REAL-TIME DIGITAL SIGNAL PROCESSING (DSP)

Using Matlab, Simulink, and TI's TMS320C6713 DSK

Department of Electrical Engineering

REU Student: Rene van Ee, SUNY Buffalo

REU Student: Tiesha Searcy, Prairie View A&M

Graduate Advisor: Julien Jainsky, Texas A&M

Faculty Advisor : Dr. Deepa Kundur , Texas A&M

PURPOSE & METHOD

- Develop and implement signal and image processing techniques used in ECEN448
- Solve interfacing problems between Matlab, Simulink, Code Composer Studio, and the Texas Instruments' TMS320C6713 DSK (C6713)
- Communicate and manipulate information using the board's Real-Time Data eXchange (RTDX) capability and Matlab's Graphical User Interface (GUI)

LAB 10 – IMAGE ENCRYPTION

PURPOSE

- To develop and implement a simple exclusive OR encryption algorithm
- Use multiple RTDX channels to pass each color plane of the image to be encrypted
- Develop a M-file to aid the transferring of image and reconstruction

METHODOLOGY

- Built a XOR algorithm in Simulink
- Used Matlab's random number generator for keys
- Simulated the encryption and decryption of an image
- Built actual model to be written to board using RTDX
- Wrote a M-file to open the channels, send messages, receive and store messages, reconstruct image, close channels

FUTURE WORK

- Develop algorithm that accepts images of different sizes and more efficient
- Write and receive from channels at same time

X O R

x	y	z
0	0	0
0	1	1
1	0	1
1	1	0

(A ⊕ B) ⊕ B = A

	1 0 1 0 0 1 0 1 1 0 1 1 0 1 0 1	Plaintext
⊕	1 1 0 0 1 0 0 1 1 0 1 1 0 1 0 1	Key
	0 1 1 0 1 1 0 0 1 1 0 1 1 1 1 0	Ciphertext
⊕	1 1 0 0 1 0 0 1 1 0 1 1 0 1 0 1	Key
	1 0 1 0 0 1 0 1 1 0 1 1 0 1 0 1	Plaintext

Figure (1) XOR encryption and Decryption

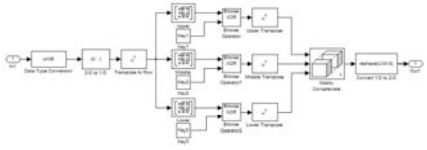


Figure (2) Encryption model for one color plane

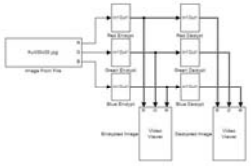


Figure (3) Simulation Model

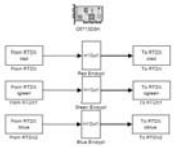


Figure (4) Model written to board

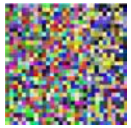


Figure (5) Encrypted Image

Figure (6) Decrypted Image

LAB 11 – IMAGE RESTORATION

Objective

The purpose of this study was to develop a state of the art real time digital signal processing lab involving image restoration for the Texas Instruments TMS320C6713 DSP board for the purpose of engineering education

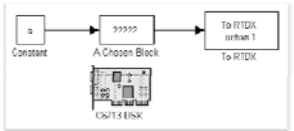


Fig. 1 Simulink Model

Fig. 2 Original Color Image

Methodology

- Create simulink code
- Build and run simulink model using CC Studio
- Create M-Code using editor that will take a color image and turn into a grey scale image
- Run M Code and in math lab window use command that will display required image with proper dimensions

Conclusion

The simulink and M-code take a color picture, outputs a 200 *200 grey scale section of the image with chosen modification form the middle process block and recreates the image of hues of blacks and whites.

Fig. 3 **Image Complement**
Makes darker areas lighter

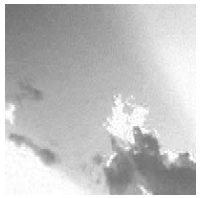


Fig.4 **Deinterlacing**
Creates pixels in white area

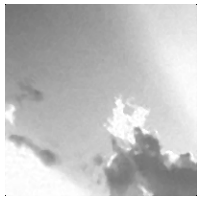
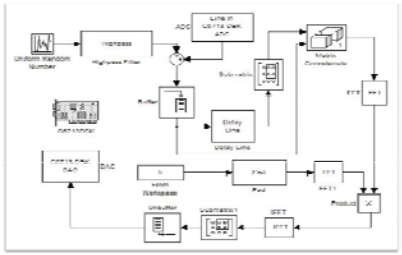


Fig. 5 **Median Filter**
Darker right corner

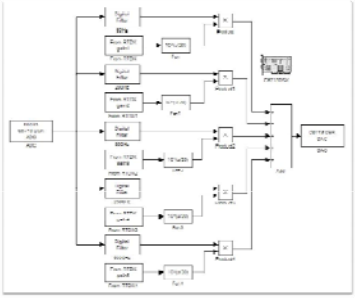
Future Works: Be able to use this process with live images i.e. web camera

LAB 4 - FAST FOURIER TRANSFORM (FFT) CONVOLUTION



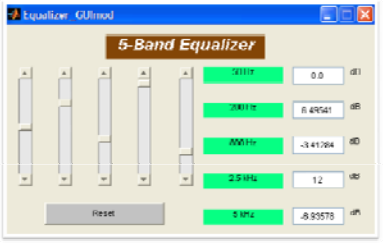
- FFT algorithm allows filtering in the frequency domain
- Overlap-Add & Overlap-Save algorithms allow for frame based processing

LAB 5 - AUDIO EQUALIZER



- RTDX allows the user to write commands to board
- The user can control the gains of each frequency band, causing amplification or attenuation of bass, mid, or treble

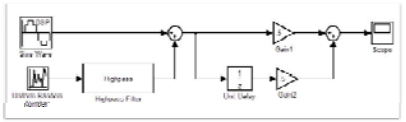
LAB 6 - GUI



- Sliding bars replace writing commands to board
- Display boxes allows the user to see the signal strength (dB)
- Reset button sets all sliders and display boxes to 0 dB

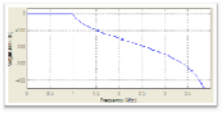
FILTERING

LAB 1 – INTRO TO DSP

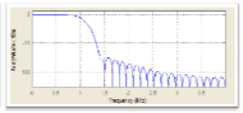


- Finite Impulse Response Filter (FIR)
- Simulated, non real-time

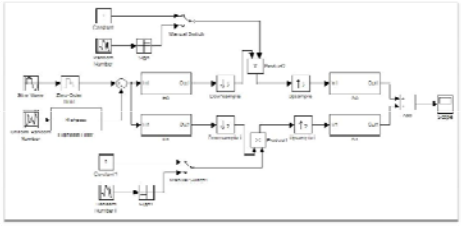
LAB 2 – FILTER DESIGN



Chebyshev Type 1 Low Pass Filter

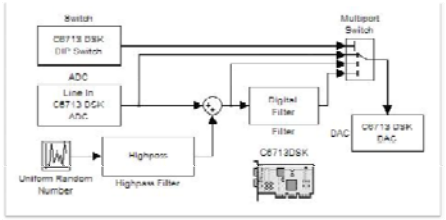


Blackman Window Low Pass Filter



- Real-time simulation using host computer
- Haar Wavelet transform
- Application in Steganography

LAB 3 – HARDWARE IMPLEMENTATION



- Analog to Digital Converter captures and digitizes input
- Digital to Analog Converter replicates an analog output
- Onboard DIP switches allow us to view multiple points in the model as an output

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