

ECAI-96 workshop on validation, verification and refinement of KBS: A short report

MARIE-CHRISTINE ROUSSET¹ and SUSAN CRAW²

¹*L.R.I., U.R.A C.N.R.S., University of Paris-Sud, Building 490, 91405 Orsay Cedex, France (email: mcr@lri.lri.fr)*

²*SCMS, The Robert Gordon University, Aberdeen AB25 1HG, Scotland, UK (email: smc@scms.rgu.ac.uk)*

1 Introduction

Ensuring reliability and enhancing quality of Knowledge Based Systems (KBS) are critical factors for their successful deployment in real-world applications. This is a broad task involving both methodological and formal approaches for designing rigorous Validation, Verification and Testing (VVT) methods and tools. Some of these can be adapted from conventional software engineering, while others rely on specific aspects of KBS.

In recent years, KBS VVT has become a significant area of research, as demonstrated by the appearance of the specialised EUROVAV symposia and annual workshops associated with major AI conferences such as ECAI, IJCAI, AAAI. In particular, the two biennial series of EUROVAV symposia and ECAI workshops have provided an annual meeting place for the European KBS VVT community. The most recent of these was the “Validation, Verification and Refinement of KBS” workshop held in association with the ECAI-96 conference at Budapest in August.

This workshop was successful from several perspectives. Firstly, there were 20–25 participants at this workshop; higher than the average attendance at the 30 competing ECAI-96 workshops. In addition, the workshop audience was truly international; many European countries were represented, but in addition, there were two American attendees, one Australian speaker and one Hong-Kong participant. Secondly, many interesting, and sometimes even heated, debates occurred involving both presenters and participants, creating a lively and productive atmosphere.

2 Main topics

The workshop programme committee worked hard to select the papers to be presented at the one-day workshop. From 26 submitted papers, seven were accepted for a long presentation and 10 for short talks. Four main topics emerged from the accepted papers, and these formed the themes of the four workshop sessions. Each of the sessions ended with a mini-panel where there were lively discussions which continued over the coffee and lunch breaks.

2.1 Representational issues for verification and validation

The common theme of the papers presented in this session considered verification as a logical analysis of the knowledge base (KB) expressed in a declarative knowledge representation language. In addition to providing good representational properties associated with clearly defined inference algorithms, a declarative language also allows anomalies or discrepancies, between the knowledge represented in the KB and the actual knowledge, to be revealed by identifying logical inconsistencies with respect to some constraints that are known to hold in the domain. This approach, often referred to as the “verification approach”, is one line of research in the VVT community for the early stages in the KBS lifecycle. These papers provided three main ideas. First, a better understanding of the verification problem, in terms of complexity and decidability, based on the

properties of the representation languages used to express the knowledge. Second, new representation languages to express and verify knowledge were considered. Description logics were proposed in two papers as a logical language with good properties for representing and verifying structured knowledge, and also able to be combined with logical rules. Third, new properties, such as completeness or determinism, which are desirable for some applications, like control systems, were studied from a logical point of view. The programme of the session follows:

- “A computer algebraic method for verification and deduction in KBS: Theory and implementation”, L. M. Laita and E. Roanes, Spain.
- “Verification of KB based on containment checking”, A. Levy and M-C Rousset, USA and France¹.
- “Exclaim: A hybrid language for knowledge representation and reasoning using description logics”, L. Badea, Romania.
- “Logical support for design of RBS: Reliability and quality issues”, A. Ligeza, France.

2.2 *Modelling issues for verification and validation*

This session contained papers that integrated the verification or validation processes into the modelling stage of a KBS. Most of them considered KADS-like conceptual models, and proposed ways to verify some aspects of the models. Some issues related to verifying conceptual models expressed in formal languages turned out to coincide with representational issues for verification. This is not surprising, since we are faced with the same problem: verification is reduced to some formal analysis of the language used to express the knowledge. However, a heated discussion saw the advocates of a knowledge modelling approach opposed to the supporters of a more direct knowledge representation approach. The debate was started by the claim that the formal languages used to formalise conceptual models were at a better level of abstraction than the logical formalisms used to represent knowledge. A more unifying view is to point out the complementary nature of these first two sessions: the first session concentrated on the verification of domain knowledge, whereas the second one focussed more on the verification of control knowledge. The classification of formalisms used to express the knowledge in levels of abstraction is still open to debate. The papers in this session follow:

- “Fuzzy decision tables: Modelling and verification/validation issues”, J. Vanthienen and G. Wets, Belgium.
- “Applying rule-base anomalies to KADS inference structures”, F. van Harmelen and M. Aben, The Netherlands.
- “Correctness of methods w.r.t problem specifications”, C. Pierret, France.
- “Specification and verification of KBS”, D. Fensel, A. Schonegge, R. Groenboom and B. Wielenga, The Netherlands.

2.3 *Refinement of KBS and verification and validation issues*

The programme committee chose to highlight this area of related research and dedicated an entire session to KBS refinement; a new departure in these VVT workshops. Knowledge refinement is the process of revising the KB in order to correct errors that have been revealed by a verification or test process applied to the KBS. The refinement problem can be viewed from several perspectives. From a purely logical point of view, it is the process of restoring the logical consistency. Within machine learning, the aim is to refine an existing domain theory in reaction to a set of examples and counter-examples. When considered as knowledge debugging, the goal is to correct the KB whilst preserving the existing modelling work as much as possible. Furthermore, refinement tools tend to be advisory

¹This paper was presented at the AAAI-96 conference, where it received a best paper award.

systems that assist the knowledge engineer by proposing repairs, but it is he who normally eventually decides which refinement actions are appropriate. The papers presented in this session addressed different and complementary issues. First, the refinement problem was addressed as the continuation of the detection of inconsistencies revealed by a verification approach. The minimal causes for an inconsistency were computed and formed the basis for the refinement actions that were proposed. Second, refinement was investigated as a debugging process in reaction to wrongly solved cases identified during testing. The final review paper pointed out interesting connections between the refinement process for debugging and theory revision in the context of concept learning. The refinement papers are now listed:

- “Explaining anomalies as a basis for KB refinement”, N. Zlatareva, USA.
- “Automated refinement of a product formulation expert system”, R. Boswell and S. Craw, United Kingdom.
- “A knowledge-based tool for the incremental construction, validation and refinement of large KB”, R. Nouira and J-M Fouet, France.
- “From theory refinement to KB maintenance: A position statement”, A. Abecker and K. Schmid, Germany.

2.4 VVT issues for new AI systems and applications

The last session was dedicated to the presentation of issues raised by new AI systems, and lessons learned from practical applications. This session resulted in a wide-ranging set of talks. One paper advocated the use of abduction as a generic process for both the execution and testing of KBSs covering a wide range of problem solving tasks. Other papers considered the effect of particular knowledge representations on VVT processes. Another paper proposed a verification method for distributed KBS to support the increasing popularity of multi-agent architectures. A paper describing experiences from a real application on the use of KADS-like models and their validation noted that the generic nature of a conceptual model is a major drawback in its validation by a domain expert. The final session contained the following papers:

- “Generalised test = generalized inference”, T. Menzies, Australia.
- “An approach towards the verification of fuzzy hybrid rule/frame-based expert systems”, S. Shiu, J. N. K. Liu and D. S. Yeung, Hong-Kong.
- “Verification of multi-agent KBS”, N. Lamb and A. Preece, United Kingdom.
- “Validation of rule bases containing constraints”, A. Bendou and M. Ayel, France.
- “Which formalism to validate: Experience of a KADS model validation”, I. Andre and G. Bezard, France.
- “Validation and verification: A modal approach”, J. Hoelter, France.

3 Conclusion

All the accepted papers were issued to the attendees as an informal workshop proceedings, but the organisers are currently investigating getting these workshop papers published. It is important to mention that most of the papers (or their abstracts) are available on the web²:

<http://www.csd.abdn.ac.uk/~apreece/ECAI96/workshop.html>

This workshop showed that the KBS validation community has reached a degree of maturity where links with other communities, such as the knowledge acquisition, knowledge representation, and KB refinement/revision communities, benefit everyone. One objective of this workshop was to

²Alun Preece (University of Aberdeen) has to be thanked for creating the web pages for this ECAI-96 Validation, Verification and Refinement of KBS workshop.

initiate and strengthen these links to provide cross-fertilisation between these related areas. On behalf of the programme committee, we would like to thank the presenters and participants of the workshop for very interesting papers and fruitful panel discussions that enabled this objective to be attained. However, it is unfortunate that only a few papers from KBS practitioners are submitted to VVT workshops; only a synergy between academic work and practitioners' needs and experience will allow the field of KBS Validation, Verification, Testing and Refinement to progress significantly, thereby supporting the development of knowledge-based applications.

Finally a date for the diary—EUROVAV'97 will be the next European meeting for researchers and practitioners working on, or interested in, issues related to the Verification and Validation of KBS. It will be held in Leuven, Belgium in June 1997, the fourth in a series of EUROVAV meetings held in Chambéry, France ('95); Palma, Spain ('93); and Cambridge, United Kingdom ('91).