



HAL
open science

Clinica: an open-source software platform for reproducible clinical neuroscience studies

Omar El-Rifai, Mauricio Diaz Melo, Ravi Hassanaly, Matthieu Joulot,
Alexandre M Routier, Elina Thibeau-Sutre, Ghislain Vaillant, Stanley
Durrleman, Ninon Burgos, Olivier Colliot

► **To cite this version:**

Omar El-Rifai, Mauricio Diaz Melo, Ravi Hassanaly, Matthieu Joulot, Alexandre M Routier, et al..
Clinica: an open-source software platform for reproducible clinical neuroscience studies. MRI Together
2021 - A global workshop on Open Science and Reproducible MR Research, Dec 2021, Online, France.
hal-03513920

HAL Id: hal-03513920

<https://hal.science/hal-03513920v1>

Submitted on 6 Jan 2022

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Clinica: an open-source software platform for reproducible clinical neuroscience studies

Omar El Rifai¹, Mauricio Diaz Melo², Ravi Hassanaly¹, Matthieu Joulot¹, Alexandre Routier¹, Elina Thibeau-Sutre¹, Ghislain Vaillant¹, Stanley Durrleman¹, Ninon Burgos¹, Olivier Colliot¹

¹ Inria, Aramis project-team, Sorbonne Université, Institut du Cerveau - Paris Brain Institute, Inserm, CNRS, AP-HP, Hôpital Pitié Salpêtrière, Paris, France
² Inria Paris, SED, 75013 Paris, France

Introduction:

Neuroimaging studies often rely on heterogeneous tools and complex data processing workflows. Initiatives such as Nipype¹ for cross-interface uniformization of tools, and BIDS² for data organization, help researchers achieve reproducible results. Nonetheless, the entry-cost for non-specialists remains significant and the room for error non-negligible. For that purpose, we present Clinica³, an open-source, community-oriented software platform for reproducible clinical neuroscience studies. As such, Clinica bridges the gap between neuroimaging experts and users looking for a straightforward and efficient way to process and analyse neuroimaging data.

Methods:

Clinica is developed around three main axes: BIDS converters, neuroimaging processing, and statistics and machine learning workflows. For each of these axes, Clinica puts forward several pipelines through a uniform and simple to use but powerful command line interface. BIDS converters allow users to transform several publicly-available imaging datasets into the community-driven BIDS standard. The converters serve as an entry point into further analysis workflows. Next, the neuroimaging processing workflows provide step-by-step procedures to prepare neuroimaging data (T1w-MRI, DWI and PET) for neuroscience studies. These are organized into goal-oriented pipelines and rely on third party tools. Finally, statistics and machine learning pipelines allow users to perform univariate analysis and classification on the organized and pre-processed datasets.

Results:

Clinica provides a unified set of tools to tackle neuroimaging studies relying on best-practices and community driven efforts. It is a gateway into performing reproducible research. The source code of Clinica is hosted on Github and the software is distributed under an MIT license. A comprehensive user guide accompanies the software platform (available from www.clinica.run).

Discussion:

By providing a user-friendly, end-to-end, and standards-reliant neuroimaging software platform, Clinica's aim is twofold. First, it encourages community-driven efforts through the adoption of open-source tools and standards such as Nipype, BIDS and Github. Second, it paves the way for more reproducible and less error-prone research. As such the software has been used to that purpose in several works^{4,5}.

Conclusion:

As a general neuroimaging software platform, Clinica tackles most challenges around the open-science and reproducible problems for MRI. It is open-source, uses and encourages open-data formats and favours and assists in reproducible research.

References:

- [1] Gorgolewski et al. "Nipype: a flexible, lightweight and extensible neuroimaging data processing framework in python." *Frontiers in neuroinformatics* 5 (2011): 13.
- [2] Routier et al. "Clinica: an open-source software platform for reproducible clinical neuroscience studies." *Frontiers in Neuroinformatics* 15 (2021)
- [3] Gorgolewski et al. "The brain imaging data structure, a format for organizing and describing outputs of neuroimaging experiments." *Scientific data* 3.1 (2016): 1-9.
- [4] Wen et al. "Convolutional neural networks for classification of Alzheimer's disease: Overview and reproducible evaluation." *Medical image analysis* 63 (2020): 101694.
- [5] Wen et al. "Reproducible evaluation of diffusion MRI features for automatic classification of patients with Alzheimer's disease." *Neuroinformatics* 19.1 (2021): 57-78.