

ADAPTATIONS TO THE EMBEDDED CONTROLS ENGINEERING CURRICULUM IN SWITZERLAND

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Abstract: The technical and political requirements for the control-engineer curriculum changes all the time. In Switzerland new research institutes based on UAS are started with governmental support. This paper presents the environment and shows some topics of research in the domain of distributed control. *Copyright © 2003 IFAC*

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1. CHANGE MANAGEMENT IN AUTOMATION TECHNOLOGY

In the last 10 years the control technology changed dramatically: The central controller is not wired anymore directly to all sensors and actuator, but the star cabling is replaced by a Fieldbus. This reduces the installation costs and gives a much more flexible system.

These developments required new skills also in the education (Sauter and Felser, 1999) and led to the concept of Fieldbus Competence Centres which was also supported by the EC. In the world of PROFIBUS this concept of PROFIBUS Competence Centres (PCCs) has also a good success: Today 23 PCCs are accepted by PROFIBUS International (PI) in more than 17 countries. These PCCs offer similar services around the world and meet once a year to co-ordinate their activities and exchange technical information about new developments in the Fieldbus world.

To get a uniform distribution of knowledge about Fieldbus technology, a certification program of network engineers was introduced by the PROFIBUS Integration Center (PIC). This program was taken over by the Manchester University of Technology (MUT) and the University of Applied Science (UAS) of Bern (Felser, 2000). Until today several hundreds engineers followed this identical certification program on the three different locations offering this education program.

1.1 Technical Changes.

The technical developments do not stop. Today more and more of the control functions are distributed over several controllers, the importance of the industrial networking is increased. In automation technology dedicated Fieldbus get replaced more and more by solutions based on the Ethernet technology. Also the PROFIBUS system is enlarged by a version PROFINet based on Ethernet transmission technology. This requires a adaptation of the control-engineer curriculum: the knowledge on Fieldbus must be enlarge with knowledge of Ethernet and TCP/IP technology. The technology used in the domain of automation differs a little bit from the technology in the domain of the information techniques (Felser, 2001a; Felser, 2001b).

1.2 Political Changes.

In the same time the political situation for technical engineering education changed in Switzerland. The traditional engineering schools are replaced by 7 new founded Universities of Applied Sciences (UAS). To ensure the high quality of the UAS, there was a scientific inspection trough self-assessment, Peer Review, Meta evaluation and formal inspection of the UAS by different national and international delegations. Based on the results of this evaluation the 7 UAS will receive the final authorisation for the different study programs by end of 2003.

The UAS are active in the areas of technology, management, design (federal jurisdiction), health sciences, social work, art, music and teacher training.



Fig. 1. The different UASs in Switzerland.

All study programs must fulfil a good quality of service in the domain of degree courses, further education courses (NDS, NDK), applied research and development (aR&D) and third-party services and proof cooperation with third-level academic and research institutions at home and abroad.

Table 1 Key Figures of UAS in Switzerland

Number of UAS	7
Students	17'000
Study Programs	220
Postgraduate Courses	140
Costs approx.	740'000'000 CHF
Reseach/Services approx.	137'000'000 CHF

To support the different UAS to set-up and improve their capacity in the domain of applied research and development, the government prepared different research support programs.

The Commission of Technology and Innovation (CTI) gives his support to different projects proposed by the UAS and the local industry

2. NETWORKS OF COMPETENCE

The Office for Professional Education and Technology (OPET) defined the target, that the UAS should define national networks of competence.

2.1 National Networks

Accepted national networks are given the permission to use a trademark protected logo. These national networks must be based on more than topic, be based

on more than one location and offer all services with international cooperation.

At the moment there are networks accepted for Information and Communications Technologies Network (ICTnet), Integrale Produktion und Logistik (IPLnet), MICROSWISS network, Netzwerk Holz (building with wood), Swiss BiotechNet, National Network for E-Business and eGoverment (ecademy.ch), building and renewable energies network of technology (brenet), Network Public Management (puplinet.ch) and MatNet. At the moment, there is no network in the domain of automation technology accepted as national network.

2.2 Soft[net] Program

To fill this gap, the OPET started the Soft[net] research program, to support the software development skills in Switzerland. This program was founded with CHF 30'000'000 and supported and still supports more than 50 projects during a four year period (2000-2003).

Inside this program is also space for the support of embedded control technology.

2.3 EDiSoN

To simplify the cooperation between the different research groups at the 7 UAS dealing with embedded control, a technological network of competence, the Embedded and Distributed Solutions Network (EDiSoN) was founded. This EDiSon network is supported by the Soft[net] Program by different projects.

3. PROJECTS IN EMBEDDED CONTROL

The following projects are currently running in EDiSoN and will be finished before 2003:

3.1 Industrial Ethernet Real-Time Aspects

Reliable real-time communication for hard-real-time communication over Ethernet. The research projects includes the development of special hardware to measure signal delays in the range of microseconds. First results are already published by Scheitlin (2002).



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un réseau de compétences national des Hautes écoles spécialisées
una rete di competenze nazionale delle Scuole Universitarie Professionali
a national Network of Excellence of the Universities of Applied Sciences

Fig. 2. The protected logo of the national networks in Switzerland

3.2 Secure Communications in Distributed Embedded Systems

The objective of this project is to implement a lightweight but cryptographically secure communications protocol that due to its compact size and generic code structure can be ported easily to many popular 16 and 32 bit embedded system platforms. The project will focus on the well-known SSL/TLS transport-layer protocol because it uses fewer resources than the more complex IPsec network-layer protocol that could be tackled in a follow-up project.

Since data encryption and public key authentication operations can be extremely time-consuming on a low-end embedded system platform, a cryptographic coprocessor will be designed and realized using a fast prototyping technology based on FPGAs. The coprocessor will accelerate the modern AES encryption and ECC authentication algorithms thus allowing the use of secure communications in low-delay real-time embedded systems.

3.2 Web-enabled devices

Integration of Web Technology in embedded systems with minimal requirements of resources.

3.2 PROFInet Competence Centers (PNCC)

A new project started in 2003 to improve the knowledge in distributed control based on the standard IEC 61158 Type 10 (Sauter and Felser, 2002). This project is performed by three different UAS and has different phases: Setup of a demonstration plant on all three locations, implementation of the freeware protocol stack on a new platform (Commercial PLC) and set-up of a training program for future engineers.

The goal of this project is to get access to this new emerging technology, to enable the UASa to support the local industry with education, training and with consulting on the topic of distributed control technology with PROFInet.

The financial support of the Soft[net] program will only be provided, if the research centres are accepted by PROFIBUS International as PROFInet Competence Centre (PNCC) before end of November 2003.

4. CONCLUSION

With this new legal base and the financial founding of the Swiss government a new type of research centres of applied research was launched in Switzerland. They will try to get also contacts and collaborations with other research centres in the same domain in Europe and all over the world.

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