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**Timing correction of Frequency Demodulation of an FM signal by Zero Crossing detection
by digital signal processing**

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The Information signal of a frequency modulated (FM) signal can be recovered by detecting zero crossings (ZC) of the FM signal. Digital low pass filters which work with regular sample intervals cannot be used to recover the original message directly because ZCs occur at irregular intervals. Unknown sample values with regular intervals can be obtained by interpolating with high sampling rate. Lagrange interpolation can be used to find an unknown point which connects as a polynomial curve between known numbers of points of a plot. Generally, the three points Lagrange interpolation method cannot be used to find up sample values between real time moving zero crossing points by hardware implemented Digital Signal Processing (DSP) blocks, because mathematically it needs both last and next zero crossing point values. These type of DSP blocks can be implemented by using software defined blocks with keeping signal history and counting in both backward and forward directions. The three points $(x_2, f(x_2)), (x_1, f(x_1))$ and $(x_0, f(x_0))$ Lagrange interpolation method is used in the proposed method to find amplitude of up sampled signal between consecutive ZC points. Smooth polynomial interpolated signal values can be obtained in real time with inserting interpolated energy levels by using Lagrange interpolation.

This method finds interpolation points only within the zero crossing signals between $(x_2, f(x_2))$ and $(x_1, f(x_1))$. FM demodulator has three software signal processing blocks; the first and second blocks are connected in parallel. The input is connected to both these blocks simultaneously and outputs of these two blocks are connected to the third signal processing block for calculating the interpolated signal values. The first block passes the up sampled zero crossing signals and the second block calculates the x_2 and $f(x_2)$. The second block has two counters to count zero crossing signal length and they start the count from the end to the beginning, until they find the zero crossing signal. Outputs of the implemented FM demodulator are significantly different from the expected output. The difference may be due to incorrect calculations when changing frequencies of zero crossing points.

Key words: FM, Zero crossing, DSP, Software Defined Radio, Lagrange Interpolation.

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