A Note on MMiSS

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In this note, the MMiSS project is sketched. MMiSS is the acronym of *MultiMedia instruction in Safe and Secure systems*. The project started in 2001 and will run for three years. It is supported by the German Federal Ministry for Education and Research, bmb+f, in its programme *New Media in Education* and has five partner universities:

- Universität Bremen (Martin Gogolla, Hans-Jörg Kreowski, Bernd Krieg-Brückner (coordinator), Arne Lindow, Christoph Lüth, Jan Peleska, Markus Roggenbach, Lutz Schröder, Hui Shi),

- Universität Freiburg (David Basin, Felix Klaedtke, Jan-Georg Smaus, Burkhart Wolff),

- FernUniversität Hagen (Marc Jelitto, Bernd Kraemer, Nathalie Poervantoro, Arnd Poetzsch-Heffter, Jin Sun),

- Ludwig-Maximilians-Universität München (Florian Hacklinger, Fred Kroeger, Stefan Merz, Martin Wirsing),

- Universität des Saarlandes (Dieter Hutter, Paul Libbrecht, Erica Melis, Jörg Siekmann, Carsten Ullrich).

The aim of the project is the development of a multimedia Internet-based adaptive educational system the content of which will cover a whole curriculum in the area of safe and secure systems. Traditional teaching materials such as transparencies, handouts, exercises are to be converted into a new hypermedia format integrated with tool interactions for formally developing correct software. The MMiSS system is intended to be suitable for learning on campus and for distance learning as well as for interactive, supervised, or co-operative self-study. Coherence and consistency are especially emphasised through extensive semantic linking of teaching elements and through a process model borrowed from the theory of formal software development. The idea is to enlarge the knowledge base with the help of version and configuration management

to ensure sustainable development, i.e. continuous long-term usability of the contents and tools.

The MMiSS system is not meant for the project partners only. On the contrary, the teaching materials and tools will be made freely available so that a much greater national and international take-up is to be expected. To assist this, a MMiSS Forum has been founded with German and international members from academia and industry to evaluate the emerging curriculum and support its development and distribution. The advisory board shall advise the project from a scientific as well as an industrial perspective including a view to future applications.

The area of safe and secure systems has become increasingly important in the last years. Software is widely used to control safety-critical embedded systems in aeroplanes, spaceships, trains and cars, and electronic trading over the Internet with growing security risks. Therefore, there is a growing need of education and training in methods and tools to develop safe and secure software.

The hypermedial adaptation of a series of classes on the development of safe and secure systems is at the core of the system. Lecturers using the system should be able to store various sorts of course materials, such as overhead transparencies, bibliographies, books, lecture notes, comments, exercises, animations and so on, and retrieve them later for use in teaching. The system provides a formal framework for the integration of teaching materials based on a semantic structure, an ontology, and enables fast access to individual teaching elements. An initial collection of teaching materials is already available and will be further developed as part of the project. It covers the use of formal methods in the development of provably correct software and includes data modelling using algebraic specifications, modelling of distributed reactive systems, handling of real-time with discrete events, and the development of hybrid systems with continuous technical processes, so-called safety-critical systems. The curriculum also covers informal aspects of modelling, and introduces into the management of complex developments and security.

The system will also contain a meta-database providing methodological, ontological and pedagogical knowledge about the content. The teaching materials should be available in several different variants whenever this is meaningful. It should be left to the teachers or to the students to choose between variants according to the educational or application context.

An important educational aspect is to teach about the possibilities and limits of formal tools. Tools for formal software development should be integrated in the system to illustrate and experience the contents to be taught. Thus students doing assignments can use the system to test their own solutions while gathering experience with non-trivial formal tools. The integration of didactic aspects with formal methods constitutes a new quality of teaching. It will become possible, for the first time in formal methods,

both to present a variety of formal tools as a subject for teaching, and to use them as a new medium. Thus an algorithm can for example be simultaneously developed, visualised, and verified.

The goal of applying the new system in as many universities and companies as possible, and the fact that the area of safe and secure systems will continue to develop in the future, requires a high level of flexibility, extensibility and reusability of the content. It should be possible to extend incrementally or adapt content and meta-data to suit the teacher's individual requirements and to keep them up-to-date.

As the individual parts of the curriculum rely on each other, there is a network of semantic dependencies, which the system should be able to administer. Thus it must at the least handle version and configuration management. The ontology additionally allows better support for orientation and navigation within the content. It should also form the basis for adaptation to the user, for example by learning from exercises which concepts the students have understood, and adapting future assignments accordingly.

The formalisation of semantic dependencies means that the system can help maintain the consistency of the content. Definitions must be coordinated to suit each other; the removal or adaptation of part of the material may force the removal or adaptation of all dependent concepts. In formal software development, a similar problem has to be solved: there are also semantic dependencies between different parts of a development, for example between specification and implementation. Some of the project partners have already developed techniques for the administration of such dependencies as things change, and implemented them in development tools. Here we perceive an important synergy between expertise in formal software development – and support tools – and the demands of long-term sustainable administration of consistent multimedia materials in an efficient and productive educational system.

In this very brief note, the aims and scope of the MMiSS project have been sketched. Everyone who wants to see more about it can find further information on the MMiSS webpage `http://www.mmiss.de`.