



A DSP Systems Design Course based on TI's C6000 Family of DSPs

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Course Enviroment

- The course, **DSP Systems Design**, is delivered in the 3rd semester of the two Master Degree Courses, in *Electronics and Computers* and in *Electronics and Information Processing*, at the Dept. of Physics, University of Patras.
- The number of postgraduate students who are attending the course is 20-30 students per year.

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DSP Systems Design

The **DSP System Design** course is a three parts course, consisting of:

- Lectures (2 hours per week)
- Laboratories (2 hours per week)
- Projects

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The lectures include the following topics :

- Introduction to the DSPs
- Basic families of Texas Instruments (TI), Analog Devices, Motorola and AT&T DSPs
- Floating point vs fixed point TI's DSPs
- Main Emphasis to the Architecture of the TI's C6000 DSPs family (TMS320C6711, TMS320C6713 and TMS320C6416)



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- Programming in assembly and C using the development environment, Code Composer Studio (CCS) v3.1
- FIR and IIR digital filters
- FFT (512, 1024 points)
- Coding – Decoding of DTMF signals
- Modulation – demodulation of digital signals (FSK and DPSK)



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- Image processing (edge detection, histogram equalization)
- Image coding based on JPEG
- Development of graphical environments with Matlab and LabVIEW, for DSPs application support

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The graduate students attending this course, are required to complete a set of six laboratorial exercises, running on the TMS320C6711 (TMS320C6713) :

- Lab. 1

Introduction to the DSPs architecture (TMS320C6711 and TMS320C6713) and familiarization with CCS

- ✓ Recognition of a DSK67XX basic parts
- ✓ CCS based applications development
- ✓ Programming in assembly language
- ✓ GEL files creation



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- Lab. 2

Design and implementation of FIR digital filters

- ✓ Design of various types of FIR digital filters (LP, HP, BP, BS) with Matlab
- ✓ Implementation of FIR digital filters on the DSK67XX, both in C and assembly
- ✓ Control of accurate operation with the oscilloscope

- Lab. 3

Design and implementation of IIR digital filters

- ✓ Design of various types of IIR digital filters (LP, HP, BP, BS) with Matlab
- ✓ Implementation of IIR digital filters with DSK67XX, both in C and assembly
- ✓ Control of accurate operation with the oscilloscope



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- Lab. 4

Implementation of a FFT

- ✓ Implementation of a FFT with Matlab
- ✓ Implementation of a FFT on a DSK67XX, both in C and assembly
- ✓ Control of accurate operation with the oscilloscope



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- Lab. 5

Design and implementation of a 3rd order graphical equalizer controlled with a GUI in Matlab

- ✓ Design of a 3rd order graphical equalizer with Matlab
- ✓ Implementation of the graphical equalizer on the DSK67XX, in C
- ✓ GUI creation with Matlab for the control of the equalizer
- ✓ Control of accurate operation with the oscilloscope



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- Lab. 6

Design and implementation of a 3rd order graphical equalizer controlled with a GUI in LabVIEW

- ✓ Implementation of the lab. 5 graphical equalizer on the DSK67XX
- ✓ Introduction to the RTDX technology and to the DSP/BIOS
- ✓ Implementation of the graphical equalizer on the DSK67XX using RTDX technology and DSP/BIOS
- ✓ GUI's creation with LabVIEW for the control of the equalizer
- ✓ Control of the right operation with the oscilloscope

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Within the framework of the course, the students in teams of three to four persons, have to undertake, design and implement one of the followings projects:

- Voice processing (Analyze – Synthesize with LPC method)
- Image processing (DCT – IDCT, coding based on JPEG)
- 10th band parametric equalizer
- DTMF encoder - decoder
- DPSK transmitter – receiver
- FSK transmitter – receiver



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- I2C protocol for the communication with other devices
- Applications for fingerprint image capture and processing

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Aiming to the improvement of the course, several new projects are being under development in the following areas:

- V34 coding - decoding
- Fingerprint recognition
- Real-time image processing
- Development of a toolkit in LabVIEW for automation and communication with TI's DSPs through CCS v3.1



Laboratory Equipment

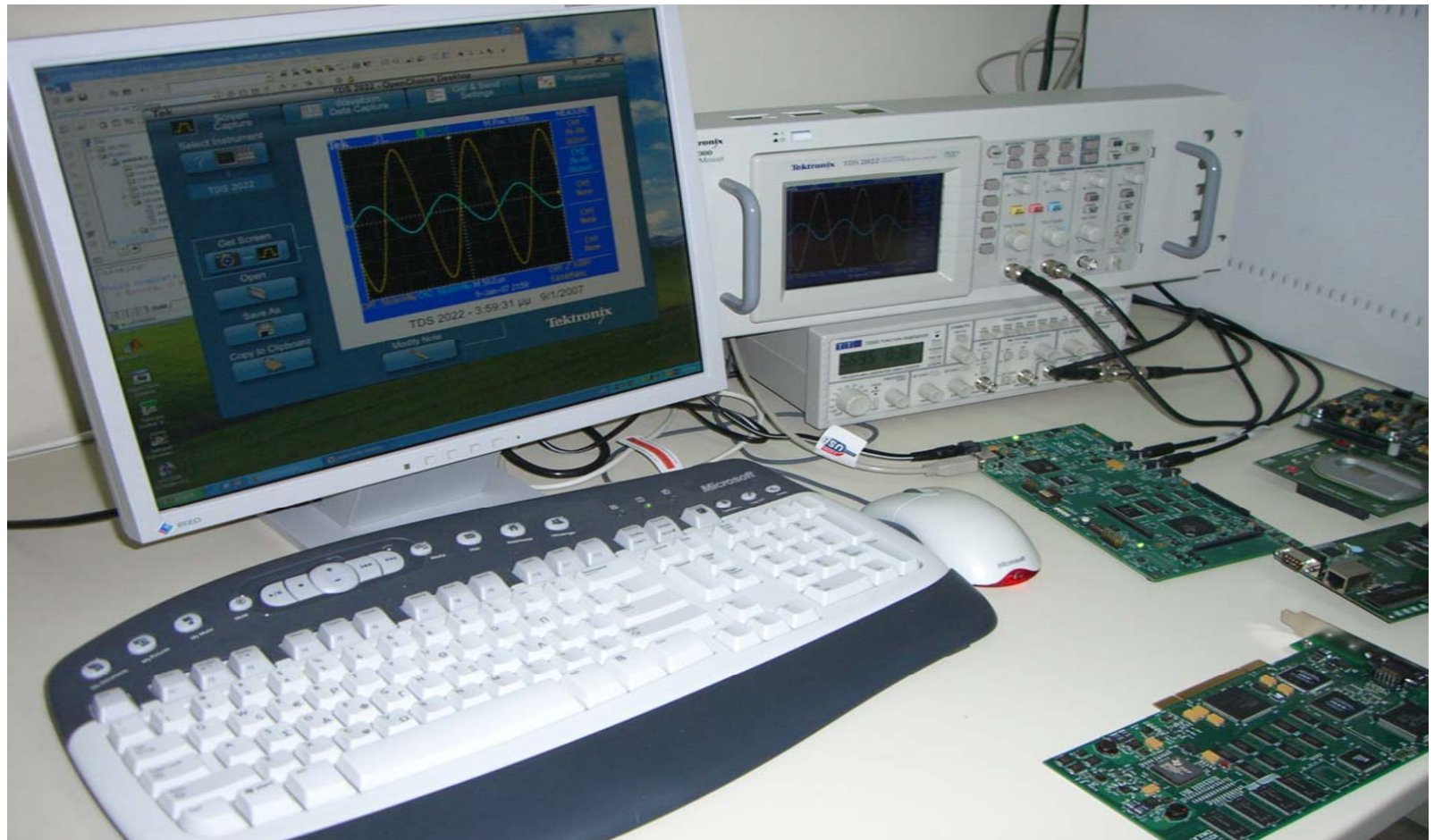
The laboratory is constituted of ten workstations each one equipped with:

- A PC based on Windows. In every PC are installed the following programs:
 - Code Composer Studio by Texas Instrument v3.1
 - Matlab by Mathworks
 - LabVIEW by National Instrument
 - Open Choice Desktop by Tektronix
- Oscilloscopes TDS210, TDS1012 and TDS2022 by Tektronix. The TDS2CMA communication module has been installed in every oscilloscope
- A function generator TG550 by TTI

Laboratory Equipment



Laboratory Equipment



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Laboratory Equipment

- DSK6713 or DSK6711 (Every DSK6711 is equipped with a TMDX326040A Audio Daughter Card)

For the needs of the projects and relative Master Theses, the laboratory is additionally equipped with :

- A number of Daughter Cards DSKcam by BiTEC with OmniVision's OV7620 VGA image sensor
- An Emulator XDS560 by Texas Instruments
- A number by Spectrum Digital FPC1010 Fingerprint Sensor Daughter Card

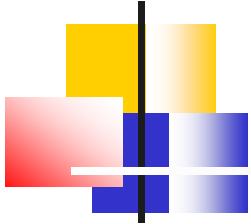


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- New material both for the Lectures and the Labs is under preparation, covering most of the presented before, in details.
- For the moment the material is written in Greek

<http://www.hep.upatras.gr>

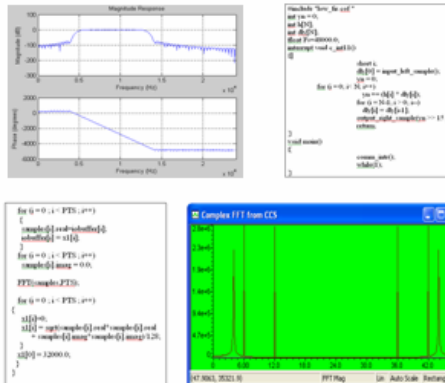
<http://www.ellab.physics.upatras.gr>



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Αλγόριθμοι ψηφιακής επεξεργασίας με χρήση των DSPs

Ευάγγελος Ζωγράφος

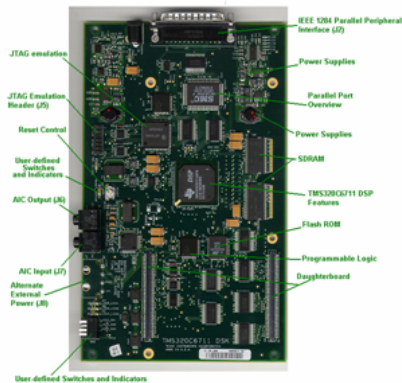


Εργαστήριο Ηλεκτρονικής
Πάτρα 2006

DSP Systems Design

Σχεδίαση Συστημάτων με DSPs

Εργαστηριακές Ασκήσεις



Εργαστήριο Ηλεκτρονικής
Γάρα, 2006

ΣΧΕΔΙΑΣΗ ΣΥΣΤΗΜΑΤΩΝ ΜΕ DSPs

ΠΕΡΙΕΧΟΜΕΝΑ

ΑΣΚΗΣΗ 1^η

ΕΙΣΑΓΩΓΗ ΣΤΗΝ ΑΡΧΙΤΕΚΤΟΝΙΚΗ ΤΩΝ DSPs (TMS320C6711)
ΚΑΙ ΕΒΟΙΚΕΙΩΣΗ ΜΕ ΤΟ CCS

ΑΣΚΗΣΗ 2^η

ΣΧΕΔΙΑΣΗ ΚΑΙ ΥΛΟΠΟΙΗΣΗ FIR ΨΗΦΙΑΚΩΝ ΦΙΛΤΡΩΝ

ΑΣΚΗΣΗ 3^η

ΣΧΕΔΙΑΣΗ ΚΑΙ ΥΛΟΠΟΙΗΣΗ IIR ΨΗΦΙΑΚΩΝ ΦΙΛΤΡΩΝ

ΑΣΚΗΣΗ 4^η

ΥΛΟΠΟΙΗΣΗ ΕΓΓ. ΜΕΤΑΣΧΗΜΑΤΙΣΜΟΥ

ΑΣΚΗΣΗ 5^η

ΣΧΕΔΙΑΣΗ ΚΑΙ ΥΛΟΠΟΙΗΣΗ ΓΡΑΦΙΚΟΥ ΠΡΟΣΤΑΘΜΙΣΤΗ
ΜΕΣΩ GUI

ΑΣΚΗΣΗ 6^η

ΣΧΕΔΙΑΣΗ ΚΑΙ ΥΛΟΠΟΙΗΣΗ ΓΡΑΦΙΚΟΥ ΠΡΟΣΤΑΘΜΙΣΤΗ ΜΕ
ΧΡΗΣΗ ΤΟΥ LABVIEW 7.1



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- Texas Instruments, *C6000 Teaching CD_ROM Material*, Texas Instruments, 2005.
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- Lapsley P., Bier J., Shoham A. and Lee E., *DSP Processor Fundamentals, Architectures and Features*, IEEE Press, 1997.
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- Kehtarnavaz N., *Real-Time Digital Signal Processing based on the TMS320C6000*, Elsevier, 2004.



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2006-2007 Class

