Efficient Filtering Technique Based on Adaptive Rate Sampling

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MOTIVATION

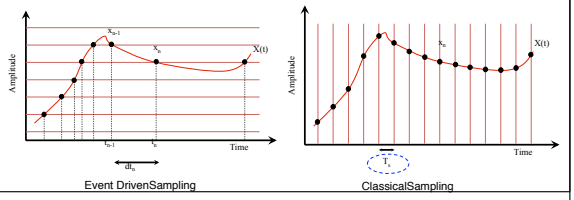
To contribute in the development of low computational complexity and power efficient signal processing chain for mobile systems.

It will lead towards ever wanted system features like reduced size, cost, processing noise, electromagnetic emission and especially power consumption.

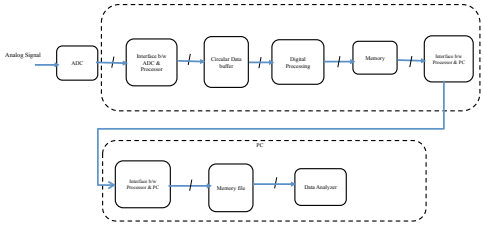
SOLUTION

Reorganize the mobile systems associated signal processing theory and architecture

NON UNIFORM SAMPLING PRINCIPLE



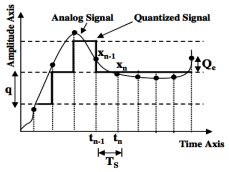
THE PROPOSED SYSTEM PRINCIPLE BLOCK DIAGRAM



SYSTEM DESIGN

1. ADC

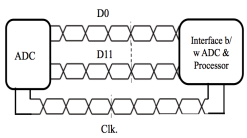
The conversion process starts by sampling the input analog signal and then rounding off these samples amplitudes that will produce the digital signal.



2. ADC to Processor Interface

The following are the characteristics of the ADC to Processor Interface:

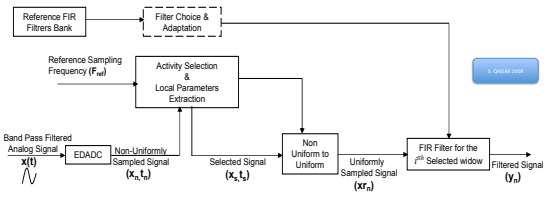
I. **Differential Ended**
II. **Double Data Rate**
III. **Sinc Synchronous**



3. Circular Buffer

The circular buffer is employed to store the sampled signal temporarily before being processed.

4. Digital Signal Processing

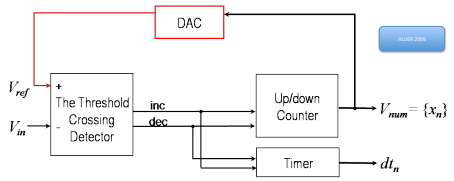


I. Computational Complexity

$$y_n = h_k * x_n = \sum_{k=0}^{P} h_k . x_{n-k}$$

- **Classical Case**: N.P+1 Multiplications and N.P Additions
- **ED Filtering case**: M.P+1 Multiplications and M.P Additions, Here M <N.

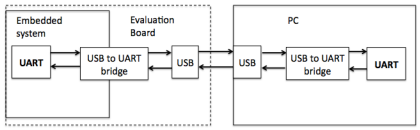
II. EDADC Architecture



5. Dual-Port RAM

The values of the processed signal are then saved in a dual port RAM (Random Access Memory) ready to be transferred to a PC .

6. Processor to PC Interface



CONCLUSION

- A novel computationally efficient filtering technique has been devised.
- It takes advantages of both non-uniform and uniform signal processing tools

PROSPECTS

- The proposed filtering technique is a potential candidate for applications, deal with low activity sporadic signals. Certain examples are speech, audio, image, Electrocardiogram and Electroencephalogram.
- Other interesting domains are PET scanners and Battery Management Systems.

References:

- S.M. Qaisar et al., "Adaptive Rate Filtering a Computationally Efficient Signal Processing Approach", ELSEVIER Signal Processing Journal, 2014.
- S.M. Qaisar et al., "Computationally Efficient Adaptive Resolution Short-Time Fourier Transform", EURASIP, Research Letters in Signal Processing, 2008.
- S.M. Qaisar, "An Efficient Signal Acquisition with an Adaptive Rate A/D Conversion", IEEE, ICCAS'13, Kuala Lumpur, Malaysia, 2013.
- Kirill Kozmin et al, "Level-Crossing ADC Performance Evaluation Toward Ultrasound Application", IEEE Transactions on Circuits and Systems, 2009.

Acknowledgements: we acknowledge Dr. Saeed Qaisar for his continuous support throughout the course of our work. [SQAISAR@EFFATUNIVERSITY.EDU.SA]