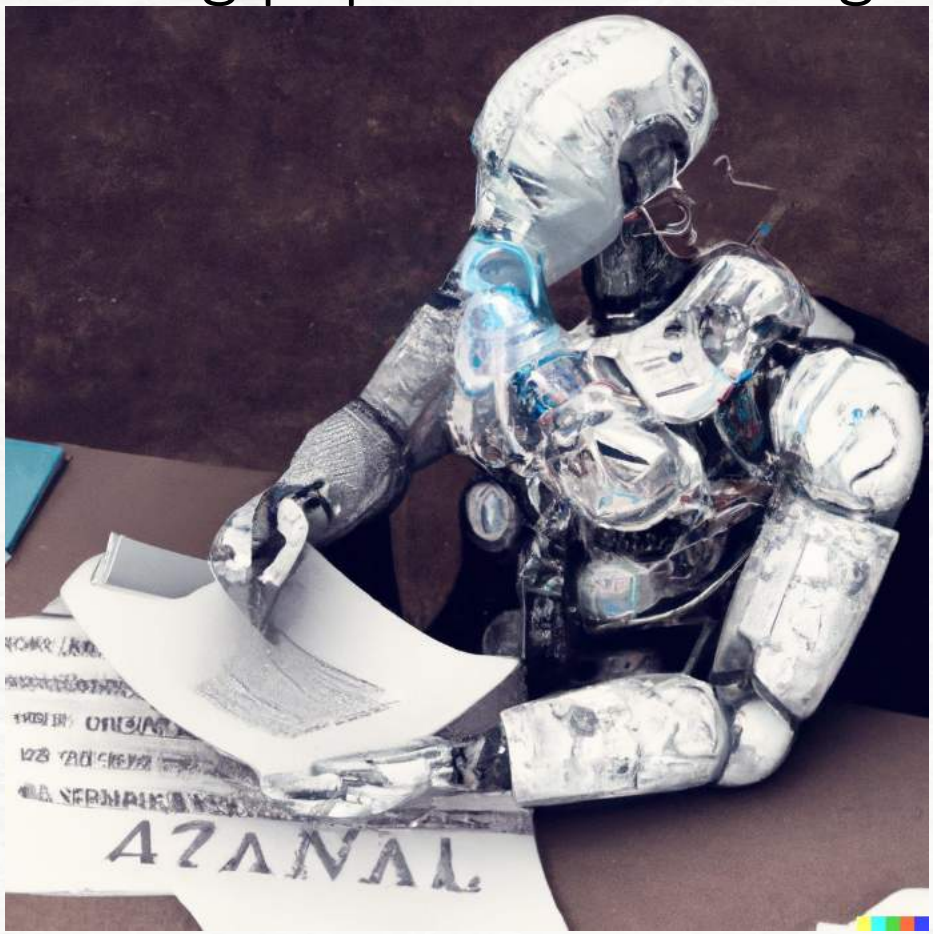
Replying to @tylercowen

My theory is different: the AI-driven commoditization of articulateness in elite registers of the English language is going to degrade its value, and by extension further degrade the social status of those who depend on it as a status marker.

9:48 AM · Nov 23, 2022

https://twitter.com/VitalikButerin/status/1595429084116520962

Taking papers to their logical conclusion



Prompt: Artificial intelligence eating a word salad and outputting an academic paper, digital art. AI image generated by DALL-E

This is not necessarily a bad thing. As science is getting more computational, papers will either evolve or die. Either way, the academic article of the future will be nothing like the 10-page word salads that AI now so successfully emulates. The question is what will become of the academic paper once you take away the prose?

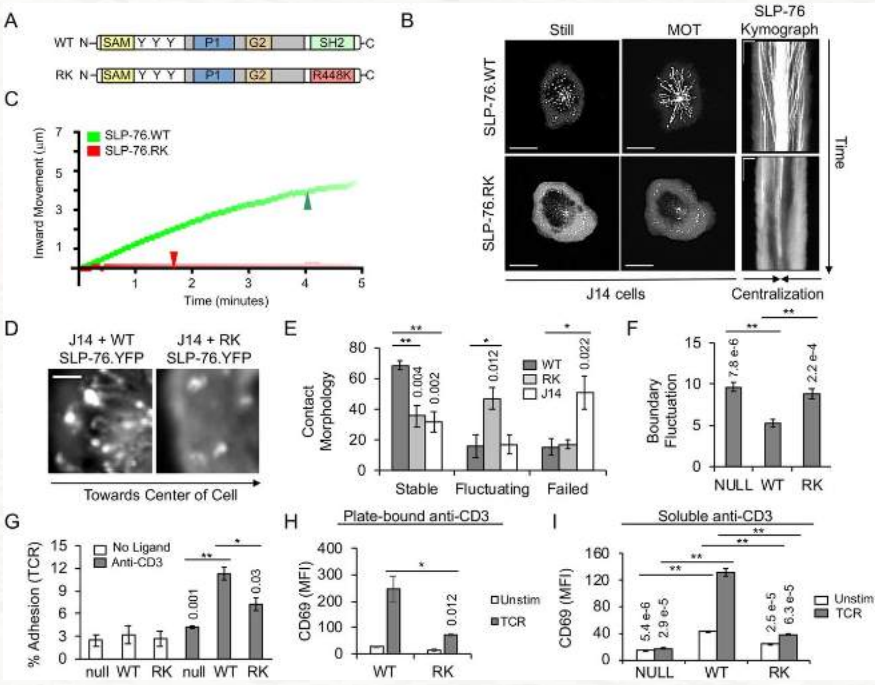
https://qantarot.substack.com/p/chatgpt-and-galactica-are-taking

WHAT REMAINS WHEN YOU TAKE AWAY THE PROSE?

Nicolas Andry
L'orthopédie (1741)

FIGURES

279 years



A typical figure in Nature

Slide courtesy of Agâh Karakuzu

Research Papers Used to Have Style. What Happened?

A Brief History of Scientific Writing

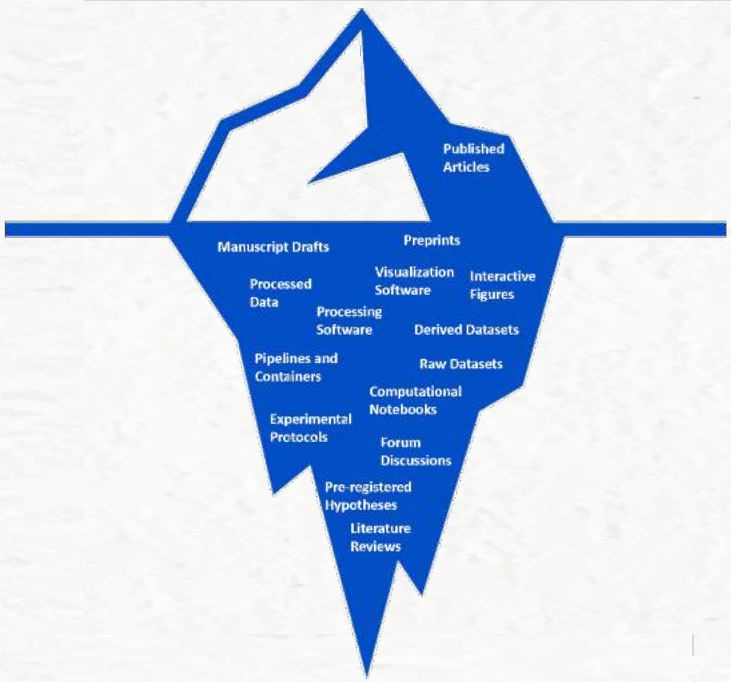
Roger's Bacon
Writes Secretorum · Subscribe
Aug 11

26 9

All this to say: Scientists in the pre-modern era wrote freely, despite calls to do away with that freedom. At some point, narrative and literary styles vanished and were replaced with rigid formats and impoverished prose. The question now is: **Have we gone too far in removing artistry from scientific writing?**

https://newscience.substack.com/p/scientific-styles

An article about computational science in a scientific publication is not the scholarship itself, it is merely advertising of the scholarship. The actual scholarship is the complete software development environment and the complete set of instructions which generated the figures.



-- Buckheit and Donoho
WaveLab and Reproducible Research, 1995

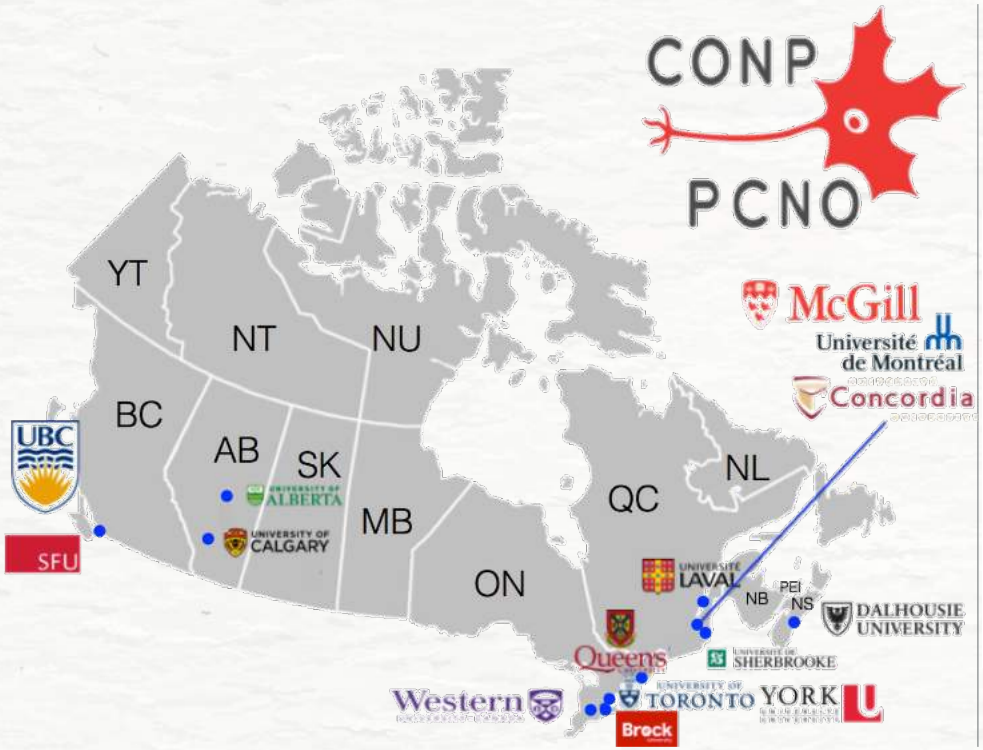
An article about computational science in a scientific publication is not the scholarship itself, it is merely advertising of the scholarship. The actual scholarship is the complete software development environment and the complete set of instructions which generated the figures.

-- Buckheit and Donoho
WaveLab and Reproducible Research, 1995

The Canadian Open Neuroscience Platform: Catching Up to Plan S and Going Further

Posted August 15, 2019 by PLOS in Advocacy, Guest blog, In the News, Open Access, Open Science, Publishing

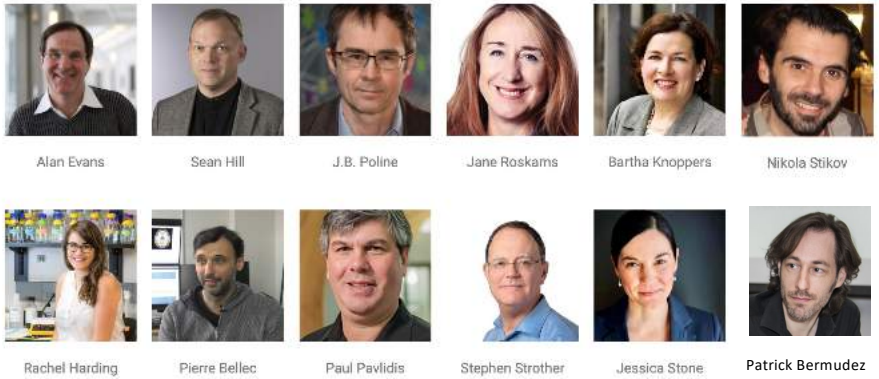
Guest Authors: Dylan Roskams-Edris (Open Science Consultant and Invited Scholar with the Center for Genomics and Policy,), JB Poline (Associate Professor, Neurology and Neurosurgery, McGill University), and Nikola Stikov (Associate Professor, Department of Electrical Engineering, Polytechnique Montreal).



Twitter: @NeuroLibre

Scientific director: Alan Evans

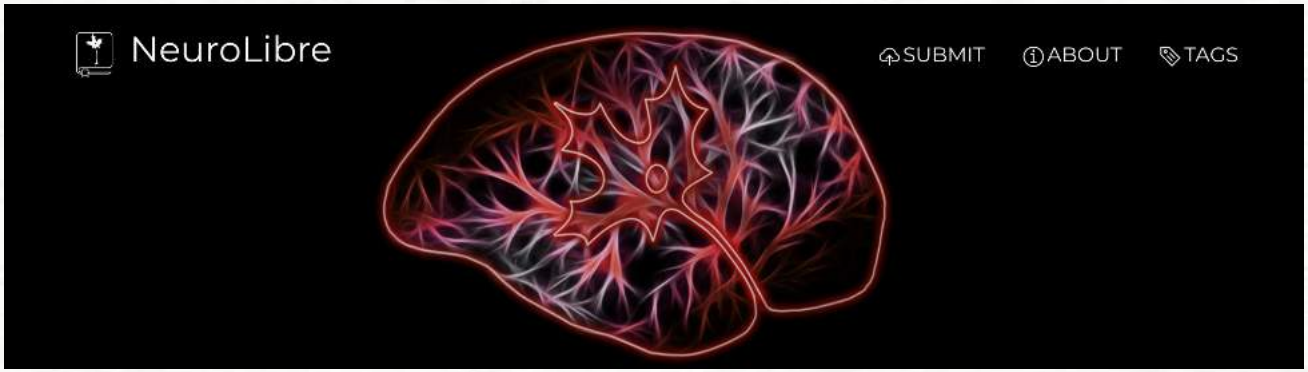
Steering Committee



Canadian Open Neuroscience Platform

CONP
PCNO

Reproducible research



https://neurolibre.org

PLOS COMPUTATIONAL BIOLOGY

OPEN ACCESS

PERSPECTIVE

Beyond advertising: New infrastructures for publishing integrated research objects

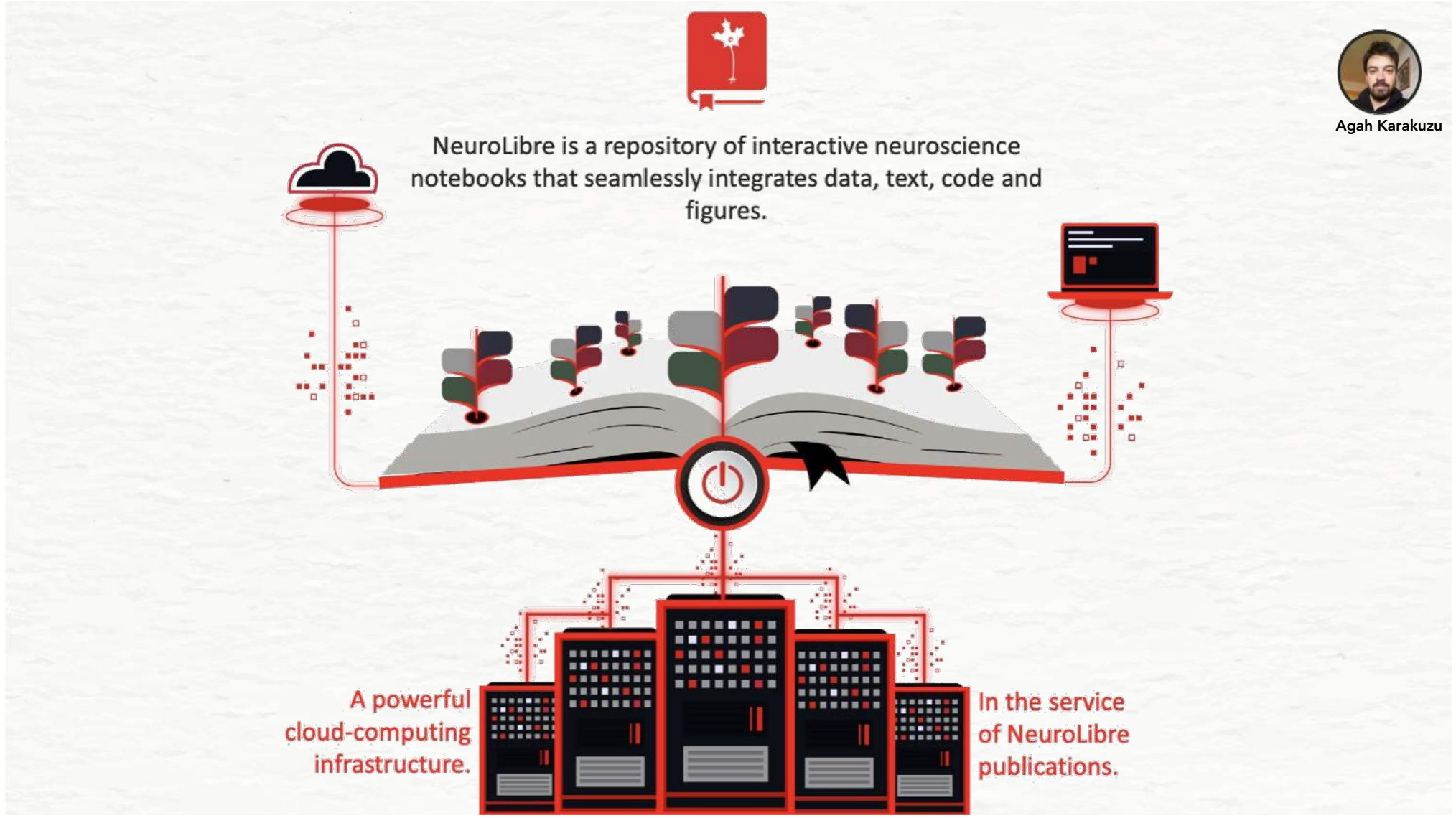
Elizabeth DuPre, Chris Holdgraf, Agah Karakuzu, Loïc Tetrel, Pierre Bellec, Nikola Stikov, Jean-Baptiste Poline

NeuroLibre

Agah Karakuzu

NeuroLibre : A preprint server for full-fledged reproducible neuroscience

AUTHORS
Agah Karakuzu, Elizabeth DuPre, Loic Tetrel, Patrick Bermudez, Mathieu Boudreau, Mary Chin, Jean-Baptiste Poline, Samir Das, Pierre Bellec, Nikola Stikov



Agah Karakuzu

NeuroLibre

Layer 1:

A PDF compatible document

The steady-state longitudinal magnetization of an inversion recovery experiment can be derived from the Bloch equations for the pulse sequence {θ_{180} – TI – θ_{90} – (TR-TI)}, and is given by:

$$M_z(TI) = M_0 \frac{1-\cos(\theta_{180})e^{-\frac{TR}{T_1}} - [1-\cos(\theta_{180})]e^{-\frac{TI}{T_1}}}{1-\cos(\theta_{180})\cos(\theta_{90})e^{-\frac{TR}{T_1}}} \quad (1)$$

where M_z is the longitudinal magnetization prior to the θ_{90} pulse. If the in-phase real signal is desired, it can be calculated by multiplying Eq. 1 by $k\sin(\theta_{90})e^{-TE/T_2}$, where k is a constant. This general equation can be simplified by grouping together the constants for each measurements regardless of their values (i.e. at each TI, same TE and θ_{90} are used) and assuming an ideal inversion pulse:

$$M_z(TI) = C(1 - 2e^{-\frac{TI}{T_1}} + e^{-\frac{TR}{T_1}}) \quad (2)$$

where the first three terms and the denominator of Eq. 1 have been grouped together into the constant C. If the experiment is designed such that TR is long enough to allow for full relaxation of the magnetization (TR > $5T_1$), we can do an additional approximation by dropping the last term in Eq. 2:

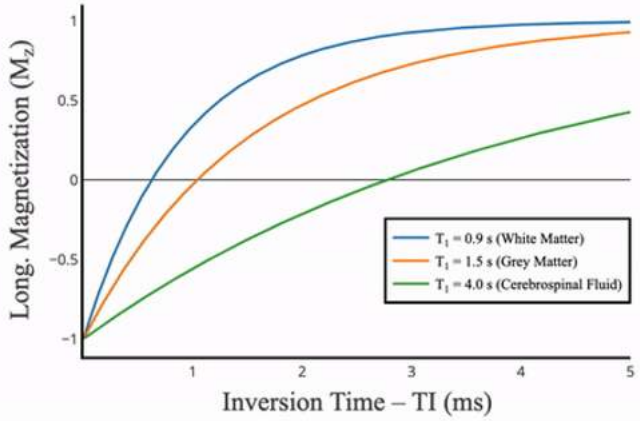
https://neurolibre.org/papers/10.55458/neurolibre.00019

QBIN QUEBEC BIO-IMAGING NETWORK

NeuroLibre

Layer 2:

Dynamic figures



Practically, Eq. 1 is the better choice for simulating the signal of an inversion recovery experiment, as the TRs are often chosen to be greater than $5T_1$ of the tissue-of-interest, which rarely coincides with the longest T_1 present (e.g. TR may be sufficiently long for white matter, but not for CSF which could also be present in the volume). Equation 3 also assumes ideal inversion pulses, which is rarely the case due to slice profile effects. Figure 3 displays the inversion recovery signal magnitude (complete relaxation normalized to 1) of an experiment with TR = 5 s and T_1 values ranging between 250 ms to 5 s, calculated using both equations.

Figure 3. Signal recovery curves simulated using Eq. 3 (solid) and Eq. 1 (dotted) with a TR = 5 s for T_1 values ranging between 0.25 to 5 s.

(View simulation code)

You can observe the actual data points

https://neurolibre.org/papers/10.55458/neurolibre.00019

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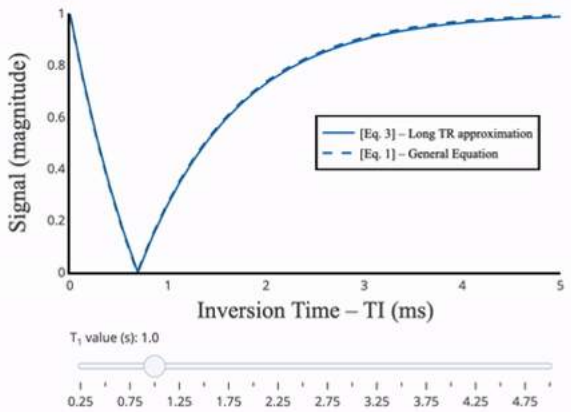
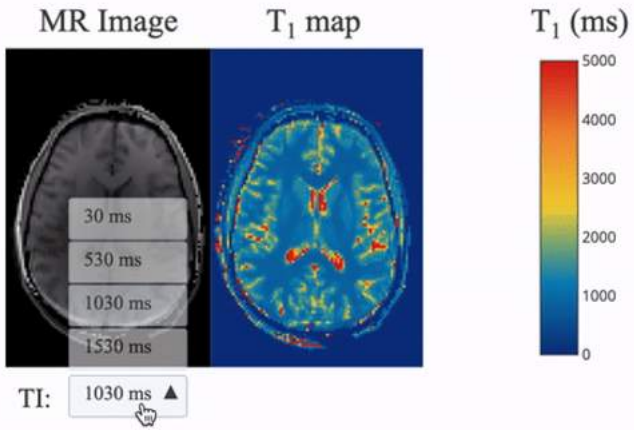
Layer 3:

Interactivity



You can explore the phenomenon.



You can interact with the real-world data.

https://neurolibre.org/papers/10.55458/neurolibre.00019

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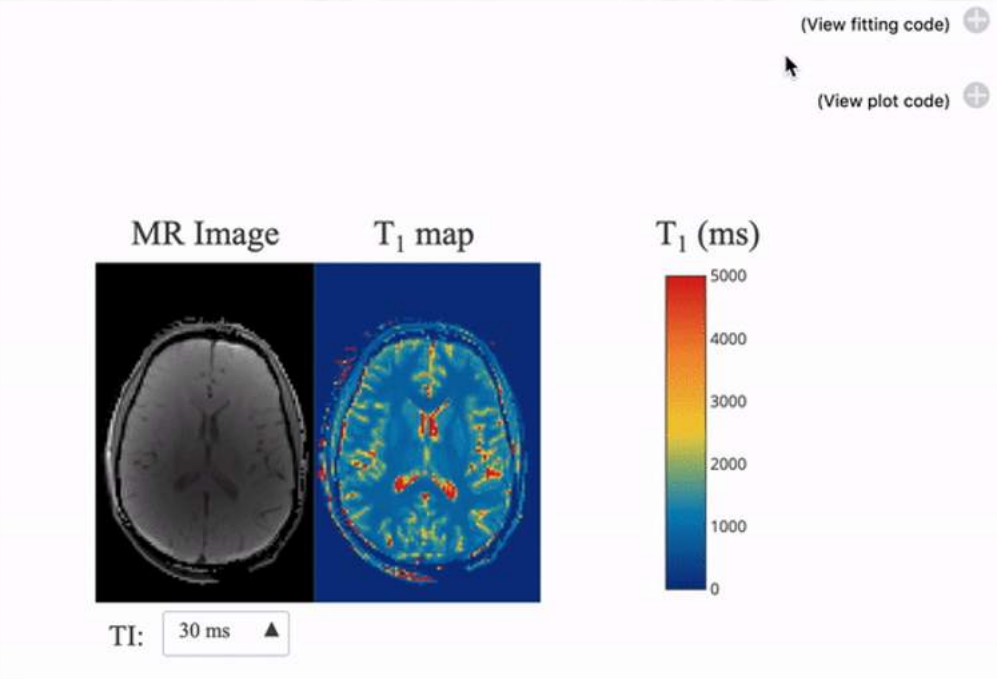
Layer 4:

Transparency



You can SEE THE CODE that generates the outputs.

https://neurolibre.org/papers/10.55458/neurolibre.00019

QBIN QUEBEC BIO-IMAGING NETWORK

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Layer 5:

Reproducibility

(View plot code)

Practically, Eq. 1 is the better choice for simulating the signal of an inversion recovery experiment, as the TRs are often chosen to be greater than $5T_1$ of the tissue-of-interest, which rarely coincides with the longest T_1 present (e.g. TR may be sufficiently long for white matter, but not for CSF which could also be present in the volume). Equation 3 also assumes ideal inversion pulses, which is rarely the case due to slice profile effects. Figure 3 displays the inversion recovery signal magnitude (complete relaxation normalized to 1) of an experiment with TR = 5 s and T_1 values ranging between 250 ms to 5 s, calculated using both equations.

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```
%use octave

% Verbosity level 0 overrides the disp function and supresses warnings.
% Once executed, they cannot be restored in this session
% (kernel needs to be restarted or a new notebook opened.)
VERBOSITY_LEVEL = 0;

if VERBOSITY_LEVEL==0
```

You can RUN the code that generates the outputs.

https://neurolibre.org/papers/10.55458/neurolibre.00019

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Quantitative Magnetic Resonance Imaging, Volume 1

1st Edition

Write a review

Editors: Nicole Seiberlich, Vikas Gulani, Adrienne Campbell-Washburn, Steven Sourbron, Mariya Ivanova Doneva, Fernando Calamante, Houchun Harry Hu

Paperback ISBN: 9780128170571

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[a]Sections 2.2–2.5 in this book chapter have been previously published under a creative commons license on the qMRLab blog. Visit the original blog posts for interactive versions of the figures: https://qmrlab.org/jekyll/2018/10/23/T1-mapping-inversion-recovery.html.https://qmrlab.org/jekyll/2018/12/11/T1-mapping-variable-flip-angle.html.https://qmrlab.org/2019/04/08/T1-mapping-mp2rage.html.https://qmrlab.org/2019/04/09/T1-mapping-t1rho.html.

https://elifesciences.org/61523

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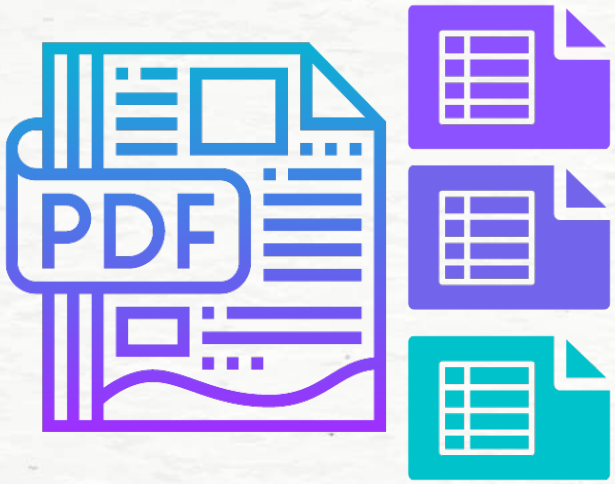
Mancini and Karakuzu et al. (2020) eLife 10.7554/eLife.61523

Myelin meta-analysis



Spreadsheets in a PDF?

Figure 6

To visually represent these results, we used two heatmaps, one for the z-scores and one for the p-values: each element refers to the comparison between the measure on the x axis and the one on the y axis.

Figure 6

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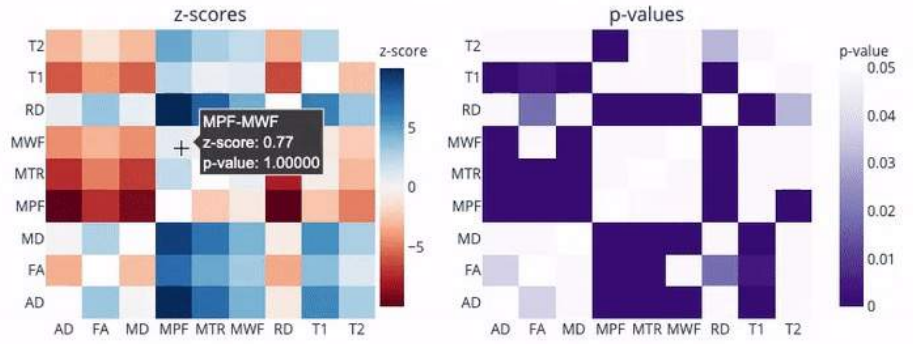
Figure 6: Statistical pairwise comparisons between R^2 estimates



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Magnetic Resonance in Medicine

Mathieu Boudreau

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

First published: 10 August 2019 | https://doi.org/10.1002/mrm.27939

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However, few would disagree that reproducibility accelerates scientific progress, as well as its translation to clinical practice. As tectonic technological changes shape research in the 21st century, we need to be careful not to damage its foundations, and instead focus on aspects of open science where we can reach consensus. The open-science movement needs to pick its battles. The battle for reproducible research is one that it cannot afford to lose.

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Mathieu Boudreau, Nikola Stikov, Peter Jezzard

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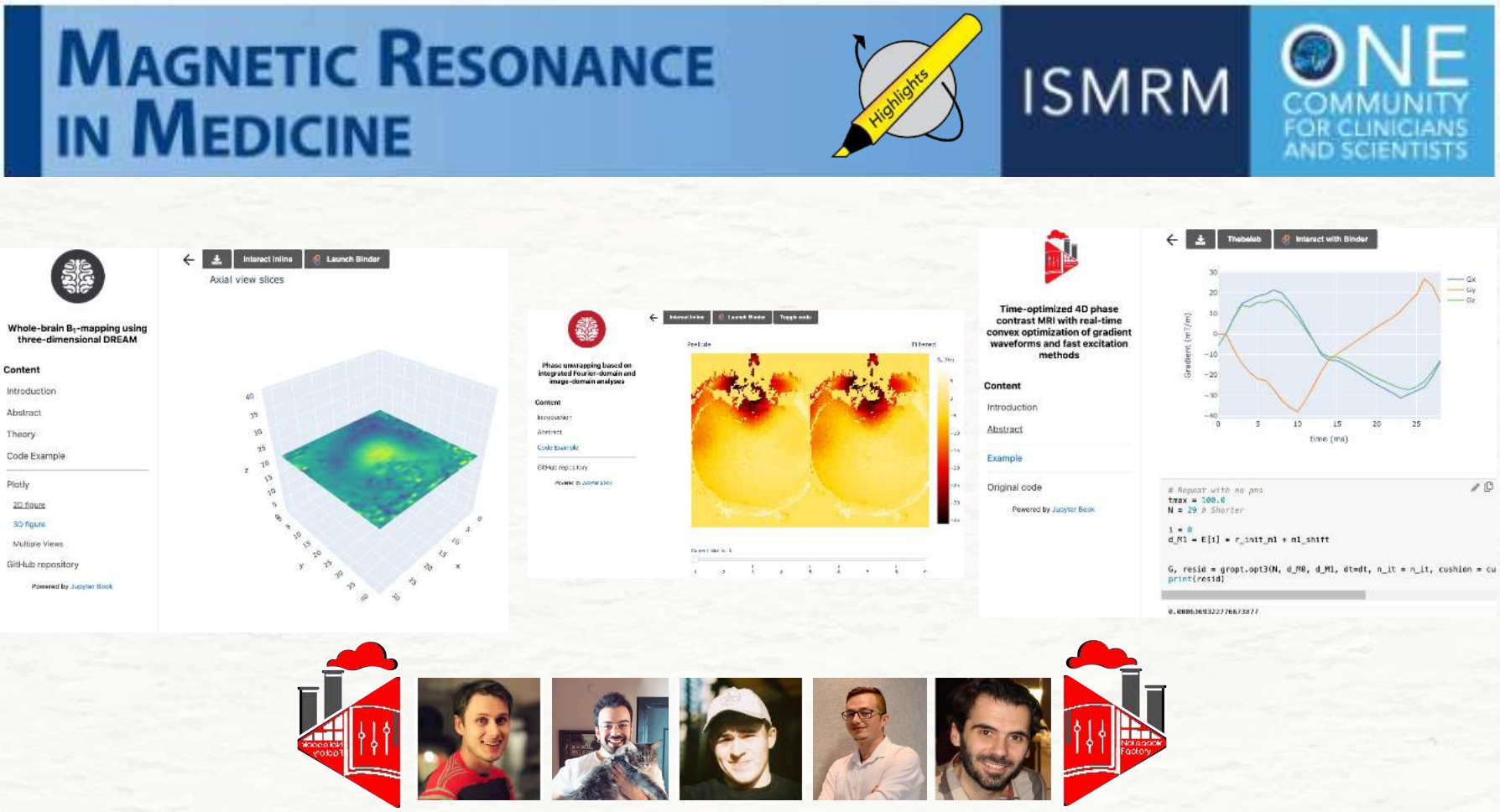

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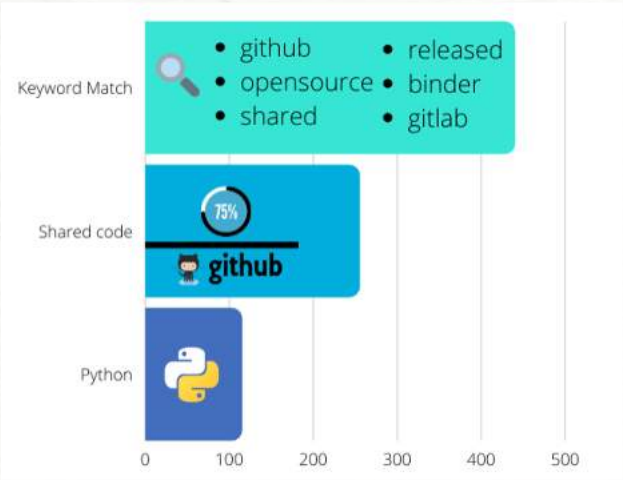
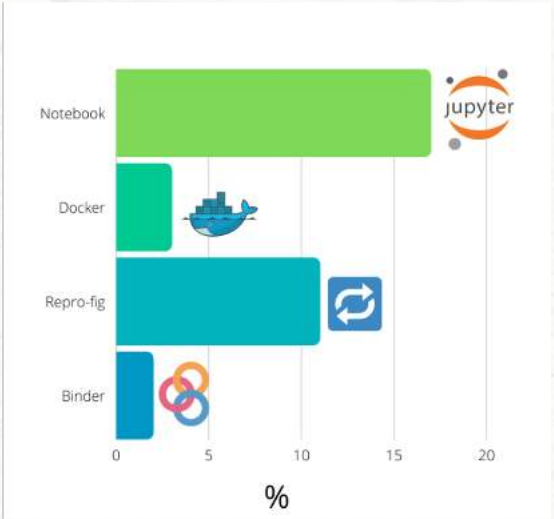
On the open-source landscape of *PLOS Computational Biology*

Mathieu Boudreau, Jean-Baptiste Poline, Pierre Bellec, Nikola Stikov

Published: February 11, 2021 • https://doi.org/10.1371/journal.pcbi.1008725





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PLOS COMPUTATIONAL BIOLOGY

Bayes-optimal estimation of overlap between populations of fixed size

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Fig 2. Inference and uncertainty using the posterior

Fig 3. Bayesian repertoire overlap consistently estimates true overlap

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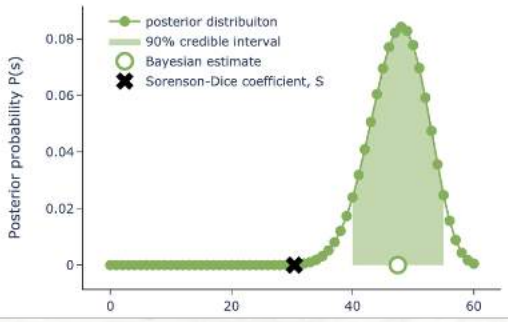
true overlap open circle; Eq (7), and the interval accounting for at least 90% of the area under the posterior curve provides an equal-tailed 90% credible interval [shading; Eq (8)]. The $\hat{S}$ estimate is shown for comparison [black cross; Eq (1)], and is typically less than or equal to $\hat{s}$.

Link to the published figure: https://doi.org/10.1371/journal.pcbi.1006898.g002



Efficient neural decoding of self-location with a deep recurrent network

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Fig 1. Accurate decoding of position with a RNN

Fig 2. Comparison of RNN and Bayesian decoders

Fig 3. Spatial decoding across animals in 2D and 1D

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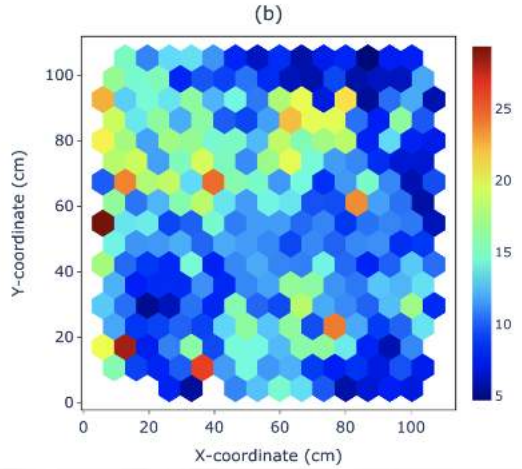
(b) Mean prediction error for different regions for R2192



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I will only publish one research article this year. This is the one!

NIKOLA STIKOV
OCT 20, 2023

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NOTE: Mathieu Boudreau, Agâh Karakuzu and Pierre Bellec contributed to this post

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https://qantarot.substack.com/

> “Had he been a lunatic or an intellectually honourable man who’d thought things through to their logical conclusion? And was there any difference?”
>
> — **Margaret Atwood**, Oryx and Crake

https://qantarot.substack.com/p/chatgpt-and-galactica-are-taking

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A sprout of living publications

Thank you!

Agah Karakuzu
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Brian Wandell

Thank you!

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