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# Viewing FSL results with SPM and vice versa

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## Introduction

A growing number of efforts are emerging in the neuroimaging community to increase reproducibility of research findings (e.g. [1,2]). In an attempt to facilitate publishing of neuroimaging data and metadata, the Neuroimaging Data Model (NIDM) defines a set of specifications based on semantic web technologies.

The NIDM-Results specification was recently introduced, providing a machine-readable representation of mass univariate statistical results, including extensive metadata and key images summarising the findings [3]. The main motivation for NIDM-Results was to make publishing of neuroimaging results data and metadata as effortless as possible and hence facilitate compliance with statistical guidelines (e.g. [4]), increase reproducibility and enable image-based meta-analyses.

An NIDM-Results pack is a ZIP archive containing a Resource Description Framework (RDF) metadata file, which stores provenance information, alongside several NIfTI images and CSV files. NIDM-Results packs can be generated via NIDM-Results exporters, which are available for Statistical Parametric Mapping (SPM) [5] and the FMRIB Software Library (FSL) [6]. However few tools exist to read and display NIDM-Results. This is hindering the distribution and acceptance of NIDM within the neuroimaging community.

Here, we introduce two NIDM-Results viewers, one each oriented for users accustomed to SPM and FSL, two of the most widely-used neuroimaging analysis softwares [7].

## Methods

The SPM and FSL viewers were written in programming languages already in use in each of the neuroimaging software packages, namely MATLAB and Python, respectively. Each viewer, provides an HTML display of NIDM-Results packs formatted according to the layout of the respective results page. The Matlab-based viewer reads a json-ld version of the RDF metadata (as presently there is no Matlab SPARQL query engine), while the Python-based viewer uses RDFlib [9] to directly query the metadata.

Both applications were tested on a set of publicly available NIDM-Results packs generated with SPM and FSL (<http://neurovault.org/collections/1692/>)[9] and designed to cover the main use-cases of fMRI analyses [10].

## Results

The SPM and FSL viewers are publically available at <https://github.com/incf-nidash/nidmresults-spmhtml> and <https://github.com/incf-nidash/nidmresults-fslhtml>. Fig. 1 presents sample results page for an example FSL and SPM study respectively. HTML versions of these results can be found here: <http://bit.ly/2hQHQhz>.

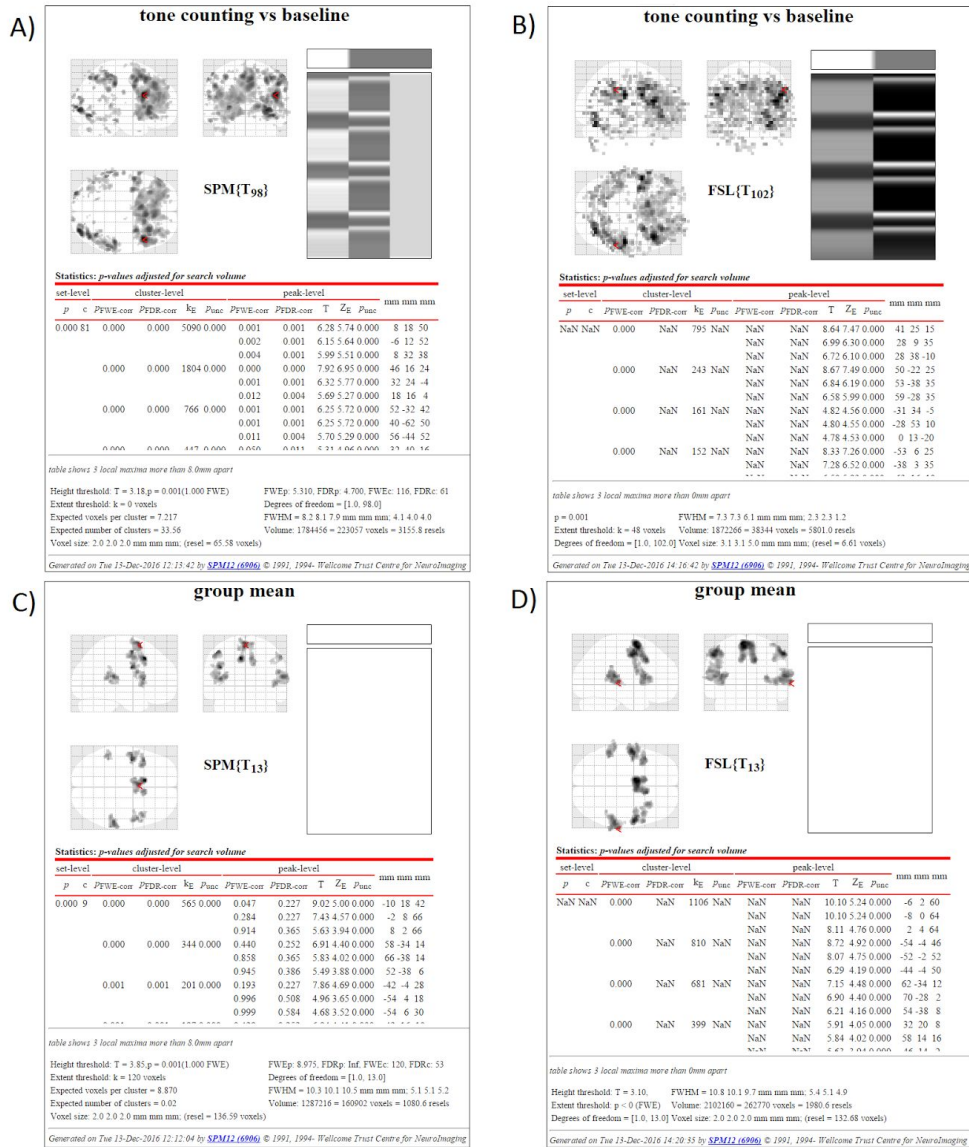
## Conclusions

We hope that the viewer will facilitate the adoption of the NIDM-Result format for sharing of statistical results in the neuroimaging community as well as interoperability across software packages. For example, it will make it easy to share results with a collaborator using different a different software package. Another important use for NIDM-Results is sharing of findings for meta-analyses, ensuring all vital metadata is retained.

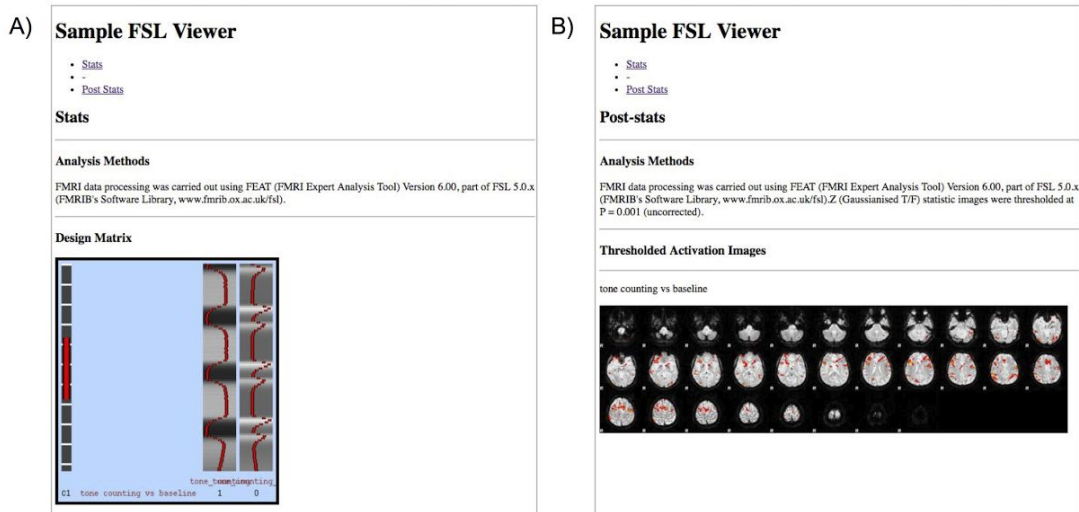
This work is part of a growing ecosystem of tools for NIDM and it is our intention to develop more applications to further to increase the practical utility of NIDM-Results. Future work will include development of NIDM-Results packs exporter from other neuroimaging software packages such as AFNI, as well as the creation of a software independent Javascript viewer for NIDM-Results which may be embedded in HTML or run locally. Other projects also include the creation tools for meta-analysis of neuroimaging data.

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**Fig. 1.** Examples of SPM HTML display for (A) SPM subject-level analysis, (B) FSL subject-level analysis, (C) SPM group-level analysis and (D) FSL group-level analysis .



**Fig. 2.** Example of FSL HTML display for an FSL subject-level analysis: (A) stats page and (B) post-stats page.

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