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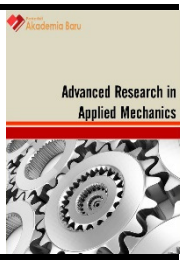


# A review on frequency synchronization in collaborative beamforming: A practical approach

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**ABSTRACT**

Coherent signal reception from distributed beamforming nodes of virtual antenna array formation requires frequency synchronization of the participating nodes. Signals at the target receiver are out of phase due to unsynchronized local oscillator's (LO) reference signal of all the nodes in the systems. Practical cases of this problem are considered. In this article, a brief overview is presented of the need for the frequency synchronization and the resulting effect of mitigation avoidance. A variant of the closed-loop feedback algorithm is used to provide LO drifts information to the beamforming transmitters. These feedbacks are used to estimate, correct, and predict the nonlinear LO offsets that will result in near (0) phase offset of the received signal. The algorithms are implemented in software defined radio (SDR) and transmitted through the RF front end of devices like the NI 2920/N210 USRP.

***Keywords:***
Frequency Synchronization, Collaborative Beamforming, Local Oscillator, Phase Offset, 1-bit feedback



## 1. Introduction

Software simulated approach to collaborative beamforming (CB) in wireless sensor network (WSN) for the purpose of steering virtual antenna beams towards a receiver have been covered in the literature such as [1-3] and referenced therein. The practical implementations of CB are rare, which is mostly due to the phase offset of signals received at the receiver. To address the latter problem, frequency synchronization among collaborating sensor nodes must be taken into account in solving the phase offset problem.

Radiation beam pattern from antennas of a single element are relatively wide and have directive gains of low values. Because of this, the need to design antennas with high directive gain becomes paramount. This is to enhance longer transmission range with narrower beamwidth to the desired

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