Machine Learning for MRI Phenotype Detection

By

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Hypothesis-Driven Analysis

- Volume only encodes size of anatomy
- Inference assumes homogeneity of volumetric scores within cohorts
Data-Driven Approach

Questions:
• What scores to extract?
• How to perform inference?
Tracking Morphological Changes*

* Bernardis et al. MICCAI 2012
Compare Subjects*

* Konukoglu et al. TMI 2012, PAMI 2013
Create image Map*

* Ye et al. MICCAI 2012, ISBI 2012
MICCAI 2013, ISBI 2014
Step 1: Use iMap to identify cohorts
Step 2: Measure accuracy of cohorts by projecting new scan onto the iMap
Impact of Alcohol*

* Bernardis et al. TMI under review

<table>
<thead>
<tr>
<th></th>
<th>Volume Measurement</th>
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<tbody>
<tr>
<td>HIV vs. CTRL</td>
<td>53 %</td>
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<tr>
<td>Alc vs. CTRL</td>
<td>55 %</td>
</tr>
<tr>
<td>HIV&amp;Alc vs. CTRL</td>
<td>61 %</td>
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<tr>
<td>HIV&amp;Alc vs. Alc</td>
<td>50 %</td>
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Significant difference based on two-sided Fischer Exact Test
Next Step: Apply to TBSS
Next Step: Learn Map

Identify predictive markers based on iMap
Next Step: Identify Risk Factors
Creating Maps of 4D Brain Images to Unravel Dementia Heterogeneity of Aging HIV Population
National Institute of Allergy and Infectious Diseases, International AIDS Society, NIH-funded Centers for AIDS Research (CNIHR)
Role: Principle Investigator

The National Consortium on Alcohol and NeuroDevelopment in Adolescence: Data Center Component
National Institute on Alcohol Abuse and Alcoholism (U01 AA021697)
Role: Co-Investigator

Neuroimaging of Connectivity in Alcoholism
National Institute on Alcohol Abuse and Alcoholism (R01 AA012388)
Role: Co-Investigator