IJournals: International Journal of Software & Hardware Research in Engineering
ISSN-2347-4890
Volume 4 Issue 4 April, 2016

IMAGE DENOISING

Using remez exchange algorithm

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***Abstract*—Speech processing has been well applied into various areas of technology such as telephone banking, voice activation in vehicle, database access service, word recognition, speaker verification, emotional detection, assistive technology in emotional disorder diagnosis, and identification of vocal-related illnesses. In all practical situations, the received speech waveform contains some form of noise component. The noise may be a result of the finite precision involved in coding the transmitted waveform (quantization noise), or due to the Additive White Gaussian Noise (AWGN). In this paper, Removal of Additive White Gaussian Noise (AWGN) for speech enhancement is considered.**

I. INTRODUCTION

Filter Design is the process of designing a signal processing filter that satisfies a set of requirements, some of which are contradictory. The purpose is to find a realization of the filter that meets each of requirements to a sufficient degree to make it useful. The filter design process can be described as an optimization problem where each requirement contributes with a term to an error function which should be minimized. Speech is the fundamental way for humans to communicate. Sound is a sequence of waves of pressure which propagates through compressible media. During their propagation, waves can be reflected, refracted, or attenuated by the medium properties. For centuries, efforts have been made to improve individual's communication over a great distance. Speech processing techniques have been examined to be effective in improving speech intelligibility in noise for hearing impaired listeners. This technique also has the capability of preventing damage to hearing in high-noise environments such as aircrafts, factories and industries. For hearing impaired people, it is especially difficult to communicate with other persons in noisy environments. Therefore, speech enhancement systems have become an integral component of modern speech communication.

II. EXISTING DENOISING ALGORITHMS

. The most significant paradigm shift has been the introduction of statistical methods, especially stochastic processing with Hidden Markov Models (HMMs) (Baker, 1975, and Jelinek, 1976) in the early 1970's (Poritz, 1988). More than 30 years later, this methodology still predominates. A number of models and algorithms have been efficiently incorporated within this framework. The Expectation-Maximization (EM) Algorithm (Dempster, 1977) and the Forward-Backward or Baum-Welch algorithm (Baum, 1972) have been the principal means by which the HMMs are trained from data. Despite their simplicity, N-gram language models have proved remarkably powerful and resilient. Decision trees (Breiman, 1984) have been widely used to categorize sets of features, such as pronunciations from training data. Statistical discriminative training techniques are typically based on utilizing Maximum Mutual Information (MMI) and the minimum-error model parameters. Deterministic approaches include corrective training (Bahl et al, 1993) and some neural network techniques (Lippman, 1987; Beaufays et al., 2002)

A. Maintaining the Integrity of the Specifications

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III. REMEZ EXCHANGE ALGORITHM

The Remez exchange algorithm finds the set of (N+1) coefficients that minimize the maximum deviation from the ideal. Intuitively, this finds the filter that is as close as you can get to the desired response given that you can use only (N+1) coefficients. This method is particularly easy in practice since at least one text includes a program that takes the desired filter and *N*, and returns the optimum coefficients.

A. Significance of REX algorithm

The Remez algorithm can be used to design all four types of linear- phase filters, but for convenience only the design of type I filters will be described here.

$$E(\omega) = W(\omega)\,(A(\omega) - D(\omega))$$

The Chebyshev design problem can formulated as follows. Given:
N: filter length
D (w): desired amplitude function
W (ω): nonnegative weighting function,

Find the linear-phase filter that minimizes the weighted Chebyshev error, defined by

$||E(\omega)||_\infty = \max_{\omega \in [0,\pi]} |W(\omega)(A(\omega) - D(\omega))|$ (2.3)

The solution to this problem is called the best weighted Chebyshev approximation to D (ω). Because it minimizes the maximum value of the error, it is also called the *minimal solution.*

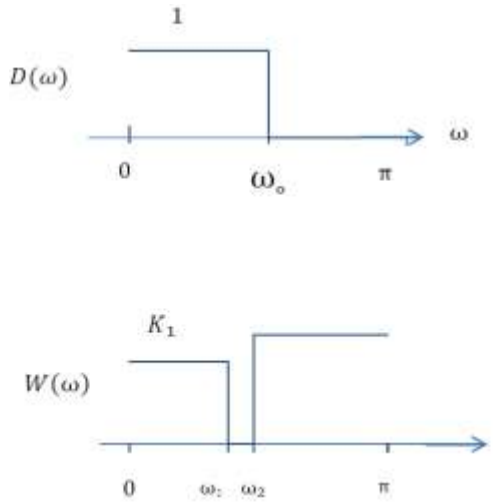

Fig 2.1 frequency response of low pass filter

IV. ROBUST CONVERGENCE OF REMEZ EXCHANGE ALGORITHM

The Remez algorithm has very robust convergence properties. Even if the initial interpolation points are very different from the extremal points of the optimal solution, the Remez algorithm converges rapidly. In the following example, the design of the length 13 filter in the previous example is repeated, but with initial interpolation points that are more different from the final extremal points.

V. REMEZ EXCHANGE ALGORITHM: ADVANTAGES AND DISADVANTAGES

- Produces linear-phase FIR filters that minimize the weighted Chebyshev error.
- Provides explicit control of band edges and relative ripple sizes.
- Efficient algorithm always converges.
- Allows the use of a frequency dependent weighting function.
- Suitable for arbitrary D (ω) and W (ω).

VI. REFERENCES

[1] O. Rioul, member, ieee and p. duhamel, senior member, IEEE transactions on circuits and systems-11: analog and digital signal processing, vol. 41, no.8, august 1994a remez exchange algorithm for orthonormal wavelets.

[2] Z. Battles and L. N. Trefethen, An extension of Matlab to continuous functions and

operators, SIAM J. Sci. Comput., 25 (2004), pp. 1743–1770.

[3] Ricardo Pach´on and Lloyd N. Trefethen McClellan algorithms for best polynomial approximation in the chebfun system.

[4] T. W. Parks and J. H. McClellan, *Chebyshev approximation for nonrecursive digital filters with linear phase*, IEEE Trans. Circuit Theory, 19 (1972), pp. 189–194.

[5]Y. Ephraim and I. Cohen, "Recent Advancements in Speech Enhancement," in *the Electrical Engineering Handbook*, CRC Press, 2006, ch. 15, pp. 12-26.

[6] SanthuRenuVuppala, " Speech Enhancement in Hands-free Speech Communication with emphasis on Wiener Beamformer ," M. S. Thesis, Dept. of Signal Process., Blekinge Institute of Technology (BTH), Blekinge, Sweden, 2012.

[7] B. Le Bailly and J. P. Thiran, *Computing complex polynomial Chebyshev approximants on the unit circle by the real Remez algorithm*, SIAM J. Numer. Anal., 36 (1999), pp. 1858–1877.