

Chapter 11

Methods for Ontology Alignment Change

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ABSTRACT

Different repositories of ontology are available on the web to share common understandings of the knowledge of different domains with semantic web applications. They store, index, organize, and share ontologies and alignments between them that allow applications to search for and use the appropriate semantics on the fly. The quality of the ontologies and the alignments between them is a great challenge to guarantee the usefulness of ontology repositories. Like ontologies, alignments are subject to changes throughout their life cycle, which can decrease their quality. As a result, alignments must be evolved and maintained in order to keep up with the change in ontology or to meet the demands of applications and users. This chapter reviews and classifies the main ontology alignment change approaches. In addition, the chapter presents a new approach for the alignment change problem. The approach proposes a general framework that consists of a process of change. Various methods, each with a specific purpose, are proposed to automate and support the change process.

INTRODUCTION

Ontologies and alignments between them enhance semantic interoperability for many Web applications such as Web services interoperability and query answering on the Web to name a few (Euzenat & Shvaiko, 2013). While ontologies provide specifications of the semantics of vocabularies in order to share a common understanding of domain knowledges, alignments overcome heterogeneity and diversity in these specifications.

With the emergence of the semantic Web, ontology repositories such as Swoogle (Ding et al, 2004), Watson (D'Aquin,, Gridinoc,, Angeletou,, Sabou,, & Motta, 2007), OntoSelect (Buitelaar, Eigner,, & Declerck, 2004), the DAML ontology library (<http://www.daml.org/>) and Schema.org (<http://schema.org>).

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org/) have proliferated and are accessible to a wide audience. They store, index, organize and share ontologies. Early semantic Web applications such as AquaLog (Lopez, Pasin, & Motta, 2005) and Magpie (Dzbor, Domingue, & Motta, 2003) integrate ontologies starting with the design phase. This hampers their dynamism to diversify their fields of application. Thanks to ontology repositories, a new generation of applications (Motta & Sabou, 2006) can find and use dynamically appropriate ontologies in the run-time. For instance, PowerAqua (Lopez, Motta, & Uren, 2006), the successor of AquaLog, is a cross-domain question answering system. It locates thanks to Watson (<http://watson.kmi.open.ac.uk/WatsonWUI/>), online semantics documents that match user's queries. Besides ontologies, some repositories such as Bioportal (<http://bioportal.bioontology.org>), AgroPortal (<http://agroportal.lirmm.fr/>), and Alignment server (<http://alignapi.gforge.inria.fr/aserv.html>) consider alignments as first class objects, enhancing the dynamic interoperability of ontologies. They, store, index, organize and share alignments. These infrastructures allow applications to seek and use on the fly the appropriate alignments.

The quality of ontologies and alignments between them is a great challenge to guarantee the usefulness of these repositories. Like ontologies, alignments are subject to changes throughout their life cycle, which can decrease their quality. Many reasons can trigger this change. Alignments cannot keep their consistency in time because of the dynamicity of ontologies. For instance, adding new knowledge in ontologies can make alignments inconsistent (Euzenat, 2015). Retracting knowledge from ontologies in response to some needs forces also alignments to follow this change. Another reason that can trigger the alignment change is alignment debugging and repair. Indeed, ontology matching tools may produce redundant, missed, or erroneous correspondences that can lead to an alignment inconsistency (Wang & Xu, 2008; Jean-Mary, Shironoshita, & Kabuka, 2009; Meilicke & Stuckenschmidt, 2009; Meilicke & Stuckenschmidt, 2007; Qi, Ji, & Haase, 2009).

As a result, alignments must be evolved and maintained in order to keep up with the change in ontology or to meet the demands of applications and users. However, methods for the alignment change should cover the following underlying issues:

- **Change Capture:** Alignments maintainers may request to express the alignment change in terms of predefined changes, to parse a journal of an ontology change, or to identify and make explicit the ontology change when only versions of the evolved ontologies are available.
- **Alignment Consistency:** Alignment change methods need to produce consistent alignments. The alignment consistency is expressed as a set of constraints qualified as hard since their violation makes the alignment obsolete and useless.
- **Minimality of Change:** Different ways may exist for resolving same inconsistency. One criterion that can guide the resolution is the principle of minimal change. Unlike consistency, the minimal change expresses a soft constraint since it doesn't affect the usefulness of the alignment. Which means; consistency constraints take precedence over minimal change during resolution of inconsistency. Sometimes, it is inevitable to sacrifice the minimal change against the consistency satisfaction. The challenge question is how to ensure the compromise between the consistency and the minimal of change constraints.
- **User Involvement:** The alignment change is a knowledge intensive task which can't be fulfilled without the involvement of users. Maintainers may want to review the change before its implementation. They may seek justifications for consistency violations, validate the change, recover the unnecessary changes, adapt, track, or cancel the change. Hence, they need a friendly easily interaction with the alignment change methods.

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