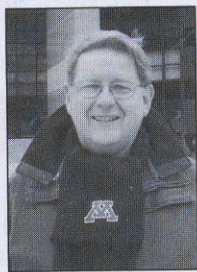


A letter from America



I spend a sabbatical year at University of Minnesota, working with profs. Ned Mohan and Bill Robbins. They are heavily engaged in revision of the way courses in power electronics and electric drives are taught. Mainly based upon this but also on the initiative of prof. Werner Leonhard (see EPE Journal Vol 10 n^o 2) and the EPE chapter conference on education, $E = T_e M^2$, on all the sessions and panel discussions on education at EPE and EPE-PEMC conferences, (at EPE-PEMC 2002 there will be a tutorial and a session including a panel discussion on education), I would like to open for some debate.

- Power electronics and Electric drives, PE&ED, are commodities,
- There are no jobs in designing electric machines,
- Few students apply for courses in PE&ED,
- At some universities in USA courses in electric machines and even power electronics are cancelled,
- Some European universities introduce Master programs in electrical power engineering taught in English to compensate for the reduction in their native student enrolment.

Students are clever; they see where the jobs are; with old fashion teaching the students see no applications and no jobs, so the enrolment is dropping.

There is a need for changes in PE&ED education at universities

How should universities cope with this need? We must prepare the students for jobs in industry.

More must be done in less time

The teaching should be a top-down approach with basis in applications. This is no new thought: it has been stated: "Students are more interested in applications that convey a vision, such as environmental issues, energy saving, electro-medicine or mobility. The systems aspects should be stressed instead of components."

Sure, fundamentals must be known in order to apply converters in systems. This means that there is only need for two fundamental courses in electric machines and power electronics: These courses are outlined hereunder, they are already implemented in Minneapolis. The basic course in Electric drives is implemented in many universities in the USA, and in Cork, Ireland and Delft in The Netherlands.

Power electronics

- Start with appealing applications,
- Use building block (two-port) approach, thus the teaching of all power converters can be done in an efficient and non time consuming way;
- Include control, illustrated by simulation with a professional tool for waveforms in time and labs where easy to implement digital control through a PC is utilized,
- Introduce magnetics design to provide a clear understanding of why switching frequency should increase and also as background for lab,
- The concept of thermal design should be introduced,
- The topics are taught in "just in time" or as needed basis,
- An attractive lab is a part of the course, every week a new experiment is offered.

Electric drives

- Start with appealing applications,
- Courses in electric machines and in power electronics are not a prerequisite, an integrative approach should be used,
- Necessary power electronics is taught by building block (two-port) approach,
- Necessary electric machines theory is taught without including machine design related topics nor description of outdated machines,
- Include control, illustrated by simulation with a professional tool for transfer functions and labs which implement digital processors,
- An attractive lab is a part of the course, where the machines are controlled through a professional easy to program digital processor,
- A well balanced textbook must be available.

There should not be too many power-engineering courses. In addition to the required courses, the students should be advised to attend courses in control, digital control, programming of Digital Signal Processors and FPGAs (Field Programmable Gate Arrays), environment issues, making web sites, economics to get the competence needed to work in small industry or even to start a company. These courses will also give good background for starting a Ph.D. study.

The approach described above for teaching electric machines as electric drives has already paid off at some universities in USA where the student enrollment has tripled from one year to the next. This is by just changing the way the course is presented in the syllabus.

The new courses are based upon discussions among about 250 US professors at four workshops over the year supported by the National Science Foundation and NASA. Workshop # 5 was organized in Arizona in January of 2002. Hopefully there will also be a workshop in January of 2003.

Another basic course should be developed: Power Electronics in Power Systems. This course could be a bridge between power electronics and power systems. Topics like distributed generation and new renewable energy sources as wind and solar energy will make such a course attractive. Also here applications should be the basis and students will see where there are jobs.

It might be useful to think about organising similar reflections in Europe. EPE and its chapter on Education is the ideal forum for this. Let's communicate and start the process to help renewing the Electrical Engineering studies.

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