Constructing an Ontology of Neuroscience Experiments for the Neuroimaging Data Model (NIDM) Authors: Introduction

Karl Helmer, David Keator, Tibor Auer, Satrajit Ghosh, Camille Maumet, Thomas Nichols, Jean-Baptiste Poline

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Authors:

Karl Helmer[1], David Keator[2], Tibor Auer[3], Satrajit Ghosh[4], Camille Maumet[5], Thomas Nichols[6], Jean-Baptiste Poline[7]

Institutions:

[1]Massachusetts General Hospital, Charlestown, MA, [2]University of California Irvine, Irvine, CA, [3]University of London, London, United Kingdom, [4]MIT/HMS, Cambridge, MA, [5]Inria, Univ Rennes, CNRS, Inserm, Rennes, France, [6]University of Oxford, Oxford, Oxfordshire, [7]Montreal neurological Institute and Hospital, McGill University, Montréal, Canada

Introduction:

To address the problem of result reproducibility, experimental methods must be captured and data fully described. This is true also of data reuse [Poline,2012] for the purpose of building specific cohorts, as well as testing of processing or analysis tools. Critical to all these endeavors is the use of a controlled vocabulary, which, when definitions are provided, avoids ambiguities in interpretation. When new terminologies are constructed, good practice dictates that terms from existing well-constructed sources be reused first before new terms are introduced [Arp,2015]. This aids the future user by eliminating the need to distinguish between many terms with the same label with slightly different, or even unknown definitions. Part of the art of term reuse is the identification of the ontological viewpoint of the existing terminology and determining whether the context of the existing term fits within the terminology under construction.

We report here on recent progress in the construction of two ontologies used to describe the metadata from neuroscience experiments. This work arose out of the need to describe neuroimaging experiments, but recently expanded to encompass other modalities. The current work is focused on incorporating terms describing electrophysiology experiments. The goal of this work is to provide a set of terms that can be employed by the Neuroimaging Data Model (NIDM) [NIDM]. This model comprises three distinct models: 1) NIDM-Experiment, NIDM-Workflows, and NIDM-Results. These models are being developed under the aegis of the International Neuroimaging Coordinating Facility [INCF] (INCF) Standards for Data Sharing

Workgroup. NIDM-Results was developed first and is now available for use [Maumet,2016]. The other two models are under active development.

Methods:

We currently have a collection of terms to describe both a general experiment acquisition and workflow (e.g., "Acquisition Modality"), and those that are modality specific (e.g., "Flow Weighted" and "Voltage Clamp"). The figure shows a small example for an fMRI experiment. We use as our base ontology, the PROV Ontology (PROV-O) [Prov-O] that expresses the PROV Data Model (PROV-DM) [Prov-DM] using the OWL2 Web Ontology Language (OWL2). It also incorporates terms from several other ontologies, to provide terms specific to a given area, e.g., clinical assessment instruments.

In addition, we have also created an ontology of DICOM tag labels and related terms (terms that have been extracted from DICOM supplement documents) [DICOM]. Each entry includes a definition as well as the Value Representation (for the tag terms). We also provide a document that lists the complete description and notes text for each tag that can be useful for other applications.

We are using GitHub as a framework within which to discuss terms and definitions. The agreed-upon definitions are then referenced by URI in Terse RDF Triple Language (Turtle) documents and expanded into a hierarchical Web Onotology Language (OWL) file. The final OWL file and files containing terms imported from other ontologies are also available on Github.

Results:

The NIDM-Experiment ontology is available online [9]. We are currently adding definitions for electrophysiology experiments and expanding the scope of existing modalities. Potential users are encouraged to debate or request terms by raising a new GitHub issue and participating in the process.

Conclusions:

We have created a set of defined terms for describing neuroscience-related experiments both for general data description and for use with the INCF Neuroimaging Data Model. In future work, we will be exploring ways incorporate terms from new modalities as well as ways to streamline the process of incorporating public input.

We would like to acknowledge the work of all the INCF task force members as well as of many other colleagues who have helped the task force. We are particularly indebted to M. Abrams and the INCF secretariat staff.

Informatics:

Databasing and Data Sharing [1]
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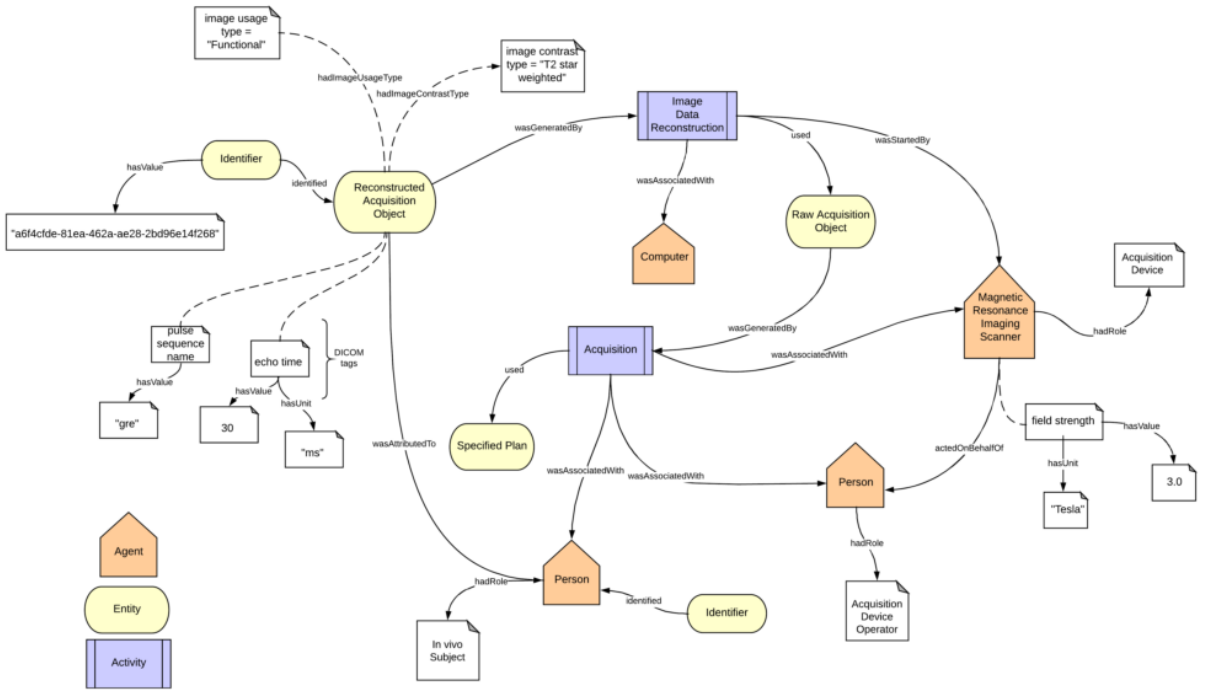
[1|2]Indicates the priority used for review



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Prov Ontology: https://www.w3.org/TR/prov-o/
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