New Education Trends in the Interdisciplinary Areas of Electromagnetic Compatibility

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***Abstract* – As we look at the environmental issues from the viewpoint of overall technical progress, we should give, as soon as possible, the same priority to the issues of electromagnetic compatibility (EMC) in the context of teleinformatic systems development. Due to its interdisciplinary nature it requires specific approach within the educational system since it introduces substantial benefits for the developing information society, mainly in the areas of teleinformatic systems reliability and human health protection. The educational process must respect both the said interdisciplinary nature and also the specific approach with respect to the individual engineering branches, including the possibilities of technical equipment for laboratory education. Also the hygienic aspects of EMC cannot be omitted. It is necessary to bring enlightenment to the wide public, but also to improve the approach to education and training of prospective specialists for the industry.**

Index Terms – Electromagnetic compatibility, Teleinformatic systems, Engineering education.

INTRODUCTION

As the 19th century was called "the century of steam" and the 20th one "the century of electricity", it is a question how the 21st one will be labeled. We can estimate that perhaps "the century of computers" but of course there are many possibilities. The changes in the technology (and in society as well) we can witness in the recent years are faster then ever before. That should be our motivation for education of the young generations in the disciplines that can substantially influence the future of mankind.

EMC – THE ECOLOGY OF ELECTRICAL TECHNOLOGY

In the times when the individual electrical "systems" were operated quite independently or just with a loose link to the other ones (e.g. power distribution, electrical engines, radio transmitters and receivers etc.), it was the main goal of the specialists to ensure reliable operation of "their own" system, maintaining the necessary economical effectiveness; they did not take into account how this "their" system affected the operation of the other ones and what measures had to be taken by the other operators to eliminate the disturbing effects and ensure reliability of the other systems. The situation today is totally different.

In order to have an extensive system for production and distribution of electricity effective enough, it is necessary to use higher and higher voltages and currents and to employ high-power electronic regulators. In many cases high signal power has to be used also for communication systems (major radio and TV transmitters, ripple control systems etc.).

On the other hand, the development trends in process control and communication require using of very low voltages and currents in microprocessor systems as well as in data transmission and processing. For example, a control computer connects to a technological process through numerous sensors and often through very long (hundreds of meters) cables conducting low-level signals (mV and mA). Especially in heavy machinery works, the cables are exposed to powerful electromagnetic fields that may induce voltages of tens or even hundreds of volts.

Another problem is that various systems of different nature that used to be housed separately are being placed in close vicinity of each other, in smaller and smaller rooms (e.g. thyristor regulators built into a textile machine or into a machine tool together with microprocessor control blocks). Substantial changes in the technologies used in electronic elements may also remarkably worsen the coexistence of different systems.

As a reflection of the necessary coexistence of electrical systems (mutually as well as in relation to living organisms), the new discipline – electromagnetic compatibility – was established in the 60's of the last century.

Although EMC always analyzes the mutual relations of two or more systems, each of them being both the interfering and the interfered one, we usually regard one of the systems as the source of electromagnetic interference and all the other ones as the objects of interference; then we reverse the approach, regarding the first system as the interfered one and evaluating how it is influenced by all other systems forming its surrounding electromagnetic environment, looking for possible effects of the interference.

Like in the ecology, also in the area of EMC we have to differentiate between interfering effects, which are related to the intended function of the disturbing system, and undesired parasite electromagnetic products (such as sparkles on contacts etc.). According to that, we focus the methods and measures minimizing the disturbance either on the source of interference or on the disturbed object.

The described overview represents also the suggested pedagogical approach to the problems EMC, taking into account the logical division of the discipline as a basis for the engineering education.

EMC IN THE CONTEXT OF TELEINFORMATICS

The initial period of computer technology development, the important thing was the possession of important tools for calculations of all types and for processing of mass data processing (e.g. for statistical purposes). Computer became an excellent essential instrument. This development was also reflected in the approach to education of young generations. We can remember that in the recent period the education of computer science penetrated all types of schools very quickly, within the education projects supported by the state. The said penetration, however, was often too much forced. The imbalance between the technical and organizational capabilities for real practical employment of computer technology and, on the other side, the efforts to learn every student the art of programming resulted in partial antipathy towards computers in a certain group of young people (and their parents). Despite that, we can witness the new situation: for the former generations, the most attractive area of electrical engineering was radio technology or television and studio technology; nowadays, the most desired branch is computer science, which is now also – more and more – referred to as informatics. The probable reason is that a considerable part of the young population has entered the computer world very quickly and promoted the programming and the work with computer technology to the most important subject, while the others are not interesting for them any more. Among the students of technical universities, this trend has been reflected in lower concern about other disciplines of electrical engineering.

However, the view of computer technology and computer engineering has been substantially changing since certain time. Along with the development of technology, the computer means are more and more used for the control of technological (and even social) processes. The original term "computer" is often replaced by other ones, such as "processor", "microprocessor", "microcontroller", "control terminal", "communication terminal", etc. Besides that, it is becoming clear that the increased effectiveness of computer technology means is being shifted from their typical local applications towards cooperation with remote access tools. The importance of high-speed data transmission systems and broadband access networks is growing – today they are reaching almost all buildings. And the problems of electromagnetic compatibility (including their handling) are becoming the logical and very important consequence of this trend.

The purpose of this paper is to attract the attention to some aspects of the described situation and propose some ways leading to its solutions. The emphasis is laid on some problems concerning the buildings for offices and homes, not the (much more complicated) issues of special-purpose objects, such as manufacturing halls, power devices and systems, telecommunication facilities, hospitals, etc.

A special area is emerging, called "EMC of Fixed Installations". With respect to the development of teleinformatics, especially radio means, it is necessary to consider also another sub-discipline – EMC of biological systems; which studies the disturbing effects of so-called non-ionizing radiation on living organisms. The given term, non-ionizing radiation, comprises the electromagnetic waves with frequencies up to 1.7×10^{15}Hz, as well as the static and low-frequency electric and magnetic fields. The EMC of biological systems deals with the general "electromagnetic background" of our environment and determines the acceptable levels of disturbing (undesired) and useful electromagnetic signals with respect to their influence on living organisms.

EDUCATION IN THE AREA OF EMC

The transformation towards information society results in successive transition of students' interest from traditional informatics towards teleinformatics – and it is important to realize that the electromagnetic compatibility is its important part. The mutual links between teleinformatics and EMC should be reflected in new approach to education in the respective areas – the earlier, the better.

At most faculties of electrical engineering, the education in the area of electromagnetic compatibility is provided within independent courses. However, with respect to the issues described above, the curricula should be much more differentiated in order to meet the needs of the individual electrical engineering areas, paying more attention to laboratory exercises (measurements of spatial and conducted disturbing radiation and testing of the electromagnetic susceptibility of electronic devices).

As EMC plays a key role in the contemporary world (especially that of fixed installations), it is advisable to pay the same attentions to the curricula at faculties of mechanical, civil and transportation engineering. Also the problems of influencing living organisms by electromagnetic fields should be lectured, including the respective hygienic standards. Subsequently, the overview of EMC-related problems should be included also in curricula of e.g. faculties of medicine and law.

We have already pointed out that EMC has similar meaning for electrical systems in all areas of human activity as ecology has for other areas of national economy. That should be reflected in education at all levels, including lifelong learning of wide technical public.

The change of attitudes towards some aspects of education is necessary within the preparation for the developing information society, in order not to lag behind in the critical moments of change, to enter successfully the century, which will perhaps be called "the century of new technologies and new approaches to life".

ACKNOWLEDGMENT

This paper has originated thanks to the support obtained from the Czech Universities Development Fund (FRVŠ) within the grant No. 2537/2007-F1a.

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