WITAS

Wallenberg Laboratory for
Information Technology and Autonomous Systems
at Linköping university, Sweden

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Chapter 2.1

WITAS Phase I (1997-1999): Summary of achievements

Erik Sandewall

Related information can be obtained via the following WWW pages:

Linköping university:	http://www.liu.se/
WITAS Project:	http://www.ida.liu.se/ext/witas/
Author's Department:	http://www.ida.liu.se/
The author:	http://www.ida.liu.se/~erisa/

The results of the WITAS project during 1997 and 1998, and the ongoing work during 1999 is reported in Chapters 2:2 – 2:6 which follow. The present Chapter 2:1 is a brief summary.

Organization

Since its start on 1997-01-01, WITAS has consisted of four subprojects, each led by a senior scientist and involving between three and eight persons, most of them in the interval between 50 percent and 100 percent time for the effort. (See the annex for the list of current subprojects and project members). The project is led by a Project director, professor Erik Sandewall, who in turn reports to a Board that has been appointed by the Rector of Linköping University. The Board meets twice a year, follows the progress of the project, and makes recommendations on budgets and on the proposed directions of the project. The recommendations of the Board are made available to the Knut and Alice Wallenberg Foundation, which sponsors the full cost of the project.

The joint WITAS system is developed by requesting a part of the time of the subproject members, and is done under the authority of a System development director, docent Patrick Doherty. Under the direction of the Board, the project has defined a suite of *demonstration events* (demos) which have been completed in December 1997, April 1998, and December 1998. The third demo had in fact been scheduled for the spring of 1999, but since good progress was made and almost all the intentions had been completed, we chose to make it earlier than had initially been scheduled.

Results from the first two years: 1997 and 1998

The December, 1998 demonstration event verifies that we have now a WITAS Software System (WISS) for research purposes which has the following essential properties:

- A simulated UAV flies in a simulated operational environment ("virtual reality") of the kind that is defined in the WITAS challenge, that is, over a system of roads where cars move around.
- The UAV simulation is based on a quite precise, mathematical model of a helicopter, which has been obtained from contemporary literature and under the direction of an expert from Saab Dynamics, civ.ing. Erik Skarman.
- The control system of the simulated UAV contains the required levels of control, up to a "deliberative" layer where the system is able to predict the possible actions of cars that it observes, and to take "intelligent" action with respect to them.
- The simulated UAV also contains a computer vision system that analyzes images that are obtained from the virtual reality. The vision system provides the results of that analysis to the cognitive layers of the architecture. It makes use of new advances in computer vision technology. Parts of it have been structured as a set of relatively independent "skills", thus moving away from the traditional concept of a monolithic vision system. In this way the higher levels of the WISS

architecture are able, more than before, to control the allocation of computational resources within the scene understanding process.

- The computer vision system has been developed on the basis of research frontline techniques that must be run in laboratory environments and on very powerful computers when they are in their development stage. In our system, some parts of the computer vision algorithms have been transferred to a compact computer system that weighs only a few kilograms, and that can therefore realistically be brought on board a small conventional UAV. As the project proceeds, all the vision algorithms will be transferred to the on-board computers. Further minimization using various VLSI techniques is also foreseen.
- The UAV simulation and the virtual operational environment are constructed using a combination of commerically available software tools and the results of our own research. The grahical rendering software is a standard, commercial product. The project develops a modelling system and language, Modelica, for describing complex, object-oriented systems. In this respect it particpates in an international, cooperative effort that is intended to lead to standardization.
- The developed system has a clean, well defined, and well documented architecture that lends itself to the replacement of modules and the extension with additional subsystems. In particular, modules communicate by TCP/IP connections, which means that different modules can be located on different nodes in the Internet, even at arbitrary distance from each other. The architecture therefore provides an excellent platform for the continued reseach.

Each of the participating subprojects has also developed results in the form of theory, methods, and software tools that are relevant for the overall goals, but that have not (yet) been used in the integrated WITAS system.

Work during 1999

This proposal for work during the years 2000-2003 is written in March–April, 1999. The continued work during 1999 is done within the presently approved allocation (1997-1999), and focuses on the following:

- Using the WITAS Software System (WISS) as a tool for continued development and extension of knowledge modules, WISS defined UAV behaviors, and improved computer vision capabilities.
- Continued work on the WISS system itself, turning it into a reliable tool for the work according to the previous item.
- Specification and planning for the development of the WITAS On-board Computing System (WOCS). The concrete implementation of the WOCS will begin with Phase II.
- Exploration of the use of the modelling language, Modelica, for the creation of a second operating environment for the WISS system. The new operating environment concerns automatic "service stations" where the UAV can refuel, load and unload cargo, and in general perform operations that require docking against other autonomous devices. More about this in the plans for Phase II.

- Exploration of techniques for human-machine interaction between operator and UAV, and integration of a Geographical Information System (GIS), in the context of international cooperation.

Electronic Publication

WITAS has also facilitated the development and operation of the Electronic Transactions on Artificial Intelligence, which is a new kind of publication and communication medium for research results. The ETAI makes full use of the Internet's capability for rapid communication and on-line information service. It is now emerging as a trend-setter since similar initiatives, inspired by the ETAI, are being planned in several other disciplines.

Costs

The Wallenberg Foundation initially approved a total allocation of 40 MSEK for the first three years of this seven-year project. Actual costs during 1997 and 1998 plus the budget for 1999 total 36.5 MSEK, leaving adequate room for making use of additional opportunities that may arise during 1999.