

Real-time Software for Versatility, Scalability and Reconfigurability in Complex Embedded Feedback Control Systems

ARTES project no: A4-9805

Status report for the ARTES internal evaluation

1. PROJECT GOAL AND STATUS

The goal of this project is to progress the state of the art on software architectures for complex control systems. A specific goal of the project is to provide a system architecture suitable for scalable, maintainable and reconfigurable mechatronic systems controlled by an embedded distributed computer system. These are requirements found by the legged locomotion systems that are being studied and used as a case study within the project.

The project is jointly supported by ARTES and the Centre for Autonomous Systems (CAS), each providing funding corresponding to one PhD student. So far one PhD student (De-Jiu Chen), corresponding to the ARTES funded one, has started within the project.

Since the project has been recently started this is a brief status report that provides information on what has been done so far and points towards future directions. Other information about the project (including remarks on scientific merits, industrial relevance and exploitation) can be found in the project application, [1].

2. PROJECT ACTIVITIES SO FAR

The project builds upon earlier projects carried out at the mechatronics lab. As a result of this, the initial state of the art report of the project is expected to be ready early this autumn, and a preliminary summary of it will be presented at the SNART conference, [2], and is enclosed for the ARTES evaluation.

The state-of-art survey discusses and introduces the bases for architecture based system development, including,

- the definitions and scope of the concept,
- architectural quality attributes,
- architectural description/modeling,
- usable analytical/non-analytical methods,
- architectural styles/patterns/ principles.

99-09-22, a seminar on architecture will be arranged by the mechatronics lab at the Royal Institute of Technology, see the enclosure for a preliminary program. The seminar, which is arranged to stimulate a discussion on research on architecture, includes presentations on system architecture, software architecture, industrial case studies/experiences and ongoing research in our project.

A dialogue with SAAB Combitech Software has been started. It is probable that a closer cooperation with this company will be formed within the project.

3. FURTHER IDEAS IN THE PROJECT (spurred by the state of the art study)

These ideas should be seen as complementary to the ones presented in the project proposal, [1].

- The most important property offered by adopting the architecture concept in the system development process is the possibility of quality predictions. Thus, the useful concepts (together with the analytical/nonanalytical methods) have to be elaborated for complex control systems.
- Since there may be some system properties that can not be fully created at the architectural level, how to provide the reasonable assumptions (e.g., reliability estimations and execution time budgets) of the upcoming system should be considered.
- To facilitate the work of quality predictions, architectural styles/patterns/principles (especially control styles) should be further elaborated for the system.

- Another important and inherent issue is the architecture description of the system, i.e., how to provide proper means to record the architectural information in a form such that it may be used (communicated, analyzed, manipulated) and re-used.

4. REFERENCES

[1] Wikander Jan, Christensen Henrik, Törngren Martin. *Real-time Software for Versatility, Scalability and Reconfigurability in Complex Embedded Feedback Control Systems*, Research proposal to ARTES. ARTES project no: A4-9805.

[2] D.J. Chen, M Törngren, *System Architecture in a Mechatronics Perspective*. To appear in Proc. of the SNART'99 conference, Linköping, August 24-25, 1999.

5. ENCLOSURE:

Preliminary program: "Swedish architecture seminar" at KTH, September 22, 1999

>> 09.00 Registration/coffee
>> 09.30 Introduction to the DOORS project
>> Project leader Prof. Jan Wikander
>> Introduction to architectures for embedded systems
>> Bengt Asker, Swedish National Board for Industrial and Technical
>> Development
>> 09.45 Keynote 1 - Prel. Prof. Mark Maier (confirmed)
>> 10.45 Coffee
>> 11.15 Architectures for Autonomous Systems with examples from the CAS
>> walking robot. DAMEK/KTH (speaker to be decided)
>> 11.45 Architectures and Testability for embedded real-time systems
>> PhD, Henrik Thane, MDH
>> 12.15 Lunch
>> 13.15 Keynote 2 - Professor Jan Bosch (confirmed)
>> [http://www.ipd.hk-r.se/\[bosch,RISE\]](http://www.ipd.hk-r.se/[bosch,RISE])
>> Research in Software Architecture (title not confirmed)
>> 13.55 Industrial experiences I: Volvo Wheel Loaders
>> Mikael Gustavsson, ENATOR (confirmed)
>> 14.25 Coffee
>> 14.45 A mechatronics perspective to architecture based design
>> De Jiu Chen, DAMEK/KTH
>> 15.15 Industrial Experiences II:
>> Anders Magnusson, Combitech Software (confirmed)
>> 15.45 "Requirements engineering and architecting"
>> Industrial control systems/KTH (confirmed)
>> 16.15 Discussion and conclusions