

# SNePS As An Ontological Reasoning Tool

Jonathan P. Bona, Stuart C. Shapiro

University at Buffalo, The State University of New York, Buffalo, NY, USA

## Abstract

*SNePS is a logic-based Knowledge Representation, Reasoning, and Acting system. We have created extensions to SNePS that allow its use as an ontology reasoning system, combining (1) instance data stored in a Referent Tracking<sup>1</sup> system, (2) facts from domain ontologies such as FMA, and (3) rules from a domain-independent ontological theory. This paper discusses the first of these.*

## Introduction

SNePS is a Knowledge Representation, Reasoning, and Acting system that combines elements of network-based, frame-based, and logic-based systems, with models of inference appropriate to each paradigm.<sup>2</sup> SNePSLOG, the logical language of SNePS is higher-order, allowing variables to range over predicates and function symbols, and term-based, allowing proposition-valued terms to be arguments of other functional terms. The software interface that is the subject of this paper connects SNePS to a prototype implementation of a referent tracking system (henceforth “The RTS”).<sup>3</sup>

Electronic health systems in the Referent Tracking paradigm improve on previous systems by making unique, explicit, reference to individual particular entities in the world, universals, and the relationships that hold between and among these.<sup>1</sup> Each particular entity to which the system refers has assigned to it a globally unique identifier, which is used to refer to the entity in assertions about it that are stored in the system. Such assertions may also refer to universals and relations defined in external ontologies such as the Foundational Model of Anatomy (FMA), and to concept codes from SNOMED CT and others.

## SNePS/RTS Interface

We have implemented an interface that allows SNePS to import data from an online RTS system in real time as it is needed in the course of reasoning, or as the result of a query, and perform inference on that data.

Entries stored in the RTS can be viewed as tuples, each representing an assertion by an agent that a state of affairs was observed at one time to obtain at some time. There are tuples to represent that a particular instantiates a universal, that a particular stands in some relation to other particulars, and more.

For example, the *Particular-to-Universal* tuple:

*<id1,2004.03.23 21:37:53, instance of, OBO\_REL, id2, Face, FMA, 2004.03.23 21:37:53 >* says that the entity with id *id1* asserted on 23 March 2004 at 21:37:53 that the entity with id *id2* instantiates, via the *OBO\_REL* relation *instance of*, the FMA universal *Face* on 23 March 2004 at 21:37:53.

These assertions are represented in SNePS as *Asserted(p,t,asn)*, meaning that *p* asserted at time *t* that *asn*. Each assertion, *asn*, is represented by a proposition-valued functional term. For example, *Inst(p,u,r,t)* means that entity *p* instantiates universal *u* via relation *r* at time *t*.

The information in the *PtoU* tuple above is represented in SNePSLOG as the formula:

```
Asserted(id1,  
         time(2004,03,23,21,37,53),  
         Inst(id2, universal(Face, FMA),  
             relation(OBO_REL, instance_of),  
             time(2004,03,23,21,37,53)))
```

## Conclusion

This interface allows SNePS to access instance data in the RTS *as needed* in the course of answering a query or performing other reasoning tasks. It provides a simple way of querying the RTS system from SNePS. This interface may also be used in combination with SNePS’ native reasoning and acting capabilities to perform advanced reasoning tasks with patient data in a referent tracking system. In a similar manner, SNePS can import data from other sources (ontologies, concept systems, etc.), and combine them with data from the RTS.

## References

1. Ceusters, W. and Smith, B. Strategies for referent tracking in electronic health records. *Journal of Biomedical Informatics*. 2006; 39:362-378.
2. Shapiro, S. C. and The SNePS Implementation Group (2008). *SNePS 2.7 User’s Manual*. Department of Computer Science and Engineering, University at Buffalo, The State University of New York, Buffalo, NY.
3. Shahid Manzoor, W. C. and Rudnicki, R. Implementation of a referent tracking system. *International Journal of Healthcare Information Systems and Informatics*. 2007;4:41-58.