LORIS neuroinformatics platform for Imaging Genetics

C. Rogers[1], S. Das[1], Z. Mohaddes[1], D. MacFarlane[1], P. Kostopoulos[1], E. Portales-Casamar[2], and A.C. Evans[1]

[1]Montreal Neurological Institute, Montreal, QC, Canada

[2]Centre for High-Throughput Biology, University of British Columbia, Vancouver, BC, Canada

Introduction

LORIS[2] (loris.ca) is a web-based open-source data management system, integrating imaging, behavioural/clinical and summary genetic data within a single informatics platform. Developed at the McGill Centre for Integrative Neuroscience (MCIN) within the Montreal Neurological Institute (MNI), LORIS manages the flow of data in a study from acquisition and storage through processing and dissemination.

LORIS' Genomic Browser module is designed to address a key challenge of imaging genetics research, providing pivotal support for cross-linkage of detailed genotype information with neuroimaging, behavioural/clinical and demographic data, all coordinated within the same web-accessible platform.[5,12] This is timely given the increase in interest within the research community for imaging genetics studies and the formation of consortia such as ENIGMA[13] that aim at understanding brain function and disease through imaging and genetic data.

References

1. Bae, J.B. et al. Genomics Inform, 2013, 11(1):7–14
2. Das, S. et al. Front Neuroinform, 2011, 5(37)
3. Evans, A.C. et al. Neuroimage, 2006, 30(1):184-202
4. Wolff, J. et al. Am J Psychiatry, 2012, 169(6):589-600
5. Ge T. et al. Quant Biol, 2013, 1(4)227-245
6. Kent et al. Genome Res, 2002, 12(6):996-1006
7. MacFarlane, D. et al. OHBM 2014
8. Meaney, M. et al. Annu Rev Neurosci 2001, 24:1161-92
9. Rogic, S. et al. ISMB-ECCB, 2013
10. Sherif, T. et al. Front.Neuroinform, 2014, 8(54)
11. Sherif, T. et al. Front.Neuroinform, 2015, 8(89)
12. Stein, J et al. Neuroimage, 2010, 52(3):1160-1174
13. Thompson, P. et al. Brain Imaging Behav, 2014, 8(2):153–182

Acknowledgements

Development of LORIS has also been funded by the National Institutes Health and the NeuroDevNet Network of Centres of Excellence.

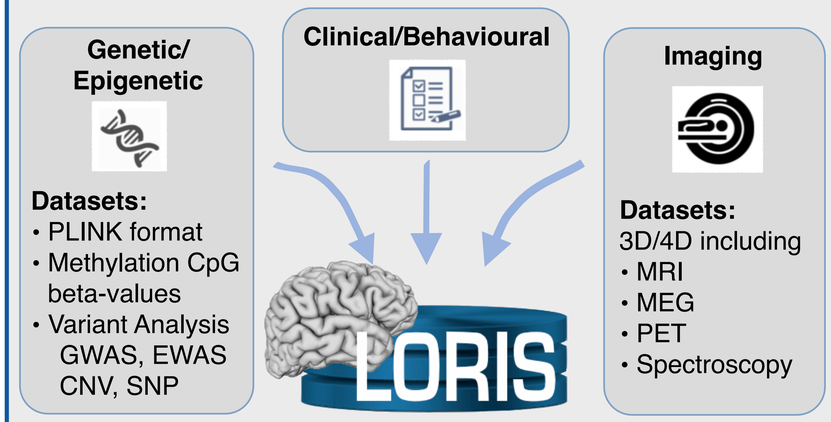
Additional contributing developers: Dario Vins, John Harlap, Matt Charlet, Andrew Cordery, David Brownlee, Sebastian Muehlboeck, Tarek Sherif, Mia Petkova, Cecile Madjar, Justin Kat, Rathi Gnanasekaran, Tara Campbell, Jordan Stirling, Ted Strauss Karolina Marasinska, Xavier Lecours-Boucher, Evan McIlroy, Olga Tsibulevskaya, Nic Kassis, Marc-Etienne Rousseau, Pierre Rioux.

MCIN MCGILL CENTRE for INTEGRATIVE NEUROSCIENCE

For more information visit LORIS.ca

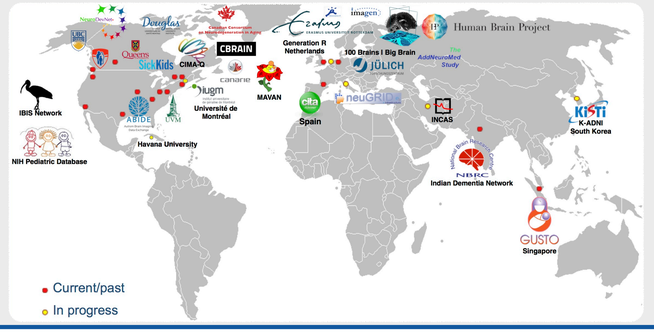
Methods

LORIS' Genomic Browser embeds display and download tools for multiple formats of genomic and imaging data, facilitating large-scale data acquisition, dissemination and analysis. Any format of derived genetic dataset, including metadata about genetic data collection and analysis, can be loaded and seamlessly linked with multi-modal subject data in the database.



Global collaborations

LORIS serves as the technical platform for large-scale projects such as the NIH-funded Fragile X and Infant Brain Imaging Study (IBIS)[4], MAVAN[8] (Maternal Adversity Vulnerability and Neurodevelopment), and the NeuroDevNet Network Centres of Excellence.



Results

LORIS' demonstration database features a sample implementation of the Genomic Browser: https://demo.loris.ca/main.php?test_name=genomic_browser

827 CNV and 153 SNP sample records can be queried and filtered across subjects to provide:

- Genomic profiles for individual subjects, summarizing available datasets
- Distribution of genomic variants for any subset of a study population
- Cross-linkage to neuroimaging and behavioural datasets for each subject
- Metadata associated to each subject's dataset by analysis type
- Summary display of key columns vs. complete view across all available fields

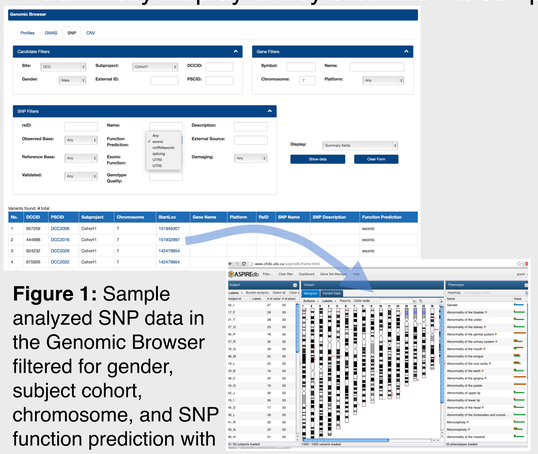


Figure 1: Sample analyzed SNP data in the Genomic Browser filtered for gender, subject cohort, chromosome, and SNP function prediction with projected links to AspireDB[9] phenome-genome visualization tools.

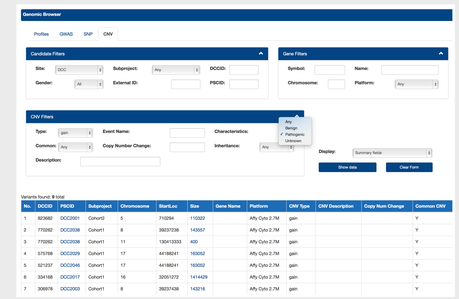


Figure 2: Sample analyzed CNV data in the Genomic Browser, filtered by type (gain) and characteristic (Pathogenic).

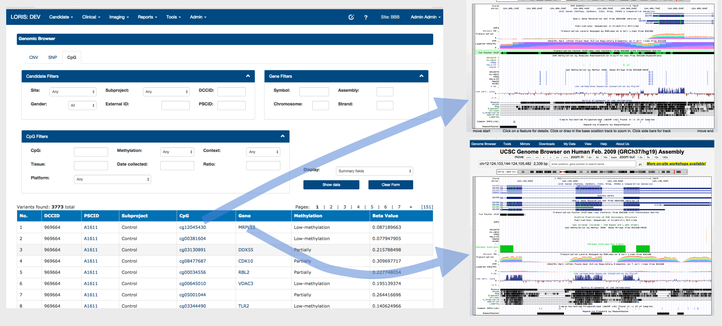


Figure 3: Sample methylation data in the Genomic Browser, with links to the UCSC Genome Browser[6] CpG and Gene visualization utilities.

Ongoing development of the Genomic Browser includes support for methylation data, upload and download of voxel-wise GWAS data[12], links to external data resources such as the UCSC Genome Browser[6] as well as the ASPIREdb[9] engine for phenome-genome exploration, and data visualization utilities from the IHEC Data Portal[1] for epigenetic visualization.

Conclusions

LORIS' ability to cross-link subject datasets across genomic, neuroimaging and behavioural modalities serves as a key tool for imaging-genetics, providing seamless centralization and dissemination of comprehensive datasets for large-scale research initiatives in the age of Big Data.