

# Contents

<b>Acknowledgements</b>	<b>v</b>
<b>Abstract (English/Français)</b>	<b>vii</b>
<b>List of Figures</b>	<b>xiii</b>
<b>List of Tables</b>	<b>xvii</b>
<b>1 Introduction</b>	<b>1</b>
1.1 Epilepsy and Surgical Treatment . . . . .	2
1.1.1 Neural Activity Monitoring Methods . . . . .	2
1.1.2 Macro and Micro-Electrodes for Intracranial Recordings . . . . .	3
1.1.3 Challenges in Intracranial Recordings . . . . .	5
1.2 Thesis Goal: Implantable Monitoring System . . . . .	5
1.2.1 Wireless Implantable Neural Recording Systems . . . . .	6
1.2.2 Anticipated Challenges . . . . .	6
1.2.3 Research Objectives . . . . .	7
1.3 Thesis Outline . . . . .	7
<b>2 Implantable Monitoring System for Epilepsy</b>	<b>9</b>
2.1 System Overview . . . . .	9
2.1.1 Electrodes and Analog Front-end . . . . .	10
2.1.2 Analog to Digital Converter and Compression . . . . .	12
2.1.3 Controller Unit . . . . .	13
2.1.4 Energy Source of the Implanted System . . . . .	13
2.1.5 Wireless Data Transmission . . . . .	15
2.2 System Specifications . . . . .	17
2.3 Summary . . . . .	18
<b>3 Powering of the Implanted Monitoring System</b>	<b>21</b>
3.1 Power Sources for Implanted Systems . . . . .	21
3.2 Wireless Power Transfer (WPT) . . . . .	25
3.3 WPT with Magnetic Coupling . . . . .	27
3.3.1 Inductive Link . . . . .	27
3.3.2 Rectifier . . . . .	31

- 3.3.3 Regulator . . . . . 41
- 3.3.4 Automatic Resonance Tuning . . . . . 44
- 3.3.5 Power Feedback Generation . . . . . 47
- 3.4 Summary . . . . . 51
  
- 4 Wireless Data Communication . . . . . 53**
- 4.1 Downlink Data Communication . . . . . 54
- 4.2 Uplink Data Communication . . . . . 62
  - 4.2.1 Narrowband Transmitter . . . . . 64
  - 4.2.2 Ultra-wideband Transmitter . . . . . 71
- 4.3 Summary . . . . . 84
  
- 5 Experimental Validations . . . . . 85**
- 5.1 Biomedical Packaging . . . . . 85
- 5.2 Animal Experiments . . . . . 87
  - 5.2.1 *In Vivo* Characterization of Remote Powering . . . . . 90
  - 5.2.2 *In Vivo* Characterization of Wireless Data Communication . . . . . 91
  - 5.2.3 System Level *In Vivo* Characterization . . . . . 93
- 5.3 Summary . . . . . 98
  
- 6 Conclusion . . . . . 99**
- 6.1 Future Work . . . . . 100
  
- Bibliography . . . . . 114**
  
- List of Acronyms . . . . . 115**
  
- Publications . . . . . 117**
  
- Curriculum Vitae . . . . . 119**