DC-Offset Compensation in a Bistatic 77GHz-FMCW-Radar

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***Abstract*—In this paper the necessity for a DC-offset compensation in a bistatic 77GHz-FMCW-radar is discussed. Measurements of DC-offset voltages of a pseudo monostatic system, with two receiver and two transceiver channels, are presented and conclusions for a bistatic application are drawn. Two reasons for DC-offset are differentiated. First, DC-offset due to the characteristics of the radar circuit itself. Second, DC-offset caused by reflections of the near environment of the radar, such as bumpers.**

I. Introduction

In FMCW-radars a critical aspect is the appearance of a DC-offset at the mixers output. For monostatic radars the DC-offset is a well known problem. Because of the geometrical and electrical separation of the transmitting and receiving components in a bistatic radar sensor, it is assumed that the DC-offset is much smaller and has no negative influence to the system performance. For automotive 77GHz-FMCW-radars the advantage of separation disappears in consequence of its miniaturization and the direct feed of the transmitted power to the receiving mixer increase. An other point is the desire to mount the sensor behind bumpers. Unwanted reflections caused by them generate an additional DC-offset. For bistatic radars in such an application situation a DC-offset compensation might be needed.

The main principle of a mixer can basically described by formula 1 [1].

$$IF(t) = LO(t) \cdot RF(t)$$
$$= \frac{A_{LO}A_{RF}}{2}\left[\begin{array}{c}\underbrace{cos\left(2\pi\left(f_{LO}-f_{RF}\right)t+\left(\varphi_{LO}-\varphi_{RF}\right)\right)}_{downconverting}\\ \underbrace{+cos\left(2\pi\left(f_{LO}+f_{RF}\right)t+\left(\varphi_{LO}-\varphi_{RF}\right)\right)}_{upconverting}\end{array}\right] \quad (1)$$

Where IF is the baseband signal, LO the signal of the local oscillator and RF the received signal. The amplitude of the signals is A_i, the frequency f_i and the phase φ_i. The time t symbolize the signals continuity.

The up converted part of the signal is eliminated by a filter structure. By mixing two signals with the same frequency at the IF-port a constant signal is generated, the so called DC-offset. This constrains the performance of the radar [2], as follows.
On the one hand the signal-to-noise ratio (S/N) degrades. An example is shown in Fig. 1. It is obvious that the degradation

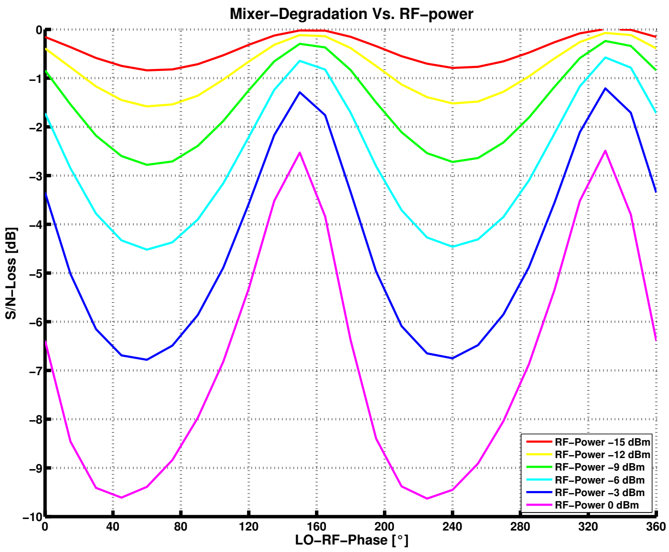

Fig. 1. Degradation of the mixer performance by a DC-offset

depends on the power, which is fed into the RF-port, as well as the phase difference between the LO and RF signal. In case the phase between LO and RF is disadvantageous the performance degradation can be considerable.
The second negative effect is related to the analog-to-digital