

## Evaluating Neurodegeneration Severity by Spectral Embedding Manifolds

Pablo F. Damasceno, Xiao Gao, Pedro Maia and Ashish Raj  
Department of Radiology and Biomedical Imaging

**Highlight:** The lack of a single “neurodegeneration severity” measurement, able to pinpoint a patient’s state of health from all their clinical data, remains a large barrier for longitudinal models of Alzheimer’s disease. We use spectral manifold methods to embed a large number of heterogeneous “features” into a single score, and show how this score can be used to track patients over time and to predict their future conversions rates to more advanced forms of the disease.

Evaluating the severity of neurodegeneration in patients with mild or severe cognitive impairment is a challenging task, and is often hampered significantly by the highly heterogeneous nature of the disease. One way to address this issue is to project the heterogeneous features (atrophy patterns, cognitive scores, patients clinical information, etc) onto a low dimensional manifold that respects the similarity distances between patients. We evaluate the use of spectral embedding, a standard machine learning technique, as a method for creating such manifold. We show that data from the largest dataset on Alzheimer’s disease (ADNI) can be used not only to order patients according to their disease severity, but also to provide insights into their rate of progression and future phenotypical differentiation into subtypes of the disease. We will also show how this method can be used to impute missing data for patients not used for the creation of the manifold.