Improved SDR Frequency Tuning Algorithm for Frequency Hopping Systems

Mostafa Ibrahim and Islam Galal

Frequency hopping (FH) is a common characteristic of a wide variety of communication systems. On the other hand, software-defined radio (SDR) is an increasingly utilized technology for implementing modern communication systems. The main challenge when trying to realize an SDR FH system is the frequency tuning time, that is, the higher the hopping rate, the lower the required frequency tuning time. In this paper, significant universal hardware driver tuning options (within GNU Radio software) are investigated to discover the tuning option that gives the minimum frequency tuning time. This paper proposes an improved SDR frequency tuning algorithm for the generation of a target signal (with a given target frequency). The proposed algorithm aims to improve the frequency tuning time without any frequency deviation, thus allowing the realization of modern communication systems with higher FH rates. Moreover, it presents the design and implementation of an original GNU Radio Companion block that utilizes the proposed algorithm. The target SDR platform is that of the Universal Software Radio Peripheral USRP-N210 paired with the RFX2400 daughter board. Our results show that the proposed algorithm achieves higher hopping rates of up to 5,000 hops/second.

Keywords: Software-defined radio, USRP, GNU Radio, frequency tuning policies, frequency hopping, wireless transceivers.

I. Introduction

In a software-defined radio (SDR) system, SDR technology enables one to easily adjust the communication parameters, such as the frequency band, modulation type, and data rates, of the system's internal software program (for example, GNU Radio). This, in turn, means that one does not have to replace all of the system hardware, thus saving time and money. In addition, such technology postpones the binding of the design decisions until execution time, thus giving designers the opportunity to incorporate any late developments, which in turn helps them improve the performance of the system. In addition, SDR further provides both flexibility and maintenance simplicity because most upgrades can be performed through the loading of new software as opposed to the changing of the hardware modules. Consequently, SDR is increasingly being exploited in numerous communication systems [1].

1. Related Work

In this section, we review works related to the present study, for example, the evolution of SDR architectures and applications.

Spill and Bittau [2] were one of the first to utilize Universal Software Radio Peripheral (USRP) and GNU Radio in the realization of an SDR Bluetooth device. The main drawback of their attempted realization is the SDR Bluetooth device's frequency retuning time. The USRP in conjunction with GNU Radio takes more than one-third the duration of a Bluetooth packet to retune to a particular frequency, which results in packets being missed.

The authors of [3] proved that it was possible to attain the

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Mostafa Ibrahim (corresponding author, mustafa.ibrahim@bhit.bu.edu.eg) and Islam Galal (islam.galal@bhit.bu.edu.eg) are with the Electrical Engineering Department, Benha Faculty of Engineering-Benha University, Egypt.

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