
Contents

| | |
|--|------------|
| Kurzfassung | III |
| Abstract | V |
| 1 Introduction | 1 |
| 1.1 Publications | 1 |
| 1.2 Endoscopy of the Gastrointestinal Tract | 2 |
| 1.2.1 Traditional Endoscopy | 3 |
| 1.2.2 Capsule Endoscopy | 4 |
| 1.3 Research Problem | 6 |
| 2 State of the Art in Localization of Capsule Endoscopes (CE) | 9 |
| 2.1 Scientific Approaches | 9 |
| 2.1.1 Video-Based Localization | 10 |
| 2.1.2 RF-Based Localization | 13 |
| 2.1.3 Magnetic Field-Based Localization | 18 |
| 2.1.4 Other Localization Methods | 28 |
| 2.1.5 Hybrid Localization Methods | 28 |
| 2.2 Commercial Approaches | 31 |
| 2.3 Discussion of the State of the Art in Localization of CE | 31 |
| 3 Aim of the Thesis | 37 |
| 4 Applied Strategy and Used Methods | 39 |
| 4.1 Differential Static Magnetic Localization for Integration with a Wearable CE System | 40 |
| 4.1.1 Simulation-Based Validation | 40 |
| 4.1.2 Experimental Validation | 46 |
| 4.2 Relative Movement Compensation for the Proposed Differential Method for Integration with a Wearable CE System | 55 |
| 4.2.1 Experimental Validation | 56 |

| | | |
|----------|--|------------|
| 5 | Results and Discussion | 61 |
| 5.1 | Evaluation of Differential Geomagnetic Compensation | 61 |
| 5.1.1 | Simulation-based Validation | 61 |
| 5.1.2 | Experimental Validation | 65 |
| 5.1.3 | Opportunities and Limitations | 76 |
| 5.2 | Evaluation of Relative Movement Compensation Method | 77 |
| 5.2.1 | Experimental Proof of Concept | 77 |
| 5.2.2 | Opportunities and Limitations | 79 |
| 5.3 | Summary of Contributions to Static Magnetic Localization of CE | 80 |
| 5.4 | Summary of Contributions to Localization of CE | 85 |
| 6 | Conclusion and Prospect | 87 |
| | References | 91 |
| | List of Abbreviations | 101 |
| | Tables and Figures | 103 |
| | Danksagung | 107 |
| | List of Own Publications | 109 |
| | List of Supervised Student Theses | 113 |