

Utilizing NCBO Tools to Develop & Use an ECG Ontology

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The CardioVascular Research Grid (CVRG)

- CVRG = a *community resource* for the *distributed management, semantic description, federation,* and *analysis* of *both primary* and *derived* CV data
- CVRG is
 - * developing new CV-specific data management resources
 - * delivering CV data analysis tools and customized workflows
 - * creating easy to use, customized interfaces for accessing its resources
 - * providing these resources in a secure manner

CVRG-NCBO Driving Biological Project (DBP)

- Use NCBO tools ([Protégé](#), [BioPortal 2.0](#)) to develop, manage & access a comprehensive ECG ontology
 - * Original plan:
 - Use BioPortal to find pre-existing concepts (and their ontology)
 - Use Protégé to develop the ECG ontology
 - Load other ontologies into Protégé, to use their concepts without having to transcribe them
 - Use BioPortal to store and manage the ontology
 - * New plan:
 - **Develop a tool to utilize BioPortal's Representational State Transfer (REST) services, to obtain pre-existing ECG concepts & definitions and export them in OWL**
 - Use Protégé to extend the ontology with novel ECG concepts
 - Use BioPortal to store and manage the ontology

Benefits of the tool

- Concept Provenance
 - * Cites source of the concept & definition, providing a timestamp for the information capture
- Obtains a subset of pre-existing ontologies quickly
 - * Original plan required importing entire ontologies to use just a few concepts
 - Foundational Model of Anatomy (FMA)
 - Anatomical structure concepts
 - National Cancer Institute (NCI) Thesaurus
 - EKG wave concepts
- Enhancement of concept mapping to pre-existing ontologies
 - * Concepts and definitions match exactly, making mapping easy & automatable

Use Case – search “EKG” in NCI Thesaurus

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Java - NCBO REST/src/org/cvrg/org/bioontology/rest/RESTCaller.java - Eclipse Platform
File Edit Navigate Search Project Run Window Help
Problems Javadoc Declaration Console Search
<terminated> RESTCaller [Java Application] C:\jdk1.5.0_12\bin\javaw.exe (Mar 5, 2009 7:52:18 AM)
http://rest.bioontology.org/bioportal/ontologies
http://rest.bioontology.org/bioportal/search/EKG/?ontologyids=1032
http://rest.bioontology.org/bioportal/virtual/1032/Electrocardiography
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Concept
http://rest.bioontology.org/bioportal/virtual/1032/Electrocardiographic_Change
http://rest.bioontology.org/bioportal/virtual/1032/ECG_Delta_Wave
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Finding_Atrial_Enlargement
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Maximum_JT_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Maximum_PR_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Maximum_QT_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Maximum_RR_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Maximum_ST_Deviation
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_JT_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_P_Axis
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_PR_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_QRS_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_QT_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_RR_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_ST_Deviation
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Minimum_JT_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Minimum_PR_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Minimum_RR_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Minimum_ST_Deviation
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Normal_Axis_Deviation
http://rest.bioontology.org/bioportal/virtual/1032/EKG_P_Wave
http://rest.bioontology.org/bioportal/virtual/1032/EKG_QRS_Complex
http://rest.bioontology.org/bioportal/virtual/1032/EKG_ST_Segment_Depression
http://rest.bioontology.org/bioportal/virtual/1032/EKG_ST_Segment_Elevation
http://rest.bioontology.org/bioportal/virtual/1032/EKG_or_ECG_Device_Subassembly
http://rest.bioontology.org/bioportal/virtual/1032/EKG_or_ECG_Device_Monitor
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Maximum_ST_Depression
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Maximum_ST_Elevation
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_P_Wave_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_P_Wave_Height
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_R_Wave_Amplitude
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_R_plus_S_Amplitude
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_S_Wave_Amplitude
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_ST_Depression
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_ST_Segment_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_ST_Elevation
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_T_Wave_Area
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_T_Wave_Axis
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_T_Wave_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_T_Wave_Height
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Minimum_ST_Depression
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Minimum_ST_Elevation
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Finding_Left_Atrial_Enlargement
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Finding_Right_Atrial_Enlargement
```

Use Case Results

The screenshot displays the Protégé 3.3.1 interface for editing an ontology. The main window is titled "EKG Protégé 3.3.1 (file:IC:MEKG.pprj, OWL / RDF Files)". The interface is divided into several panes:

- Subclass Explorer:** Shows a hierarchy of classes under "owl:Thing", including "EKG_Concept" and "EKG_Delta_Wave".
- Class Editor:** Shows the details for the selected class "EKG_Delta_Wave". It includes a table of properties and values:

Property	Value	Lang
rdfs:comment		
dc:creator	Stephen J. Granite	
dc:date	2009-03-05 07:52:30	
dc:description	An initial slurring (delta wave) of the QRS complex due to the presence of an accessory pathway. This characteristic EKG pattern is typically seen in Wolff-Parkinson-White syndrome.	
dc:source	NCI Thesaurus	

- Asserted Conditions:** Shows a list of conditions, including "owl:Thing".
- Disjoints:** Shows a list of disjoint classes.

The bottom right corner of the interface has radio buttons for "Logic View" (selected) and "Properties View".

<http://bioportal.bioontology.org/visualize/40260>

Using the ECG Ontology: CVRG ECG Web Interface

- Prototype ECG Widget
 - * Leverages Google Web Toolkit (GWT; <http://code.google.com/webtoolkit/>)
 - * Leverages Google Visualization API (<http://code.google.com/apis/visualization/>)
 - * Can exist in a portal, a web page, a dashboard, a flash drive and/or a handheld device (e.g. G3 phone)
 - Expands avenues of access to the tool, “putting it in the hands of the users”
 - Functions on multiple platforms and multiple browsers
 - * Can internationalize the tools developed without requiring additional code

Web Interface Functionality

- Functionality implemented:
 - * Integrates the ECG workflows into one unified workflow
 - Accepts ECG formats workflows processed and stores in one format
 - Allows for in-memory translation to other formats
 - * Extends the capability of scrolling visualization of the ECG
 - Allows for annotation within the waveform, leveraging NCBO REST Services real-time

The screenshot shows the CVRG Grid Node web interface. The browser address bar displays `http://localhost:8888/org.cvrgrid.widgets.node.NodeWidget/NodeWidget.html`. The main content area is titled "HL7/WFDB Widget" and "ECG Annotation". It features a sidebar with navigation options: Connect, Store, Visualize, Analyze, and Review. The "ECG Annotation" window contains the following fields and controls:

- Time & Amplitude:** "Second: 1 .00 mV: 11" with a "lookup" button.
- Ontology:** A text input field containing "MN Code 1-1-1".
- Annotation:** A text area containing the text "Q/R amplitude ratio >= 1/3, plus Q duration >= 0.03 sec." with scrollbars.
- Buttons: "Save", "Delete", and "Close".

The screenshot shows the CVRG Grid Node web interface displaying an ECG waveform. The browser address bar displays `http://localhost:8888/org.cvrgrid.widgets.node.NodeWidget/NodeWidget.html`. The main content area is titled "HL7/WFDB Widget". It features a sidebar with navigation options: Connect, Store, Visualize, Analyze, and Review. The "Visualize" section is active, showing an ECG waveform with the following details:

- Time:** "19:08 January 01, 1970".
- Lead:** "Lead II Amplitude (mV) -69".
- Annotations:** "MN Code 1-1-1 Q/R amplitude ratio >= 1/3, plus Q duration >= 0.03 sec. 1970-1-1".
- Controls:** "Scroll Up", "Enter a filter term", "Scroll Down", and "Annotate".
- Language Selection:** "English | 中國 | German | 日本 | Spanish".

CVRG NCBO DBP Web Resources

- **CVRG Website** – Information about the CVRG
(<http://www.cvrgrid.org/>)
- **NCBO DBP Tool** – Project information and source code available via JHU ICM gForge site
(http://gforge.icm.jhu.edu/gf/projects/ncbo_dbp/)

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Questions and Discussion