School of Electrical, Computer and Energy Engineering

PhD Final Oral Defense

An Analysis of the Unmanned Aerial Systems-to-Ground Channel and Joint Sensing and Communications Systems Using Software Defined Radio

by

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Abstract

Software-defined radio provides users with a low-cost and flexible platform for implementing and studying advanced communications and remote sensing applications. Two such applications include unmanned aerial system-to-ground communications channel and joint sensing and communication systems. In this work, these applications are studied.

In the first part, unmanned aerial system-to-ground communications channel models are derived from empirical data collected from software-defined radio transceivers in residential and mountainous desert environments using a small (< 20 kg) unmanned aerial system during low-altitude flight (< 130 m). The Kullback-Leibler divergence measure was employed to characterize model mismatch from the empirical data. Using this measure the derived models accurately describe the underlying data.

In the second part, an experimental joint sensing and communications system is implemented using a network of software-defined radio transceivers. A novel co-design receiver architecture is presented and demonstrated within a three-node joint multiple access system topology consisting of an independent radar and communications transmitter along with a joint radar and communications receiver. The receiver tracks an emulated target moving along a predefined path and simultaneously decodes a communications message. Experimental system performance bounds are characterized jointly using the communications channel capacity and novel estimation information rate.