Table of contents

| Li | List of Figures | | | | | | |
|----|-------------------------|--|---|--|--|--|--|
| Li | List of Tables Acronyms | | | | | | |
| A | | | | | | | |
| 1 | Inti | roduction | 2 | | | | |
| | 1.1 | Background | 2 | | | | |
| | 1.2 | Cancer in the modern society | 2 | | | | |
| | | 1.2.1 Colorectal cancer | 2 | | | | |
| | 1.3 | Cancer and electromagnetic properties | 3 | | | | |
| | 1.4 | Objectives and scope | 3 | | | | |
| | 1.5 | Thesis overview | 3 | | | | |
| | 1.6 | Contributions | | | | | |
| | | 1.6.1 Publications and activities related to this thesis | : | | | | |
| | | 1.6.2 Other publications stemming from the thesis | 3 | | | | |
| 2 | Measurement system | | | | | | |
| | 2.1 | Dielectric properties of biological tissues | : | | | | |
| | 2.2 | Dielectric characterization techniques | 4 | | | | |
| | 2.3 | Open-ended coaxial system | 4 | | | | |
| | | 2.3.1 Principle of operation | 4 | | | | |
| | | 2.3.2 Choice of calibration standards | 4 | | | | |
| | | 2.3.3 Assessment of system's uncertainty | Ę | | | | |
| | | 2.3.4 Measurement software | Ę | | | | |
| | 2.4 | Conclusion | Ę | | | | |
| 3 | Die | lectric characterization of biological tissues | 5 | | | | |
| | 3.1 | Introduction | Ę | | | | |
| | 3.2 | Measurement protocol | 6 | | | | |

TABLE OF CONTENTS

| | 3.3 | Results | 63 |
|---|-----|---|-----------|
| | | 3.3.1 Uncertainty of the dielectric data | 84 |
| | | 3.3.2 Comparison with other studies | 91 |
| | 3.4 | Conclusion | 95 |
| 4 | Die | lectric characterization of colon tissues | 97 |
| | 4.1 | Introduction | 97 |
| | 4.2 | Measurement of biopsies | 99 |
| | | 4.2.1 Sample collection protocol | 99 |
| | | 1 I | .01 |
| | | | .09 |
| | | 1 | 12 |
| | 4.3 | 3 J | 14 |
| | | r r r r r r r r r r r r r r r r r r r | 14 |
| | | | 15 |
| | | v e | 18 |
| | 4.4 | 1 | 21 |
| | 4.5 | Conclusion | .23 |
| 5 | Pro | ı v | 27 |
| | 5.1 | | .27 |
| | 5.2 | v | .30 |
| | | * * | .30 |
| | | | .33 |
| | 5.3 | v v | .35 |
| | 5.4 | v | .39 |
| | | 1 | 41 |
| | 5.5 | 0 | 47 |
| | 5.6 | Conclusion | 49 |
| 6 | Con | nclusions and future work 1 | 53 |
| | 6.1 | Concluding remarks | .54 |
| | | 9 | 54 |
| | | 6.1.2 Database of in vivo electromagnetic properties of biolog- | |
| | | | 56 |
| | | 6.1.3 Differences in dielectric properties between healthy and | |
| | | 8 8 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | 56 |
| | | 1 0 | 58 |
| | 6.2 | | .59 |
| | | 6.2.1 Dielectric characterization of the colon healthy, malig- | |
| | | nant and pathological tissues at in vivo conditions 1 | 59 |

TABLE OF CONTENTS

| 6.2.2 | 6.2.2 Development of the proposed systems for colon candidetection | | | | |
|--|--|--|--|--|--|
| 6.2.3 | Assessment of other pathologies | | | | |
| A Electromagnetic properties of biological tissues | | | | | |
| References | | | | | |