

Navigating Neuroimaging Datasets ADNI for Alzheimer's Disease

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Abstract—Many researchers have used the Alzheimer's Disease Neuroimaging Initiative (ADNI) to project Alzheimer's disease patients' brain images. However, the learning curve required to use the ADNI is not trivial; supplements are required to work with the complexity of the subject matter and convoluted user interface in times of insufficient software extensions or technical support. Meanwhile, papers published about the ADNI have involved popular artificial intelligence models while showing uneven performance, many supplying incomparable accuracy figures. A tutorial is thus offered, beyond what can be found in the ADNI website, for furthering research about Alzheimer's disease. It also recommends areas of enhancements to make ADNI datasets more user-friendly.

■ **THE 2020 CONFERENCE** on Signal Processing in the Context of Neurotechnology called out the Alzheimer's Disease Neuroimaging Initiative (ADNI) datasets for studying Alzheimer's Disease. A tutorial was offered to navigate through the ADNI website and, furthermore, to prepare evaluation of brain aging process using state-of-the-art modeling tools involving neural networking and deep learning.⁹

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The Image & Data Archive (IDA) at the Laboratory of Neuro Imaging (LONI) is a secure system for the archival of neuroimaging data that protects subject confidentiality by restricting access to authorized users. IDA provides an interactive and secure environment for storing, searching, updating, sorting, accessing, tracking, and manipulating neuroimaging and relevant clinical data.¹ The ADNI is a part of the prominent studies in IDA. The ADNI is a longitudinal multicenter study designed to develop clinical, imaging, genetic, and biochemical biomarkers for the early detection, tracking, and drug development to treat Alzheimer's disease.²

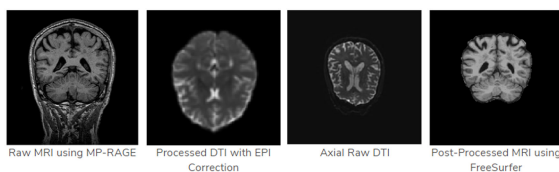


Figure 1. Brain image examples from the ADNI.

ADNI DATA NAVIGATION

Navigation through the ADNI¹² takes the following five steps:

- (a) accessing the data with required permissions;
- (b) navigating the webpage to find the data of interest;
- (c) data analysis and data cleaning;
- (d) data-storage options and memory requirements;
- (e) software tools to build classification models.

The “Image Download” section of the site enables the user to search images including MRI, Positron Emission Tomography (PET), and Diffusion Tensor Imaging (DTI) (see Figure 1). The results are generated in the “Advanced Search” tab with the option to download images one at a time or all together. The images downloaded are in formats compliant with the Neuroimaging Informatics Technology Initiative, the Medical Imaging NetCDF-Network Common Data Form, ANALYZE, DCM, and some extension to Brain Imaging Data Structure (BIDS).

The downloading of all images can take a longer time due to different factors. The size of images is about 3 TB. It is not useful to download all images together since they are in different formats, with various quality and modality. Therefore, it is much better to shortlist and download a subset of images as per individual research requirements, which take significant time to structure.

There are many software tools for analyzing the image data on the ADNI website. Some of the prominent ones are the following: FreeSurfer,^{3,4} Functional Magnetic Resonance Imaging of the Brain Software Library Analysis Group,⁵ Adult brain atlases and image registration tools,⁶ ITK-SNAP and Advanced Normalization Tools from the Penn Image Computing and Science Lab,⁷ TensorFlow and Keras,^{10,11} and LONI.⁸

BENEFITS

Researchers as well as students interested in building models to understand the brain and its functions will find the data information outlined here useful. Our structured approach can act like a bridge between the fields of data science and neuroimaging. Specifically, a tutorial is designed to benefit the participants in BDBC-2020.¹²

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