VISVESVARAYA TECHNOLOGICAL UNIVERSITY

Belgaum

A Project-Report on

"A Novel Pitch Period Detection Algorithm Based on Hilbert-Huang Transform"

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Submitted by:

Gururaj B. G
1KI07EC409

Manjunatha G. C
1KI07EC412

Ravi D.E
1KI07EC420

Vasanth Shanbhag
1KI07EC432

Under the guidance of

Mr. Rudresh M. D, M.Tech,
Lecturer, Dept. of ECE

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
KALPATARU INSTITUTE OF TECHNOLOGY
TIPTUR-572202, KARNATAKA

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ABSTRACT

Pitch period of voice signals has been a very important parameter in speech processing applications, such as speech analyzing, coding, recognition and speaker verification, pathological voice analysis etc. Although many methods of pitch estimation for voice signal have been studied for decades, reliable and accurate detection is still a challenging task, due to the complexity of the speech signal.

Basically, most of pitch detection methods are based on the assumption that speech signal is stationary in short time, but the reality is that speech signal is non stationary and quasi-periodical, it will sometimes induce detection errors.

As an important parameter in the analysis and synthesis of speech signals, pitch period information is used in various applications such as:

1) Speaker identification and verification
2) Pitch synchronous speech analysis and synthesis
3) Linguistic and phonetic knowledge acquisition
4) Voice disease diagnostics

Voiced speech analysis consists of determining the frequency response of the vocal tract system and the glottal pulses representing the voice source. Although the source of, excitation for voiced speech is a sequence of glottal pulses, the significant excitation of the vocal tract system can considered, to a first approximation, to be at discrete instants of time, called Epochs.

There can be more than one epoch within a pitch period but the major excitation usually coincides with a glottal closure. Determination of epochs solves to a large extents, the basic problem of defining the pitch periods. This is because pitch is subjective attribute of voicing and a precise definition for pitch is generally difficult due to variation in the periodicity, shape, and amplitude of the glottal pulses. Many times the glottal flow is beyond the instant of glottal closure, and speech signal in the closed glottis interval represents the force-free response of an all-pole system.

However, reliable and accurate determination of a pitch period is difficult due to the complexity of the speech signal, which can be viewed as the output of a time varying

system excited by a quasi-periodic pulse for voiced speech, or by wideband random noise for unvoiced speech.

The techniques that have been developed for automatic detection of the pitch period over the past several years can be classified two categories:

a) Event detection pitch detectors, which estimate the pitch period by locating the instant at which the glottis close, and then measuring the time interval between two such events.
b) Nonevent detection pitch detectors, which are manly based on the short-term autocorrelation function and the average magnitude difference function. Generally, the nonevent based pitch detectors are computationally simple.

Despite the high accuracy, most of them are either applicable to only a part of vowels or of computationally complexity. Because of the high time-frequency local character and being applicable to non linear and non-stationary process.

The HHT method is specially developed for analyzing nonlinear and non-stationary data. The method consists of two parts:

1) The empirical mode decomposition (EMD)
2) The Hilbert spectral analysis.

Recently, Hilbert-Haung transform (HHT) was presented, and it was proved to be a powerful data analysis method based on empirical mode decomposition (EMD).