Oponentura práce:
Tvorba Ontologie v EEG/ERP Doméně.
(Ontology Development in EEG/ERP Domain. Doctoral Thesis.)
Autor: Ing. Petr Ježek
Západočeská Universita v Plzni, Fakulta aplikovaných věd, Plzeň 2012.

Uvedená práce obnáší 127 stran textu, který je rozdělen do 15ti kapitol, má dále 59 literárních citací a 20 citací prací, kde je autorem nebo spoluautorem sám ing. Ježek, autor těchto thésí.
  Studie obsahuje řadu výstižných schémat, i barevných. Malý formální nedostatek je chybění souhrnu zkratek a jejich vysvětlivek, obojí je sice uváděno v textu, ale samostatný list by byl pro orientaci více praktický.
Autorovi jde o sbírání a tříděné dat, které lavinovitě ve svém množství ve světovém písemnictví narůstají a bez racionálního registru bude orientace brzy obtížná.
Z praktické potřeby udělat ve věci pořádek se dokonce vyvinula nová odborná disciplina, tak jako se kdysi z pouhého zeměměřičství vyvinula praktická a později teoretická geomterie a to již za časů Archimedových, jehož úvahy sahaly téměř k integrálnímu počtu. Podobně v lékařství se stalo s mikroskopem a mikroskopováním, které se před dvěma sty lety stalo histologickou vědou a dokonce i praktickou diagnostickou histopatologií.
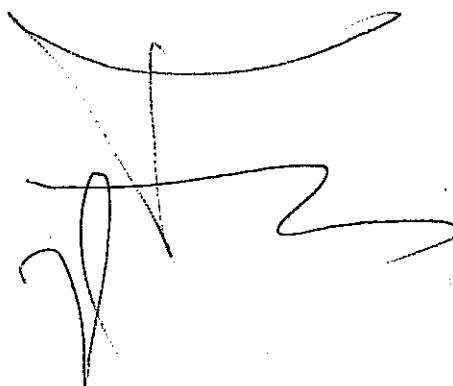Autor se specializuje na shromažďování dat v neuroinformatickém světě, kde se databáze definují do doménových ontologií pomocí jazyků tzv. Sémantického Webu. Současná „bibliografie" využívá „objektově-orientované jazyky. Autor se zdarem a vtipně řeší problém vhodného mapování faktů a vztahů v oboru EEG dat a EEG evokovaných potenciálů ve výzkumu zdravého i nemocného mozku.
Druhá část práce ukazuje problematiku sémantických rozdílů mezi algoritmy objektově-orinetovvanými a jazyky Sémantického Webu. Autor s úspěchem řeší tento problém zavedením Sémantického Framworku. Následující a poslední část studie popisuje EEG /ERP Portál, který je integrován se Sémantickým Framworkem , jenž umožňuje automatickou přeměnu uložených dat ze sledování EEG /ERP do jazyků Sémantického Webu. Nakonec si lze jen přát, aby výsledky této pozoruhodné studie „ zdomácněly" na našich i zahraničních pracovištích a umožnily nám rychlou orientaci v neuroinformatické faktografii.

Závěr: Předložená práce inženýra Petra Ježka o Tvorbě ontologie v EEG/ ERP doméně je velmi dobrá, dobře zpracovaná na teoretické logicko-matematické a „programátorské" úrovni a navíc praktická a užitečná. Plně si zaslouží jít k obhajobě a řádně oceněna a autoru být přiřčen titul doktor (PhD.) v oboru Informatika a výpočetní technika.
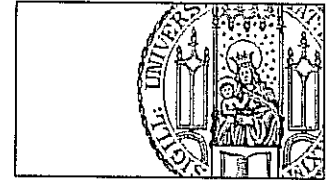
Prof. MUDr J.Faber, DrSc,
Dopravní fakulta, ČVUT, Praha, 17. května, 2012.

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Assessment of the PhD Thesis
"Ontology Development in EEG/ERP Domain"
written by Petr Ježek

In his work, Mr. Ježek comprehensively analyzed problems of development of the EEG/ERP portal, which is intended for transformation of stored experiments into the ontology representation. The topic includes EEG/ERP data formats, common systems for data modeling, semantic Web modeling, comparison and mapping of data models, construction of ontologies, and ontology development within the domain of EEG/ERP experiments. The problems of designing such a highly specialized portal that should serve as a comfortable and reliable tool for storage management, and sharing of EEG/ERP experiments are addressed. The author's approach to the topic was very responsible; he studied relevant work, performed well-founded analysis of the present state of problems being solved in the work, and made a creditable piece of work illustrated by several interesting examples. The topic of his doctoral thesis fully corresponds to its branch of knowledge and it is largely up-to-date from the point of view of the subject field development state.

The doctoral thesis is well organized into logical parts. The first chapter describes the aims of the thesis and major contributions of this work; chapters 2 - 6 give a nice introduction to the field and overview of the state of the art; the main work including the ontology development and significant results of the work are described in chapters 7 - 12. The last three chapters conclude with evaluations of the results and the authors perspective of future work.

This thesis is placed in the new research field dealing with the development of neuroinformatics databases. Data in these databases are supposed to be recognizable by interested researchers. To support the development of these databases the description of specific neuroscience fields is needed. Therefore, the scientific community is intensively working on description of individual neuroscience fields by domain ontologies, and the Czech neuroscience community is at the forefront of this development. An important aspect is that the domain ontologies are expressed by Semantic Web languages. In contrast, current neuroinformatics software tools are usually based on object-oriented languages and relational databases. Therefore, there is an urgent need to develop suitable mappings between these descriptions, a need that this thesis addresses exemplarily for the domain of EEG/ERP electrophysiology.

The work is focused on developing an ontology for EEG/ERP domain describing EEG/ERP experiments. The developed ontology is practically implemented together with the EEG/ERP portal. The goal of the EEG/ERP portal is to serve as a system for storing, managing and interchanging EEG/ERP experiments. The work presented in the thesis particularly solves semantic gaps between the object-oriented code and Semantic Web languages by adding missing semantics into the object-oriented code. The developed mapping is implemented within the presented Semantic Framework.

The integration of the Semantic Framework within the EEG/ERP portal ensures transformation of stored experiments into the ontology representation. Finally, the EEG/ERP portal is registered within the NIH Neuroscience Information Framework, the leading inventory of neuroscience resources worldwide, thus validating that the presented approach is relevant and practically sound.

The main practical result of the thesis can be seen in the proposal of an approach based on extending a common JavaBean using JavaAnnotations that adds missing semantics into the plain JavaBean. The definition of the mapping of Java annotations to the corresponding OWL constructs and the implementation of the developed framework are presented. This framework is a powerful tool for preparing domain ontologies extracted from object-oriented Java based systems, independent of the specific domain needs. Moreover, the use of Jena models is very reasonable. The EEG/ERP portal described in the twelfth chapter can be seen as the final main result of the thesis.

The doctoral thesis written by Mr. Ježek can be evaluated positively; Overall, there are no concerns regarding the relevance of the topic and results of the work. The used methods, standpoints and verification of the work represent not only valuable scientific results, but also show that the author is a motivated researcher with appropriate erudition. The content of the presented doctoral thesis will certainly be used as a suitable source material for many other studies and research projects.

I have the following comments and queries (more or less formal) to the content of the thesis:

- Section "Available Databases" (p. 40ff): The German INCF Node is running a data sharing platform (Herz et al 2008, Neural Networks 21:1070-1075; Rautenberg et al 2011, LNCS 6990:1-14), which provides a database for electrophysiological data, including data annotation, and should have been considered. The metadata approach developed at the German INCF Node is an alternative to conventional approaches (Grewe et al 2011, Front. Neuroinform. 5:16) and might be relevant for ontology development in this heterogeneous field.

- What do you mean with the term "specific metadata" (p. 60)?

- How did you implement the Annotation Tool? The description in the thesis is very short and not fully clear.

- You defined well the semantic groups in paragraph 11.2. Is this structure based on previous proposals? Is it sufficient? How does it relate to other approaches, like the NEMO ontologies developed by Gwen Frishkoff's group (Frishkoff et al 2009, Liu et al 2010)?

- Implementation of the EEG/ERP portal is very interesting, but given the amount of work, were others involved in the implementation? How much was done by yourself?

The doctoral thesis is well written and valuable. The content of the thesis shows the competence of the author to successfully implement and apply neuroinformatics resources. The illustration examples were chosen appropriately and follow up the theoretical conclusions very well. From the formal point of view, the doctoral thesis is nicely written, with only few formal or typographic errors, and it is on an appropriate graphical level.

In conclusion, this work brings several new pieces of knowledge; the core of this work was correspondingly published. The work can be qualified as a good doctoral thesis and I am happy to recommend to the Scientific Council of the Faculty of Applied Sciences of the University of West Bohemia in Plzen to award to the candidate the degree of Doctor of Philosophy.

PD Dr. Thomas Wachtler-Kulla