Chapter 3
Neurodegenerative Diseases Database

3.1 Database Survey

Looking at current status of the neuroscience databases available through Internet, Magnetic Resonance Imaging (MRI), Computed Tomography (CT), Positron emission tomography (PET), Single photon emission computed tomography (SPECT), MRI play an important role in the diagnosis of neurodegenerative diseases. In recent years MRI has become one of the most popular techniques used in radiology to visualize the structure and function of the body, because it is a non-ionizing radiation medical imaging technique. It provides detailed images of the body in any plane and techniques based on the principles of MRI like fMRI, DTI or fDTI are being increasingly used in the preclinical study of certain neurodegenerative diseases. The availability of public image databases for experimental purposes allows the validation of propositions of computational methods under a common experimental framework. They also allow reproducing the results claimed by the research groups, both relative to diagnostic issues and to computational methods. In this regard, the simulated MRI images from the BrainWeb site [96], and the clinical images from the Internet Brain Segmentation Repository (IBSR), which are provided with expert segmentations that can be used as the ground truth for validation processes, have been widely used as benchmarks for a number of algorithms devoted to segmentation, filtering and correction of artifacts in MRI, such as the Intensity Inhomogeneity (IIH). A number of new resources have been added in recent years, the fruit of public funded ongoing research projects, to those early public database efforts. During last few years new projects have been developed individually by research groups as the Laboratory of Neuro Image (LONI) [98] or through collaborations with other groups, which are working in the same research area related to image analysis and the study of neurodegenerative diseases, building consortiums. Resulting from these projects there are many public resources (images, clinical data, demographics and results of the studies) that are available for validation and refutation purposes of both clinical conclusions and computational algorithms, keeping pace with the fast evolution of the imaging devices and techniques. In fact, the field is suffering such an explosive
growth of public resources and an effervescence of results, techniques and publications that the present account may well be outdated in a very short time.

The primary requirement of current research was to have sufficient number of cases of each of disease type, for further ANN task. Hence the purpose is served by only some of these databases, namely the OASIS [97], ADNI [98] and the Whole brain atlas repositories [99]. OASIS and Whole brain atlas are having open access whereas the access to ADNI is obtained after the approval of research rationale submitted to them.

3.2 OASIS database

OASIS (Open Access Series of Imaging Studies) provides brain imaging data that are freely available for distribution and data analysis. This data set consists of a cross-sectional collection of 416 subjects covering the adult life span aged 18 to 96 including individuals with early-stage Alzheimer’s Disease (AD). For each subject, 3 or 4 individual T1-weighted MRI scans obtained within a single imaging session are included. The subjects are all right-handed and include both men and women. 100 of the included subjects over the age of 60 have been diagnosed with very mild to mild AD. Additionally, for 20 of the nondemented subjects, images from a subsequent scan session after a short delay (less than 90 days) are also included as a means of assessing acquisition reliability. All data have been anonymized to accommodate public distribution. Facial features were removed at the fMRIDC (http://www.fmridc.org) using the Brain Extraction Tool. The full set is 15.8 GB compressed and 50 GB uncompressed. The data are available at http://www.oasis-brains.org.

3.3. ADNI database

Alzheimer's Disease Neuroimaging Initiative (ADNI) database (adni.loni.ucla.edu). The ADNI was launched in 2003 by the National Institute on Aging (NIA), the National Institute of Biomedical Imaging and Bioengineering (NIBIB), the Food and Drug Administration (FDA), private pharmaceutical companies and non-profit organizations, as a $60 million, 5-year public-private partnership. The primary goal of ADNI has been to test whether serial magnetic resonance imaging (MRI), positron emission tomography (PET), other biological markers, and the progression of mild cognitive impairment (MCI) and early Alzheimer's disease (AD). Determination of sensitive and specific markers of very early AD progression is intended to aid researchers and clinicians to develop new treatments and monitor
their effectiveness, as well as lessen the time and cost of clinical trials. The Principal Investigator of this initiative is Michael W. Weiner, MD, VA Medical Center and University of California - San Francisco. ADNI is the result of efforts of many co-investigators from a broad range of academic institutions and private corporations, and subjects have been recruited from over 50 sites across the U.S. and Canada. The initial goal of ADNI was to recruit 800 adults, ages 55 to 90, to participate in the research - approximately 200 cognitively normal older individuals to be followed for 3 years, 400 people with MCI to be followed for 3 years and 200 people with early AD to be followed for 2 years. For up-to-date information, see www.adni-info.org.

The information provided in this data set is available to authorized ADNI investigators only. These data may not be shared outside the investigative team specified in the ADNI Data Use application. ADNI clinical data are managed and supplied by the Bioinformatics and Biostatistics Laboratory at the University of California, San Diego in partnership with the Alzheimer's Disease Cooperative Study.

Selection of 3D MR images from ADNI database:
Selected around 200 images which are 3D and T1-weighted MPRAGE. The MPRAGE is the T1-weighted 3D series which is used for most morphometric analyses. The various files with different levels of pre-processing correction are available to all users of ADNI. However, it is envisioned to use the scans that have undergone the maximum correction in their analyses. This file is the MPRAGE that has been identified as “best” in the quality ratings, and undergone gradwarping, intensity correction, and has been scaled for gradient drift using the phantom data. This is identifiable as the file with “N3” and “scaled” in the file name according to ADNI procedure manual. Each sample image is 3D, formed from around 150 2D MR slices occupying around 40MB of memory.
Fig. 3.3.1 Sample ADNI images for AD, MCI and Normal from top to bottom

3.4 Whole brain atlas database

Harvard Medical School's Whole Brain Atlas is an ambitious research and educational site. It is a catalog of medical images of actual human brains—coming from models that are normal and healthy to specimens with diseased, injured, and disordered tissue. Set off by examining some of the more than 100 different structures in the brain, and catch up on normal brain function and anatomy. For the
lay user, the neuroimaging primer explains some of the different tools used to collect these images. Especially stimulating are the tours that use images and text to explain the progression of Alzheimer's disease, brain tumors, and herpes encephalitis. The imaging technologies include magnetic resonance structural imaging technology and radionuclide functional imaging technology. Selected axial, T2-weighted, MR images of normal and abnormal brains, suffering from Alzheimer’s disease, Mild Alzheimer’s disease, Huntington’s disease etc.

Fig.3.4.1 Sample Whole brain atlas images for AD, Mild AD and Normal from left to right