

RepOSE: an environment for repairing missing ontological structure

Patrick Lambrix, Qiang Liu, and He Tan

Department of Computer and Information Science
Linköpings universitet, 581 83 Linköping, Sweden

Developing ontologies is not an easy task and often the resulting ontologies are not consistent or complete. Such ontologies, although often useful, lead to problems when used in semantically-enabled applications. Wrong conclusions may be derived or valid conclusions may be missed. Defects in ontologies can take different forms. Syntactic defects are usually easy to find and to resolve. Defects regarding style include such things as unintended redundancy. More severe defects are the modeling defects which require domain knowledge to detect and resolve, and semantic defects such as unsatisfiable concepts and inconsistent ontologies.

In this paper we present a system, RepOSE (*Repair of Ontological Structure Environment*), that tackles a special case of the problem of repairing modeling defects, i.e. the repairing of missing is-a relations, and to our knowledge this system is the first in its kind. In the given setting it is known that a number of intended is-a relations are not present in the source ontology. The problem is then to find is-a relations (called a *structural repair*) such that when these are added to the ontology, all missing is-a relations can be derived from the extended ontology. For formal definitions we refer to [1]. Although the missing is-a relations themselves constitute a structural repair, this may not be the most interesting solution for the domain expert. For instance, in a real case based on the Anatomy track from the Ontology Alignment Evaluation Initiative 2008, we know that an is-a relation between *wrist joint* and *joint* is missing and could be added to the ontology. However, knowing that there is an is-a relation between *wrist joint* and *limb joint*, a domain expert will most likely prefer to add an is-a relation between *limb joint* and *joint* instead. This is more informative and would lead to the fact that the missing is-a relation can be derived. In this particular case, it would also lead to the repairing of 6 other missing is-a relations (e.g between *elbow joint* and *joint*).

We have developed a tool that generates and recommends possible ways to repair the structure of the ontology (based on named concepts and subsumption axioms) and that allows a domain expert to repair the structure of an ontology in a semi-automatic way. As input our system takes an ontology in OWL format as well as a list of missing is-a relations. We use a framework and reasoner provided by Jena (version 2.5.7). The domain knowledge that we use is WordNet and the Unified Medical Language System. The ontology and missing is-a relations can be imported using the *Load/Derive Missing IS-A Relations* button. The user can see the list of missing is-a relations under the *Missing IS-A Relations* menu (see figure 1). In our example case there are 7 missing is-a relations. Clicking on the *Compute Repairing Actions* button, results in the computation of possible ways to repair. The user can select which missing is-a relation to repair first. The missing is-a relations are ranked with respect to the number of possible ways to repair, and the first in the list may therefore be a good starting point. When the

user chooses a missing is-a relation, the possible sources and targets for is-a relations that can be chosen for repairing are shown in the panels on the left and the right, respectively. The concepts in the missing is-a relation are highlighted in red. The figure illustrates this for the missing is-a relation between *wrist joint* and *joint*. The user can also ask for recommendations by clicking the *Recommend* button. In our case, the system recommends to add an is-a relation between *limb joint* and *joint*. In general, the system presents a list of recommendations. By selecting an element in the list, the concepts in the repairing action are highlighted in the panels. The user can repair a missing is-a relation by selecting a concept in the left panel and a concept in the right panel and clicking on the *Repair* button. The is-a relation is then added to the ontology, and may lead to updates for other missing is-a relations. At all times during the process the user can inspect the ontology by clicking the *Show Ontology* button. Newly added is-a relations will be highlighted. After adding the is-a relation between *limb joint* and *joint*, not only (*wrist joint, joint*) is repaired, but all other missing is-a relations as well, as they can be derived in the extended ontology. The list of missing is-a relations is therefore updated to be empty. After completing the repair of all missing is-a relations, the repaired ontology can be exported into an OWL file by clicking the *Save Repair* button.

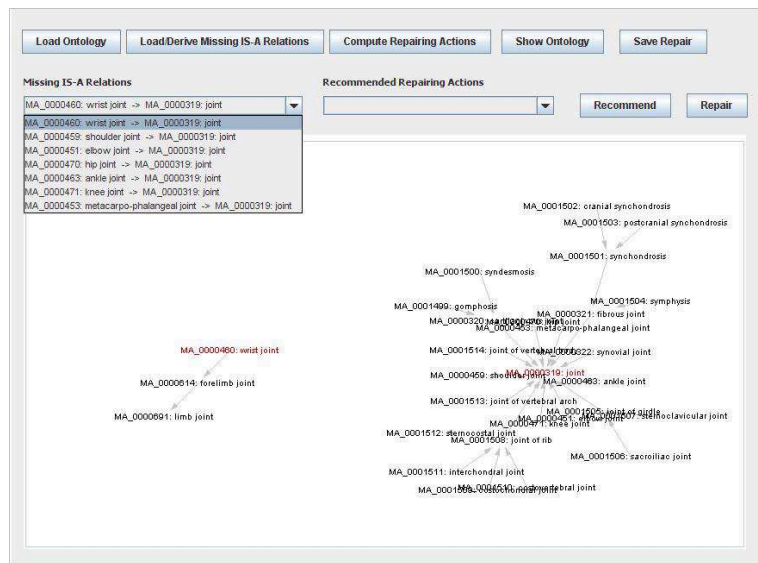


Fig. 1. Screenshot.

References

1. Patrick Lambrix, Qiang Liu, and He Tan. Repairing the missing is-a structure of ontologies. In *Proceedings of the 4th Asian Semantic Web Conference*, 2009.