Title: "Detection of drones by RadioFrequency Fingerprinting"
Post-Doctoral position in Signal Processing.

Keywords: Signal Processing, RF Fingerprinting, Identification, Drones, Physical Layer.

Laboratory: ENSTA Bretagne L**aboratory Lab-STICC UMR CNRS 6285**, 29200 BREST.

Duration: The position is for 12 months.

Contact: Please send your detailed CV with a list of your publications/communications, a cover letter with skills related to the subject and your credentials by email to**:** agnes.madec@ensta-bretagne.fr with denis.le_jeune@ensta-bretagne.fr and frederic.le_roy@ensta-bretagne.fr in cc.

1. Postdoctoral Project Team

a. Candidate

He/She must own a PhD degree in Signal Processing or related field such as Artificial Intelligence. He/She must have strong knowledge in different fields and tools of signal processing, such as detection, estimation, statistics, time/frequency transforms and others.

b. Project

The Postdoctoral position is part of a global project involving two industrial companies and two laboratories. This project is dedicated to the drone detection by radiofrequency means. More specifically, the work concerns RF fingerprint algorithms R&D based on radio-communications of the drones.

c. Supervision

The post-doctoral position will be held at ENSTA Bretagne, Brest. The supervision team consists of Frédéric Le Roy, Assistant Professor of Electronic Engineering and Denis Le Jeune, Research Fellow and Leader of a Chair on "Physical Layer Transmission by Circuits and Systems". This work is made in partnership with University of Bretagne Occidentale, Brest.

2. Context and Motivation

The use of Unmanned Aerial Vehicles (UAVs) is constantly increasing whether for leisure or professional purposes and in different domains. These aerial drones are low cost, available off the shelf and therefore affordable for individuals. They have recently raised security concerns for critical sites such as nuclear stations, strategic locations like official buildings, airports, crowded places as stadiums, etc. In this context, drones represent a risk of potential attack.

The need of drone detection is becoming essential to protect these areas. Different means can be used to perceive the drones: the classical types of detection are by physical sensing with different approaches like radar, optical or acoustic means. In recent years, another approach has appeared. It is based on the physical layer too, more specifically on the radio

communication of the UAVs. These techniques use the radio fingerprinting (RF fingerprinting) of each drone transmitter [1]. The fingerprint is obtained by an accurate measure of the physical characteristics of the signal, which is shown to be different for different families of platforms (by product class for example), quite similar to a biometric approach.

3. Content

We will focus here on the detection of the effects due to the mechanical coupling between the platform and the radio-communication signals. This coupling induces specific fingerprint superposing to the original communication signal. It allows to authenticate a signal coming from a drone versus a signal not coming from a drone, and even the type of the drone implied.

This new approach opens wide fields of study by using many different types of physical parameters, more or less precise and easy to measure, whether in the time or frequency domains. We can consider for example the use of energy transition, time or phase characteristics, modulation parameters. The associated algorithms to explore can therefore be very extensive, such as Bayesian detection techniques for transients or various characteristics, entropy, time / frequency representations, maximum likelihood discriminant analysis, and also the field of machine learning with deep learning approaches we want to explore.

This PostDoctoral position will consist in the following tasks:

- State of the art of the RF fingerprinting for drone detection: in terms of measurement parameters and estimation methods. An embedded context, like a radio node with a Software-Defined Radio (SDR) platform with limited resources for the acquisition and the processing will be considered.
- Study and simulation of selected algorithms. Tests and comparisons on signals acquired from different available drones. This step will be done iteratively, to guide the algorithmic choices.
- Team work with other students in PhD or in PostDoctoral position on connected subjects.
- Support for the implementation of the algorithms on an embedded SDR platform.
- Exploration of machine learning approaches for the signal classification.

4. Reference

[1] P. Nguyen, H. Truong, M. Ravindranathan, A. Nguyen, R. Han and T. Vu, “Matthan: Drone Presence Detection by Identifying Physical Signatures in the Drone’s RF Communication”, Proc. 15th Annual Int. Conf. on Mobile Systems, Applications, and Services, MobiSys 2017, pp.211-224.