

SOFTWARE DEFINED JAMMING DETECTION OF DRONES

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Thesis/Dissertation submitted in partial fulfillment of the requirements for the degree
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DECLARATION

I declare that this is my own work and this thesis/dissertation does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other University or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text. I retain the right to use this content in whole or part in future works (such as articles or books).

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Date: 28 June 2023

The above candidate has carried out research for the PhD/MPhil/Masters thesis/dissertation under my supervision. I confirm that the declaration made above by the student is true and correct.

Name of Supervisor: Dr. KASN Sumathipala

Signature of the Supervisor:

Date: 28 June 2023

DEDICATION

I dedicate this thesis to the people who have supported and encouraged me throughout my academic journey. To my family, for their unwavering support and encouragement, which have been my driving force. Your sacrifices and belief in me have made all the difference.

To my supervisor and academic staff, for their guidance, mentorship, and expertise. Your encouragement, feedback, and constructive criticism have been invaluable in shaping my research and developing my skills. To the Sri Lanka Navy, for providing me with the opportunity to pursue this degree while serving my country. I am grateful for the support and flexibility you have shown throughout my academic journey.

To my friends, for their camaraderie, laughter, and unwavering support. Your encouragement and positivity have been instrumental in keeping me motivated and focused.

This thesis is a testament to your support and guidance. Thank you for being a part of my journey and for helping me achieve this significant milestone.

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I would like to express my heartfelt gratitude to the Sri Lanka Navy for their invaluable support, understanding, and flexibility, which have allowed me to pursue this degree while serving my country.

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ABSTRACT

The increasing use of wireless technologies in many aspects of people's lives has led to a congested electromagnetic spectrum, making it critical to manage the limited available spectrum as efficiently as possible. This is particularly important for military activities such as electronic warfare, where jamming is used to disrupt enemy communication, self-attacking drones, and surveillance drones. However, current detection methods used by Sri Lankan armed personnel, such as optical sensors and RADAR, do not include Radio Frequency (RF) analysis, which is crucial for identifying the signals used to operate drones. To combat security vulnerabilities posed by the rogue or unidentified transmitters, RF transmitters should be detected not only by the available data content of broadcasts but also by the physical properties of the transmitters. This requires faster fingerprinting and identifying procedures that go beyond the traditional hand-engineered methods. In this thesis, RF data from the drone remote is identified and collected using Software Defined Radio (SDR), a radio that employs software to perform signal-processing tasks that were previously accomplished by hardware. A deep learning model is then provided to train and detect modulation strategies utilized in drone communication, as well as a suitable jamming strategy. This thesis presents an overview of neutralization of Unmanned Aerial Vehicle (UAV), communication signals, and Deep Learning (DL) applications. It also proposes an intelligent system for modulation detection and jamming of drones based on SDR. The DL approaches in these applications, as well as the development of more complicated UAV neutralization methods, appear to be promising research fields. Finally, the goal of this thesis is to connect recent research themes in the disciplines of UAV neutralization, signals of communications, and Machine Learning (ML) and DL applications in order to produce a more efficient and effective approach for identifying and neutralizing drones. The proposed intelligent system for modulation detection and jamming of drones based on SDR, along with use of deep learning approaches, holds great potential for future research in this field.

Keywords: UAV neutralization, intelligent system, SDR, Radio Frequency, ML, DL, modulation detection

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LIST OF ABBREVIATIONS

Abbreviation	Description
API	Application Programming Interface
AI	Artificial Intelligence
CNN	Convolutional Neural Network
COCO	Common Object in Context
DL	Deep Learning
FSK	Frequency Shift Keying
GFSK	Gaussian Frequency Shift Keying
GMSK	Gaussian Minimum Shift Keying
GPU	Graphics Processing Unit
ISM	Industrial, Scientific, and Medical
ISMD	Intelligent System for Modulation Detection
MAP	Mean Average Precision
ML	Machine Learning
RADAR	Radio Detection And Ranging
RF	Radio Frequency
RFDF	Radio Frequency Direction Finding
SDR	Software Defined Radio
UAV	Unmanned Aerial Vehicle
VM	Virtual Machine