

# List of Content

Abstract .....	ii
List of Content .....	iii
List of Figures.....	vi
List of Tables .....	viii
Index of Abbreviations.....	ix
I. Introduction .....	1
1. Thesis Structure .....	2
2. Scientific Background .....	4
2.1. Remote Sensing-Based Characterization of Surface Objects.....	4
2.2. Technological Background.....	5
2.3. Multi-Sensor Data Fusion Completing the Picture .....	6
2.4. Challenges of HSI and ALS Sensor Fusion .....	7
3. Overall Research Questions and Objectives.....	8
4. Research Design, Strategy, and Overall Framework .....	9
4.1. Sensor Characteristic, Integration and Acquisition Strategy .....	9
4.2. Acquired Data Set and Study Area .....	10
II. Geometric Fusion.....	11
1. Introduction.....	12
2. General HSI and Lidar Sensor System Characteristics.....	14
2.1. Spatial Sampling Characteristics.....	16
2.2. Challenge of the Geometric Co-registration .....	16
3. Method.....	17
3.1. Input Data Generation .....	19
3.2. Geometrical Co-alignment Method.....	23
3.3. Geometric Correction .....	30
4. Results and Discussion .....	30
4.1. Comparison of HSI and Lidar Intensities.....	31
4.2. Comparison to Related Methods.....	39
5. Summary .....	40

<b>III. Radiometric Fusion .....</b>	<b>42</b>
1. Introduction.....	43
2. Background .....	45
2.1. Radiative Transfer Characteristics .....	45
3. Methodology .....	47
3.1. Input Data Generation and Pre-processing.....	49
3.2. Cross-calibration Procedure.....	51
4. Results.....	57
4.1. Comparison Between the Overlapping Wavelength Domain of 1550 nm .....	57
4.2. Corrected HSI Data Cube .....	61
4.3. HSI Data Quality and Classification Improvements.....	63
5. Discussion .....	68
6. Conclusion.....	69
<b>IV. 3D Hyperspectral Point Cloud.....</b>	<b>71</b>
1. Introduction.....	72
2. Methodology .....	74
2.1. Input Data Generation and Preprocessing .....	76
2.2. Fused Hyperspectral Point Cloud Generation .....	76
2.3. Fused Hyperspectral Point Cloud Generation (Figure IV-3 (III)) .....	80
3. Results.....	80
3.1. Evaluation of the Proposed Data Fusion.....	81
3.2. Potential of HSPC for Improved Characterization of Surface Objects .....	84
4. Discussion .....	91
4.1. Segmentation-based Spatial Unmixing (SSA) Approach .....	91
4.2. Application Objectives .....	92
4.3. Opportunities and Limitations.....	94
5. Conclusion.....	95
<b>V. Discussion and Conclusion .....</b>	<b>97</b>
1. Findings and their Overall Context .....	97
1.1. Methodical Objective .....	97

1.2. Application Objectives .....	100
2. Outlook .....	102
3. Conclusion.....	103
References .....	105
Acknowledgements .....	112