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WAVE FILTERING AND ELIMINATION OF DEGHOSTING EFFECT DURING EARTH QUAKE USING ADAPTIVE H INFINITE WIENER FILTER

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Abstract: When a seismic event such as an earthquake occurs, the signal propagating from the source has several distinct phases which have varying propagation velocities and frequency content. By detecting and correctly identifying these phases one can estimate the distance between source and receiver. When the received signal consists of noise, there will be continuous changes change, leading to use of adaptive filtering. This paper deals with elimination of noise on seismic signal and data signals using adaptive H infinite Wiener Filter with implementation in MATLAB. Current solutions to receiver de-ghosting generally involve making complementary measurements of the wave field or alternatively, involve estimation of data not recorded due to ghost interference. Both solutions offer challenges in practice in the marine multi measurement streamers are commercially available only on a limited basis and existing single measurement de- ghosting methods must estimate unrecorded frequencies near the ghost notches. Here, we develop a new wave equation -based approach for single measurement de-ghosting that does not rely on such estimation procedures.

Keywords: Velocity, Adaptive H Infinite Weiner Filter, De-ghosting.

I. INTRODUCTION

Seismic waves move through and around the earth surface.The paper uses the input of videos as seismic data known as 'seissound' as the richness and complexities of seismic data can be easy than using separate audio and visual data. The main disadvantage in seismic data is the noise which deteriorates the received seismic wave. The Least mean square (LMS), Recursive least square (RLS), Fast Transversal Recursive least square (FTRLS) are the existing filters. Implementation aspects of these algorithms, their computational complexity and Signal to Noise ratio are examined. These algorithms use small input and output delay. The proposed method uses seismic wave which are blended to form a single wave. These waves are then filtered for noise removal. The effect of de-ghosting is also removed.

II. ADAPTIVE H INFINITE WIENER FILTER

The adaptive H Infinite Wiener Filter is a hybrid filter is a combination of Hanning, Kaiser window[1] and infinite Wiener filters. A series of seismic waves[2]are given as input to the proposed filter. The wiener filter[3] is basically not an adaptive filter because this filter assumes that the inputs are stationary. So, the work uses a Hanning window and Kaiser Window to make the filter adaptive. The wiener filter is similar t the Least Squares Filter[4] but it minimizes the error criterion. The Hanning window is used in this work as it is best for continuous signals and always positive.The filter removes the noise that is present in the seismic wave. The SNR (Signal to Noise Ratio) and MSE (Mean Square Error) are calculated to know the effectiveness of the proposed adaptive H infinite Wiener filter.

The SNR compares the input signal to the level of background noise. The SNR value of the signal obtained should be high which indicates that signal content is more than noise. The proposed filter provides an **SNR** of **40.427**

The MSE should be less, which means that the input and output are as close as possible the proposed filter was able to provide an **MSE** of **7.4790e-05**

The figure shown below shows the series of seismic signal that are acquired as input to the adaptive H Infinite wiener filter that is the noisy seismic signal and also the filtered seismic signal is shown below

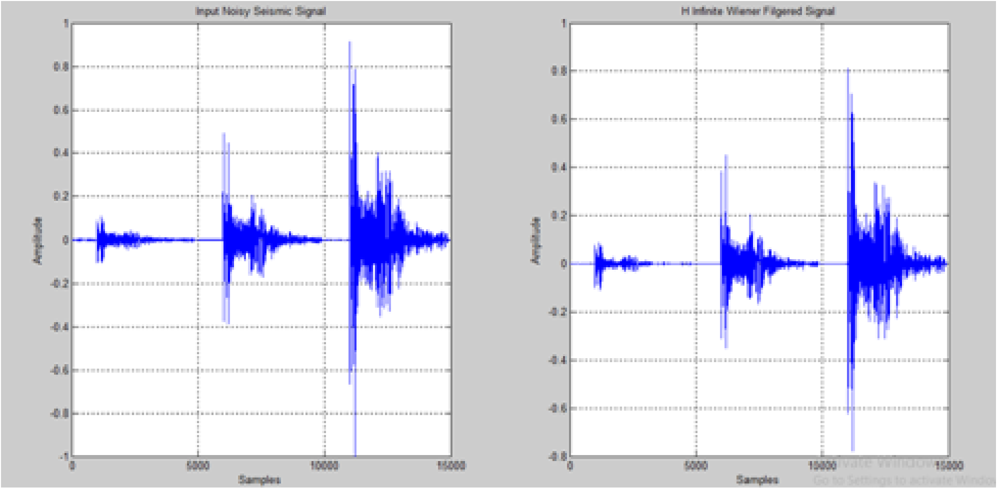

Fig 1: Input signal and filtered signal

The spectrogram of the noisy seismic signal is shown below

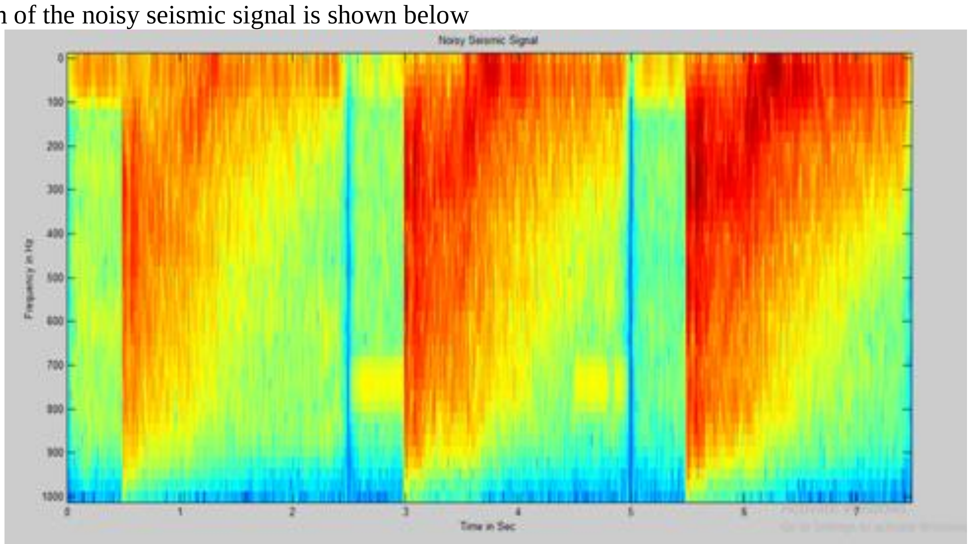

Fig 2: Spectrogram of noisy seismic signal

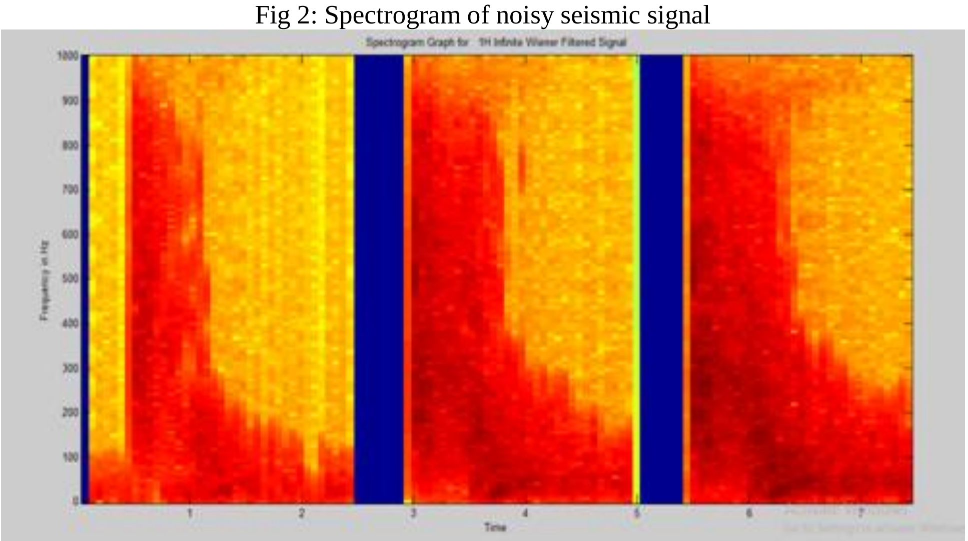

Fig 3: Spectrogram of Adaptive H infinite Weiner filter

The log spectral density or log spectral density (LSD) is a measure of two spectra,in this case it is the input noisy seismic wave and the filtered seismic wave. This work gives LSD of value 2

III. DE-GHOSTING

The de-ghosting is a effects that occurs in a seismic wave both at the source and receiver. The de-ghosting effect occurs as a result of reflections of the seismic wave so that a doublet response is recorded. Usually a single sensor measured seismic wave is not enough to measure the de-ghosting so the paper uses a series of signal obtained from three sensors which are combined to form a wave and applied as input the filter helps in removing the de-ghosting effect that is present in the seismic wave.

The figure depicts the effect of de-ghosting that is present in a seismic wave; from the figure it is evident that the ghost signal that is present completely destroys the original seismic signal

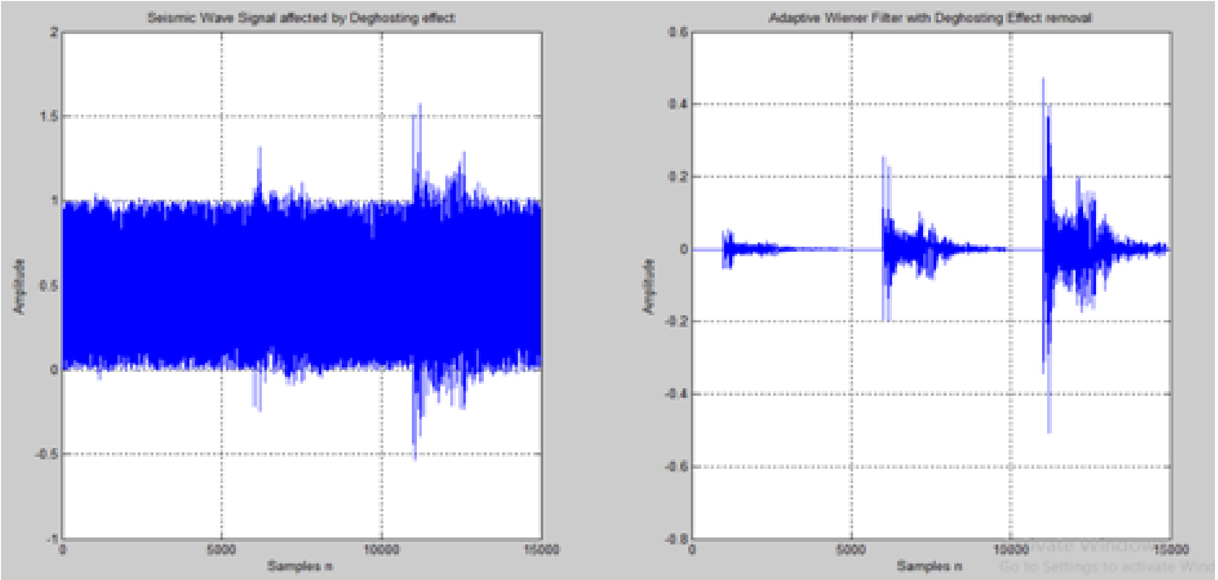

Fig 4: Ghost Signal and Deghosting

IV. GPS POSITIONING-EXTENDED KALMAN FILTER

The GPS positioning is done in order to find the latitude and longitude information of the seismic wave. The GPS positioning[5] is done using the Extended Kalman filter which follows a equation based approach. The initial step of the filter is the non-linear state equations it measures the initial state of the system with noise and the initial co-variance. This also gives the velocity, speed and time of the occurrence of the seismic signal. The graphical representation of the latitude and longitude values is displayed below

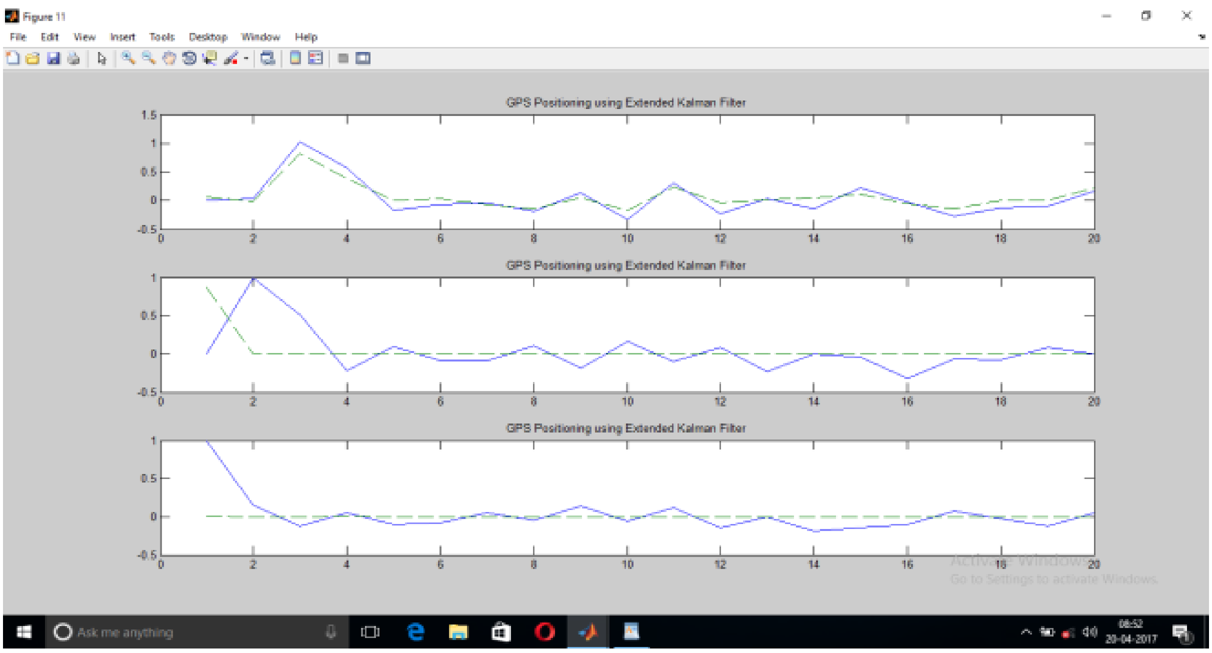

Fig 5:GPS positioning using Extended Kalman filter

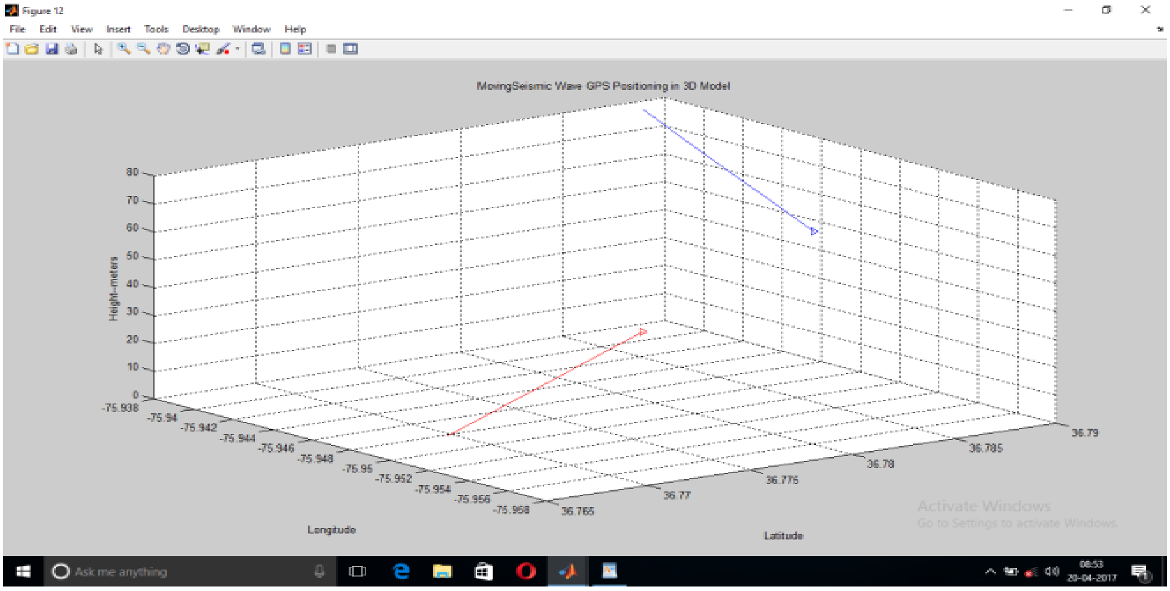

Fig 6: GPS Positioning- 3D plot which displays the latitude, longitude and height in meters.

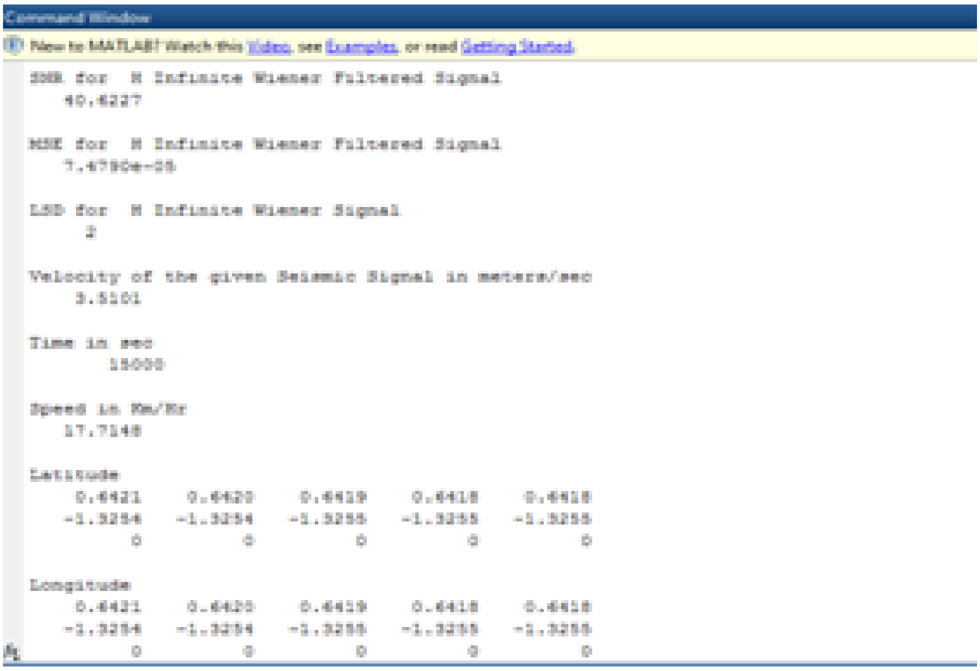

Fig 7: Velocity, speed, time, latitude and longitude values

V. CONCLUSION

Thus a new wave equation based approach that eliminates the difficulties of using a single measurement was developed and the output shows that the proposed filter is effective in reducing the effect of de-ghosting during earthquake and the extended Kalman filter gives the positioning information about the seismic signal.

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