Al-Khawarizmi Institute of Computer Science (KICS) was established in 2002 to promote industry/academia collaboration in Pakistan. Since its inception, KICS has been involved in basic and applied research, local and international collaboration, consultancy and outsourcing, and design and development of hardware/software systems that can fulfill the requirements of local industrial and academic institutions.

The main focus areas of KICS cover a broad range of electrical engineering and computer science. Our software technologies group provides outsourcing and consultancy services to software industry and develops open-source based solutions to serve the information management needs of local organizations. The embedded system group develops hardware/software solutions for industrial automation, data logging, surveillance, and monitoring. The DSP/Image processing group, that has developed the FlexTrainer, provides solutions based on real-time implementation of DSP and Image Processing algorithms on FPGA and DSP Processors.

There are other groups actively engaged in research in High Performance Computing and Networking, Optical Networking, and Wireless Sensor Networks.

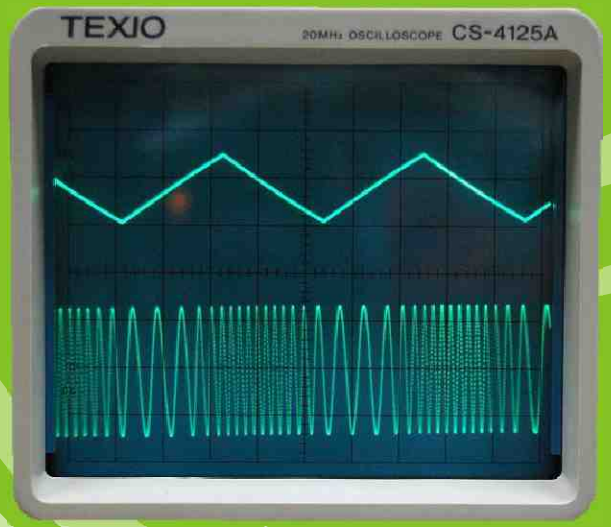
For more information about KICS, please visit
http://www.kics.edu.pk/

**Al-Khawarizmi Institute of Computer Science,
University of Engineering & Technology, Lahore.**

FlexTrainer is an indigenously developed hardware/software platform that can be used for hands-on training of undergraduate students in Electrical Engineering, Computer Engineering and Telecom Engineering. The hardware of the trainer is built around an industry-standard DSP board,which is housed in a sturdy steel-metal casing.

Input signal is supplied to FlexTrainer from either a signal or another FlexTrainer.The processed signals are either displayed on an oscilloscope or are fed to another FlexTrainer. the user interface consists of an LCD and a few switches.

The FlexTrainer provides a training platform where students select different experiments and values of relevant parameters to see the real-time implementation of different modulation / demodulation schemes. The firmware of these algorithms was indigenously developed by KICS Research Team.



Frequency modulation with a triangular signal

FLEXTRAINER

A Unique Hardware/Software Platform for Hands-on Training of DSP and its Applications

**Al-Khawarizmi Institute of Computer Science,
University of Engineering & Technology, Lahore.**

Salient Features

FlexTrainer is a unique hardware/software platform for developing the understanding of undergraduate students about basic concepts of communication systems. Its salient features are :

- Based on Analog Devices BF-537 Processor
- Built-in 24bits/sample stereo CODEC running at sampling frequency of 48 kHz.
- 20x4 character LCD for display of results
- Eight push buttons for entering the parameters
- BNC connectors for signal input/output

To have a complete laboratory setup, most of the experiments require a FlexTrainer, a signal generator and an oscilloscope. More complex experiments, that model end-to-end modulation/demodulation schemes, require two FlexTrainer, up to two function generators and an oscilloscope. A simple two-channel analog oscilloscope with capability to operate in the X-Y mode is sufficient for the experiments available on FlexTrainer

We are developing a special signal generator which will not only generate sinusoidal, triangular and square waveforms but will also serve as a microphone pre-amplifier for modulation/transmission/demodulation of speech signals.

Another module is under development that will simulate time-varying frequency selector channel in the audio range. Incorporation of this module will allow the students t o see the effects of non-ideal channel on the performance of different modulation/demodluation schemes.

For latest information on Flex Trainer, please visit
http://www.kics.edu.pk/dsp/flextrainer.php

List of Experiments

The following experiments have been implemented in the firmware of FlexTrainer. These experiments can be divided into five groups, as shown below:

The first group of experiments enables a students to undertstand the working of the FlexTrainer and fundamental concepts of signal analysis. Quantization and FIR Filtering enables students to have a good understanding of internal representation and real-time processing of different signals. To strengthen the harmonic analysis concepts, two experiments about Fourier synthesis and Fourier analysis are included. The Spectrum analyzer transforms a simple oscilloscope to audio-range spectrum analyzer, which can be used in combination with other experiments to graphically see the spectrum of different signals.

- Quantization
- FIR Filtering
- Fourier Synthesis
- Fourier Analysis
- Spectrum Analyzer

The second group consists of analog signal modulation schemes. A modulating signal from a function generator is applied to the input of FlexTrainer. The frequency of the carrier and other parameters are selected using the push buttons. The carrier is internally generated and the modulated signal is sent out, which can be monitored on an oscilloscope.

- Amplitude Modulation Transmitter
- Suppressed Carrier AM Transmitter
- Frequency Modulation Transmitter
- Phase Modulation Transmitter
- FDM Transmitter

The third group of experiments implements demodulation schemes for analog modulations of the previous group. Two FlexTrainer are required for these experiments, one acting as transmitter and the other acting as receiver. The demodulator signal can be displayed on oscilloscope and compared with original modulating signal.

- Amplitude Modulation Receiver
- Suppressed Carrier AM Receiver
- Frequency Modulation Receiver
- Phase Modulation Receiver
- FDM Receiver

The fourth group implements different digital modulation schemes. Students select different parameters of each modulation scheme and see the results on oscilloscope. The fifth group of experiments implement corresponding digital de-modulators. The digital modulation/demodulation experiments available on FlexTrainer are :

- Sigma-delta Modulation
- Pulse Width Modulation
- Amplitude Shift Keying
- Binary Frequency Shift Keying
- Quadrature Frequency Shift Keying
- Binary Phase Shift Keying
- Quadrature Phase Shift Keying
- Spread Spectrum

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