

# Contents

<b>1. Introduction</b>	<b>1</b>
1.1. Thesis Scope . . . . .	1
1.2. Objectives . . . . .	1
1.2.1. General Objective . . . . .	2
1.2.2. Specific Objectives . . . . .	2
1.3. Structure . . . . .	2
<b>2. Theoretical Background</b>	<b>3</b>
2.1. Detection techniques . . . . .	3
2.1.1. Time-domain . . . . .	3
2.1.2. Polarimetry . . . . .	3
2.1.3. Gaussianity tests . . . . .	4
2.1.4. Spectral Density Estimation . . . . .	4
2.1.5. Cyclostationary RFI . . . . .	5
2.2. Mitigation Techniques . . . . .	5
2.2.1. Regulatory methods . . . . .	5
2.2.1.1. Radio Quiet Zones . . . . .	5
2.2.1.2. Controlling Observatory Generated RFI . . . . .	6
2.2.2. Technical methods . . . . .	6
2.2.2.1. RF Frontend and Baseband Subsystems . . . . .	6
2.2.2.2. Digital Subsystem . . . . .	7
2.2.2.3. Offline Data Processing . . . . .	8
2.3. Cross-correlation . . . . .	8
2.4. Spectrometers . . . . .	8
2.5. Feature generation . . . . .	10
2.6. Dimensionality reduction . . . . .	10
2.6.1. PCA . . . . .	10
2.6.2. t-SNE . . . . .	11
2.7. Clustering . . . . .	11
2.7.1. K-Means . . . . .	11
<b>3. Work environment</b>	<b>12</b>
3.1. ROACH-2 . . . . .	12
3.2. Hardware description . . . . .	15
3.3. Compiler . . . . .	16
3.4. Communication . . . . .	16

<b>4. Methodology</b>	<b>17</b>
4.1. Formalization of the problem . . . . .	17
4.2. Tutorials . . . . .	18
4.2.1. Snapshot . . . . .	18
4.2.2. Spectrometer . . . . .	19
4.3. Detector . . . . .	20
4.3.1. Design . . . . .	20
4.3.2. Power interpretation . . . . .	21
4.3.3. Model implementation . . . . .	23
4.3.4. Detector script . . . . .	24
4.4. Classifier . . . . .	26
4.4.1. Design . . . . .	26
4.4.2. Script . . . . .	26
<b>5. Detector and classifier limitations</b>	<b>28</b>
5.1. Time Quantization . . . . .	28
5.2. Amplitude Quantization . . . . .	29
5.3. Frequency Quantization . . . . .	30
5.4. Detector Quantization . . . . .	30
<b>6. Results and analysis</b>	<b>31</b>
6.1. Detector . . . . .	31
6.1.1. Simulations . . . . .	31
6.1.2. Experimental Tests . . . . .	33
6.2. Classifier . . . . .	41
<b>7. Conclusions</b>	<b>45</b>
<b>8. Future Work</b>	<b>46</b>
<b>Appendix A. Mathematical derivations</b>	<b>49</b>
A.1. Power Spectral Density in terms of correlation . . . . .	49
<b>Appendix B. Scripts</b>	<b>51</b>
B.1. Detector scripts . . . . .	51
<b>Appendix C. ISE Design Suite Report</b>	<b>64</b>