

## The Excess Loop Delay Calibration in a Bandpass Continuous-Time Delta Sigma Modulators Based on Q-Enhanced LC Filter

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**Abstract :** The Q-enhanced LC filters are the most used architecture in the Bandpass (BP) Continuous-Time (CT) Delta-Sigma ( $\Sigma\Delta$ ) modulators, due to their: high frequencies operation, high linearity than the active filters and a high quality factor obtained by Q-enhanced technique. This technique consists of the use of a negative resistance that compensate the ohmic losses in the on-chip inductor. However, this technique introduces a zero in the filter transfer function which will affect the modulator performances in term of Dynamic Range (DR), stability and in-band noise (Signal-to-Noise Ratio (SNR)). In this paper, we study the effect of this zero and we demonstrate that a calibration of the excess loop delay (ELD) is required to ensure the best performances of the modulator. System level simulations are done for a 2ndorder BP CT ( $\Sigma\Delta$ ) modulator at a center frequency of 300MHz. Simulation results indicate that the optimal ELD should be reduced by 13% to achieve the maximum SNR and DR compared to the ideal LC-based  $\Sigma\Delta$  modulator.

**Keywords :** continuous-time bandpass delta-sigma modulators, excess loop delay, on-chip inductor, Q-enhanced LC filter

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