Implementation of GNU Radio as a Software Defined Radar Sensor Network Node

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I. Abstract

The goal of this project is to develop a low cost radar sensor network to track small targets in high clutter environments, e.g. tracking small animals in a forest.

Due to technology advances, digital signal processing software is now able to perform radio functions at performance levels that were once thought impossible without the use of analogue hardware. Hence, it is only a short step from software-defined radio (SDR) to developing software-defined radar. GNU radio is an open source software-defined radio project [1] and the Universal Software Radio Peripheral (USRP) [2] is hardware designed for the specific use with the GNU Radio software to provide a low-cost experimental platform [3]. Since software-defined radio and software-defined radar encompass similar technologies, GNU Radio and the USRP can be adapted to form a low-cost radar sensor.

II. Software Defined Radar Network

The low-cost radar sensor network test bed being developed will utilize multiple radar sensors that employ SDR concepts whose principal objective is to get software as close to the antenna as possible [4]. Since most of the processing is done in software, simple modifications or replacements within the software can completely change the functionality of the system allowing for easy testing of new functionalities and algorithms [5]. This flexibility enables rapid prototyping of new algorithms and functionality for tracking applications at low cost.

III. Software Defined Radar Sensor

Currently most of the research utilizing GNU radio concepts for radar is for passive radar applications using signals of opportunity [6-8] but we demonstrate the use of GNU Radio as an active radar sensor. Thus far, Williams and Inggs have conducted experiments using the GNU Radio and the USRP for sonar applications [9], but we are unaware of any implementation of GNU Radio and the USRP as an active radar at higher frequencies. We are investigating utilizing the USRP with a daughterboard transceiver to create a radar in the range 750 MHz – 1050 MHz [2].

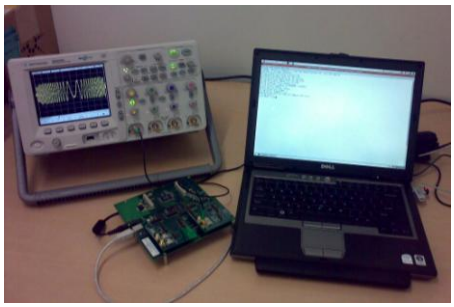

Fig. 1 Setup of the USRP showing a chirp transmit signal.

IV. Conclusion

Currently we are working on developing a sensor network for tracking studies utilizing an active radar system as a network node. We will demonstrate a low-cost active radar system that will eventually be an element in a network consisting of several such sensors. The low cost of the USRP, and the flexibility of the open-source software tools (GNU Radio Project) allow an economical solution in designing and deploying a network of elements, that is both flexible and functional, hence creating a radar sensor network that is of low cost but not compromising on desirable features.

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