INTERDISCIPLINARY IT RESEARCH: DIGITAL SIGNAL PROCESSING

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There are several areas of information technologies (IT) practical implementations, where in the most explicit way are observable effects, which can be called as interdisciplinary. In means, that almost identical data processing procedures can be used in a very different and looking not related with each other practical applications – exact measurements, technical systems control, image processing, medical diagnostics, financial mathematics, economical forecasting etc. Since first year IT students learn how to open file for reading/writing, pass through standard for all IT courses sorting/searching algorithms and foundations of mathematical statistics, they are ready to participate in a very wide area of IT activities, which is called as digital signal processing (DSP). DSP has almost unique combination of properties, which makes it so attractive from theoretical and practical points of view, that at Ventspils University College we make DSP as one of core elements for IT students preparation and recommend to do the same for other universities. The reasons are as follows.

At first, DSP has deep relations with computer science foundations. At the stage of first year students teaching to abstract Turing, Post, von Neumann, Markov machines we stress, that input text transformation into output text is possible for texts of different natures - not only for alphabet symbols strings (words) but for real time data from different sensors (signals) also. The interpretation of signals as input "words" for future processing allows to describe many possibilities to use computers as measurement and control tools for industrial processes, manufacturing, telecommunications and describe digital signal processing as a base for industrial electronics.

At second, DSP is simple for beginners. Digitalized and recorded signal from data storing point of view is file and elementary signal processing procedures (calculation of moving averages and deviations) are so simple and evident, that study of them is very pleasant for even weak students. The possibility to reach interesting and significant results (e.g. low frequency speech receiving by demodulation from high frequency radio signal) by simple methods is very attractive for students. There are so many complicated things in computer science that something efficient, but relatively simple, is accepted by students with enthusiasm.

At third, DSP has many practical applications and therefore is very important from the point of view of possible applications. Many practical tasks are related with DSP and together with Department of Mathematical Modeling of Engineering Research Center of Ventspils University College we created such tasks collection.

We have samples of tasks which were solved by DSP from industrial mathematics (identification of leaks in pipe lines), financial mathematics (currency exchange rate analysis), exact measurements (very large base radioastronomy), business administration (sells forecasting) etc. Large amount of practical tasks gives the possibility to raise interest of students for practical applications.

At fourth, there is a lot of complicated mathematics in DSP, which makes it interesting from intellectual point of view. There is a whole set of mathematical methods of different complexities, which can solve the same task (noise filtering, for example) with different degrees of exactness. The simplest way to extract signal from noise is to use moving averages. More complicated is Kalman filtering. More complicated is singular spectral analysis. Weak methods are simple, effective methods are complicated. It is interesting to start signal analysis from simplest methods and consequently improve them to receive better and better results until algorithm became efficient enough to reach necessary exactness. Possibility to compare results of simple methods with results of complicated methods is useful for explanation of complicated methods necessity. It is possible to demonstrate in clear way, that sometimes there are no other ways to solve problem than to use complicated methods.

At fifth, in DSP the same methods can be used in completely different areas and it is very interesting to show, how it is possible to implement methods, which were developed to analyse pressure oscillations in pipelines, for financial time series analysis. In this sense DSP relatively rare example of interdisciplinary science, because developed methods can be used in different areas.

At sixth, there is a lot of software for DSP, starting from standard MATLAB DSP Toolbox up to specialized packages, which makes it possible to use complicated algorithms for practical tasks solving. Of course, there are always tasks, that can not be solved with standard tools and in such cases it is necessary to realize appropriate DSP algorithms by direct programming.

All these and whole set of others properties makes DSP as a very attractive tool for IT students education. Ventspils University College has certain experience in DSP implementation for different practical tasks solving, including industrial mathematics, space technologies, financial mathematics, and uses it for IT student's education to ensure close contacts with the needs of business and industry.