VAMP: A Semantic Validation Service for MPEG-7 Profile Descriptions

Martin Höffernig, Michael Hausenblas, Werner Bailer, Peter Schallauer
JOANNEUM RESEARCH Forschungsgesellschaft mbH
Institute of Information Systems & Information Management
Steyrergasse 17, 8010 Graz, Austria
firstname.lastname@joanneum.at

ABSTRACT

MPEG-7 profiles are a way to reduce the syntax variability of MPEG-7. Semantic constraints of an MPEG-7 profile are guidelines, which explain how the tools of an MPEG-7 profile should be used. Since these semantic constraints are defined in natural language, an automated semantic validation of the conformance of MPEG-7 descriptions to an MPEG-7 profile is not possible. This paper describes the VAMP web application for the validation of MPEG-7 descriptions with respect to semantic profile constraints and semantic temporal constraints in a machine understandable way. VAMP enables the quick and direct observation of error locations in MPEG-7 descriptions.

Categories and Subject Descriptors

H.5.1 [**Information Interfaces and Representation**]: Multimedia Information Systems

1. INTRODUCTION

MPEG-7 [6], formally named Multimedia Content Description Interface, can be used to create complex and comprehensive metadata descriptions of multimedia content. To reduce the syntax variability, MPEG has introduced profiles, which constrain the way multimedia descriptions should be represented for particular applications. The specification of a profile consists of a XML schema and guidelines, which explain how these descriptors should be used and combined. These guidelines are denoted as semantic constraints of an MPEG-7 profile [7]. Since these semantic constraints are written in natural language (informal specification), they are not machine understandable. Therefore the validation of the conformance of MPEG-7 descriptions to the semantics of a given profile is not possible automatically. In order to enable a machine understandable semantic validation, it is necessary to express the semantic constraints of MPEG-7 profile explicitly by formalising these constraints.

Another class of semantic constraints are semantic temporal constraints, which can be regarded as independent of an MPEG-7 profile. The semantics of a temporal decomposition is apparent, for example the temporal extent of a child segment must be in the temporal extent of its parent segment. However, the validation of semantic temporal constraints is also not possible on the syntactic level.

Different approaches have been made to completely formalise the semantics of MPEG-7 description tools using an OWL ontology [3, 9, 5, 1]. We propose the use of Semantic Web technologies to represent only those MPEG-7 semantic constraints defined in natural language that cannot be expressed using XML schema. Our approach for expressing the semantics of profile constraints using ontologies and logical rules is presented in [8]. The validation of MPEG-7 descriptors against temporal semantic constrains is described in [4].

These two approaches are the basis for VAMP [10], which is a Semantic Web application for validating the conformance of MPEG-7 documents to the semantics of a given profile and additional to temporal constraints.

2. GENERAL WORKFLOW

First, the MPEG-7 input document is checked for syntactic validity against the MPEG-7 XML schema and the selected Profile XML schema. A syntactically valid MPEG-7 input document is a necessary precondition to start the semantic validation. Second, the MPEG-7 description is converted into RDF with respect to an ontology capturing the semantics of the selected profile. In this step a XSL transformation and additional classification rules are applied. Finally, these RDF triples are the input data for the semantic consistency check. In this step, validation rules based on the profile and temporal ontology are used. After the semantic consistency check, possible validation violations can be retrieved using a SPARQL query.

3. THE VAMP WEB APPLICATION

VAMP is a web based application with a graphical user interface (Figure 1). First the user enters the URI of the MPEG-7 document to be validated. For the demonstration of VAMP, some demo examples are provided and can be selected alternatively. The next step is to select the MPEG-7 profile, to which the input MPEG-7 description should conform to. Then the semantic validation type is selected.

Therefore two different semantic validation types are available, which can be combined: profile validation and tempo-

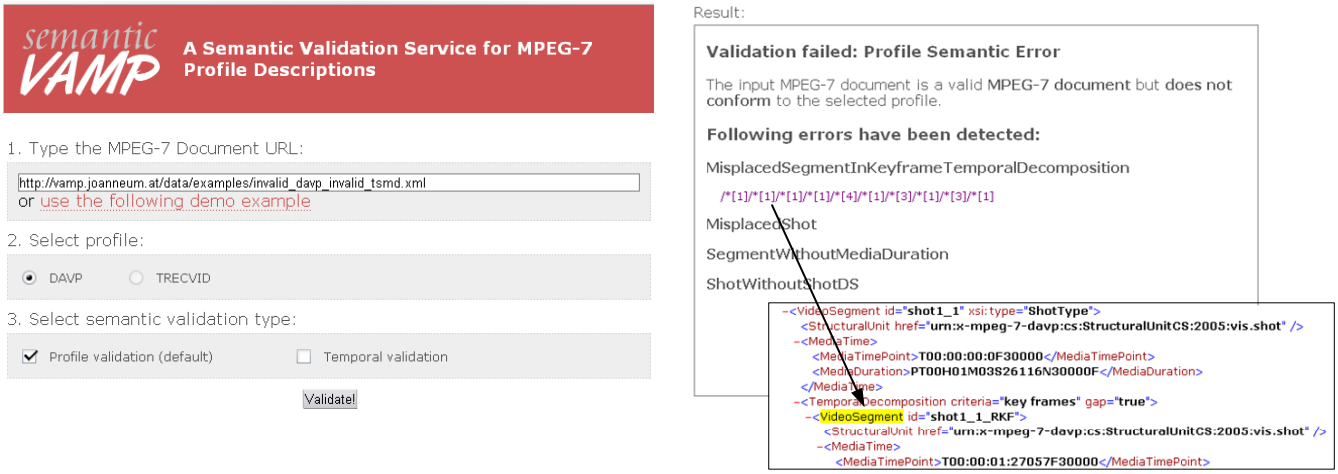

Figure 1: The VAMP web interface (left), visualisation of the validation result (right).

ral validation. The profile validation may include structural semantic constraints. For example the formalisation of the Detailed Audiovisual Profile (DAVP) [2] contains the concepts of shots and key frames. In this context a semantic constraint denotes, that a key frame can only be included in the decomposition of a shot. An example of the temporal validation is the verification of parent-child relations. The temporal extent of a child segment must be inside the temporal extent of its parent segment.

The `Validate` button provides a meaningful validation report of the input MPEG-7 document (Figure 1, top right). All detected semantic errors are listed in the result window. For each semantic error, all XML elements, which caused this error, are listed. These XML elements are identified by XPath expressions, which enables the direct observation of the error locations in the input MPEG-7 document (Figure 1, bottom right).

At the time of writing many parts of the DAVP are formalised and available in VAMP. Formalisations of other profiles (SMP, CDP, UDP) and de-facto profiles (such as the TRECVID format) are planned in the near future.

4. ACKNOWLEDGMENTS

The research leading to this paper was partially supported by the European Commission under the IST contract FP6-027026, "K-Space: Knowledge Space of semantic inference for automatic annotation".

5. REFERENCES

[1] R. Arndt, R. Troncy, S. Staab, and L. Hardman. Adding Formal Semantics to MPEG-7: Designing a Well-Founded Multimedia Ontology for the Web. Technical Report KU-N0407, University of Koblenz-Landau, 2007.

[2] W. Bailer and P. Schallauer. The Detailed Audiovisual Profile: Enabling Interoperability between MPEG-7 based Systems. In *12th International MultiMedia Modelling Conference (MMM'06)*, pages 217–224, Beijing, China, 2006.

[3] R. Garcia and O. Celma. Semantic Integration and Retrieval of Multimedia Metadata. In *5th International Workshop on Knowledge Markup and Semantic Annotation (SemAnnot'05)*, Galway, Ireland, 2005.

[4] M. Höffernig, M. Hausenblas, and W. Bailer. Semantics of Temporal Media Content Descriptions. In *Multimedia Metadata Applications Workshop at I-MEDIA'07, Journal of Universal Computer Science (J.UCS)*, pages 155–162, 2007.

[5] J. Hunter. Adding Multimedia to the Semantic Web - Building an MPEG-7 Ontology. In *First International Semantic Web Working Symposium (SWWS'01)*, Stanford, California, USA, 2001.

[6] MPEG-7. Multimedia Content Description Interface. ISO/IEC 15938, 2001.

[7] MPEG-7. Information technology – Multimedia content description interface – Part 9: Profiles and levels. ISO/IEC 15938-9:2005, 2005.

[8] R. Troncy, W. Bailer, M. Hausenblas, P. Hofmair, and R. Schlatte. Enabling Multimedia Metadata Interoperability by Defining Formal Semantics of MPEG-7 Profiles. In *1st International Conference on Semantics And digital Media Technology (SAMT'06)*, pages 41–55, Athens, Greece, 2006.

[9] C. Tsinaraki, P. Polydoros, and S. Christodoulakis. Interoperability support for Ontology-based Video Retrieval Applications. In *3rd International Conference on Image and Video Retrieval (CIVR'04)*, Dublin, Ireland, 2004.

[10] VAMP Web Application. `http://vamp.joanneum.at`.