05/5103 Formal knowledge representation of the system level spacecraft design domain

Type of activity: Medium Study (4 months, 25 KEUR)

Background

In principle, the knowledge behind the spacecraft system design can be captured by describing and relating domain specific

- strictly formal information (like physical equations, performance data sheets, etc.), and
- less formal text information (like the main guidelines on how to design a spacecraft).

The aim of the study is to assess the feasibility and descriptive power of logic (and related techniques) to represent the basic design information, the guidelines, and the main relations between the system components. The representation would cover both quantitative and qualitative information and the feature of changing time frames as the design evolves. By using automated reasoning, the formalized "knowledge" could then used to verify the consistency of a particular design, or it would propose guidelines on how the design could further evolve. In more advanced forms, such a knowledge base / reasoning system would be a useful tool for education and training, too. To the best of our knowledge, there were no attempts made yet to formalize even smaller parts of the space system design domain.

Study Objectives

- Assessing the feasibility of representing the spacecraft design knowledge and design process with the aid of first or higher order logic, taking care of both quantitative and qualitative information. The assessment would be based on attempting to formalize specific sections of spacecraft design textbooks and course notes.

- Proposing alternative and more suitable methods for the domain knowledge description in case formal logic turns out to be not suitable to achieve the above main goals.

- Assessing the required amount of expert involvement for a long term, more detailed formal knowledge representation study.

The initial formalization results should be delivered in a form which is suitable for further knowledge engineering work.

References

[1] S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach. Prentice Hall, 2002.

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[3] J.R. Wertz and W.J. Larson, Space Mission Analysis and Design. Kluwer, 1999.

[4] J. Schaefer, R. Alber, S. Rudolph, Satellite Design by Design Grammars. German Aerospace Congress 2003, Munich, Germany.