**DSP PROJECTS DEFINITION**

**Dictionary based processing**

In dictionary based processing one must have *M* numbers of samples available in dictionary which contains set of inputs and outputs. During processing if test input is *I* then find the best match for *I* from input set in dictionary and its corresponding output is the matched sample output.

**Dictionary**

|  |  |
| --- | --- |
| Input set | Processed set |
| X1 | Y1 |
| X2 | Y2 |
| X3 | Y3 |
| X4 | Y4 |
| X5 | Y5 |

If

output (O)

Input (I)

SYSTEM

If *I* matched with input set sample X5 then we may predict output (O) is Y5.

**Problem statements:**

1. **Facial Expression Recognition from Static Images** Facial expressions play an important role in human communication. The study of non verbal communication shows that 55% of information transfer is through facial expressions. An automatic facial expression recognition system can be used for human computer interaction thereby making computers more receptive to human needs. This task has always been a difficult and challenging one for the computer vision research community.

[**https://www.researchgate.net/profile/Jeffrey\_Cohn/publication/227031714\_Facial\_Expression\_Recognition/links/09e4151226a7573ae5000000.pdf**](https://www.researchgate.net/profile/Jeffrey_Cohn/publication/227031714_Facial_Expression_Recognition/links/09e4151226a7573ae5000000.pdf)

1. **Dictionary based filtering:** In this definition input is noisy image. You need to create dictionary for given filter type (Low pass or High pass) with image patch size NxN. Dictionary contains input set as NxN noisy image patch and output set contains corresponding NxN filtered patch. Using dictionary based processing one need to generate filtered output and compared its complexity with classical convolution based filtering approach.
2. **Image in-painting:** In this definition input is image which contains distracted statues. You need to create dictionary for image in painting with image patch size NxN. Dictionary contains input set as NxN distracted patch and output set contains corresponding NxN full restored patch. Using dictionary based processing one need to generate reconstructed version of distracted statues.

[**http://www.olivier-augereau.com/docs/2004JGraphToolsTelea.pdf**](http://www.olivier-augereau.com/docs/2004JGraphToolsTelea.pdf)

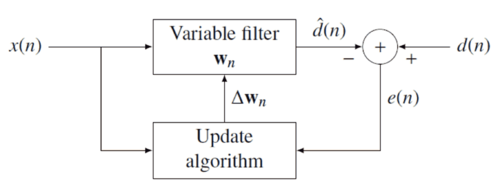
[**http://www.dtic.mil/dtic/tr/fulltext/u2/a437378.pdf**](http://www.dtic.mil/dtic/tr/fulltext/u2/a437378.pdf)

1. **Image super-resolution - Dictionary based approach:** In this definition input is image is low resolution image. You need to create dictionary for image patch size NxN. Dictionary contains input set as NxN low resolution patch and output set contains corresponding 2Nx2N patch of image with higher resolution. Using dictionary based processing one need to generate image with higher resolution.

**J. Yang, Z. Wang, Z. Lin, S. Cohen and T. Huang, "Coupled Dictionary Training for Image Super-Resolution," in IEEE Transactions on Image Processing, vol. 21, no. 8, pp. 3467-3478, Aug. 2012.**

**Adaptive Filtering**

It is a filtering technique in which the filter coefficients are not a priory fixed. The filter coefficients are adopted or changed as per the desired output.



**Problem statements**

**5. Single Image Super Resolution** with adaptive filtering: Super Resolution (SR) algorithms produce a high resolution (HR) image from single or multiple low resolution (LR) images. One can use single image to generate the high resolution image instead of using dictionary based approach used above. It can be done by modeling a blurring filter to capture the degradation process as well as modeling an innovation filter to remove the blurring effects and sensor noise using adaptive Least Square technique.

**K. I. Kim and Y. Kwon, "Single-Image Super-Resolution Using Sparse Regression and Natural Image Prior," in IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 32, no. 6, pp. 1127-1133, June 2010.**

**6. Active noise control:** Consider a video on YouTube or a MP3 audio file with noise. The background noise reduction/removal using various DSP Algorithms will be the objective of the project. There are several ways to carry out noise reduction (adaptive filtering, transforms, etc.). The analysis and comparison of the resultant signal (without noise) and the original signal along with different noise reduction techniques can be done to get the signal with the least noise.

For example, Videos by NPTEL has a lot of background noise which leads to unclear understanding of speech. Enhancement of speech by noise reduction using DSP Algorithms becomes a motivation to carry out this project.In this definition the goal is to design and test a filter mechanism which can cancel the noise which appears real time and random in nature. This design can be useful for headphones used in airlines.

**Ying Song, Yu Gong and S. M. Kuo, "A robust hybrid feedback active noise cancellation headset," in IEEE Transactions on Speech and Audio Processing, vol. 13, no. 4, pp. 607-617, July 2005.**

**7. Image de-noising:** In this definition the noisy image is given. Using the adaptive filtering approach one need to remove the noise from the image. The nature and the property is unknown to system.

**J. Mairal, M. Elad and G. Sapiro, "Sparse Representation for Color Image Restoration," in IEEE Transactions on Image Processing, vol. 17, no. 1, pp. 53-69, Jan. 2008**

**8. Sound Analysis and recognition of Musical notes**

Music is a part of everyone’s life and the most basic engineering principle over which it works is “Signal processing”. Musical instrument analysis and recognition of different  notes have  become very popular and interesting field in recent years. We have seen many software synthesizer (Android applications, PHP Programs) filled with complex signal processing mechanism at the backend.

Here the main challenge is to actually find a way to convert the actual sound note generated by musical instruments like Harmonium, Flute etc into some mathematical representation by applying some core signal processing concept, and for that analysis is the most rudimentary thing. **Note recognition** is another interesting problem where we are interested into finding the actual scale or a pitch of a particular sound. It is again a complex problem which incorporates machine learning too.

**References:**

<http://epubs.siam.org/doi/pdf/10.1137/S00361445003822>

<http://www.listening-ear-trainer.com/HowToRecognizePitch.html>

**9. Trustable and generalize biometric recognition:**

In general biometric recognition system database contains hash of encrypted version of biometric traits because data in encrypted or hashed domain provide privacy preservation. There is no any standard encryption or hash available which is globally accepted for biometric. Hence every system has its own version of hash or encryption. Moreover nobody wants to gives his/her biometric traits until we enforce. That is because of lack of trust. In this project we need to develop a biometric database which provides privacy protection, authentication, useful for different types of biometric recognition system and also creates a trust for users.

**Ref: M. A. M. Abdullah, S. Dlay, W. Woo, J. Chambers, “A Framework for Iris Biometrics Protection: A Marriage between Watermarking and Visual Cryptography,” IEEE Access, November 2016.**