
Contents

ACKNOWLEDGEMENT	ix
CHAPTER 1. BISTATIC SYNTHETIC APERTURE RADAR (BSAR) SURVEY	1
1.1. Introduction and main definitions	1
1.2. Passive space-surface bistatic and multistatic SAR	4
1.3. Forward scattering radars	6
1.4. A moving target problem as an inversion problem in multistatic SAR	8
1.5. BSAR models, imaging, methods and algorithms	9
1.5.1. Range migration algorithm for invariant and variant flying geometry	9
1.5.2. Bistatic point target reference spectrum based on Loffeld's bistatic formula	10
1.5.3. Target parameters extraction	12
CHAPTER 2. BSAR GEOMETRY	17
2.1. BGISAR geometry and kinematics	17
2.2. Multistatic BSAR geometry and kinematics	21
2.3. BFISAR geometry and kinematics	24
2.3.1. Kinematic parameter estimation	26
CHAPTER 3. BSAR WAVEFORMS AND SIGNAL MODELS	29
3.1. Short pulse waveform and the BSAR signal model	29
3.1.1. Short pulse waveform	29
3.1.2. Short pulse BSAR signal model	30
3.1.3. Target's parameters estimation in short range BFISAR scenario	31
3.2. LFM pulse waveform	32
3.2.1. LFM BSAR signal model	33

3.3. CW LFM waveform and modeling of deterministic components of BSAR signal	35
3.4. Phase code modulated pulse waveforms	37
3.4.1. Barker phase code	38
3.4.2. Complementary code synthesis	39
3.4.3. BSAR-transmitted complementary phase code modulated waveforms	39
3.4.4. GPS C/A phase code	41
3.4.5. GPS P phase code	43
3.4.6. DVB-T waveform	47
CHAPTER 4. BSAR IMAGE RECONSTRUCTION ALGORITHMS	49
4.1. Image reconstruction from a short pulse BSAR signal	49
4.2. LFM BSAR image reconstruction algorithm	53
4.3. PCM BSAR image reconstruction algorithm	55
4.4. Autofocus algorithm with entropy minimization	58
4.5. Experiment with the multistatic SAR LFM image reconstruction algorithm	59
CHAPTER 5. ANALYTICAL GEOMETRICAL DETERMINATION OF BSAR RESOLUTION	65
5.1. Generalized BSAR range and Doppler resolution	65
5.1.1. BSAR range resolution	65
5.1.2. BSAR Doppler resolution	69
5.2. Along-track range resolution	69
5.3. Range resolution along a target–receiver line of sight	72
CHAPTER 6. BSAR EXPERIMENTAL RESULTS	77
6.1. Example 1: BFISAR with short-pulse waveform	77
6.1.1. BFISAR parameters estimation	78
6.1.2. BFISAR signal formation algorithm	78
6.2. Example 2: BFISAR with pulse LFM waveform	83
6.2.1. BFISAR geometry and isorange ellipse parameter estimation	85
6.2.2. BFISAR LFM signal formation algorithm	86
6.2.3. Image reconstruction algorithm and experimental results	86
6.3. Example 3: asymmetric geometry of BFISAR with pulse LFM waveform	95
6.3.1. BFISAR LFM signal formation algorithm	96
6.3.2. BFISAR image reconstruction algorithm and experimental results	97

6.4. Example 4: BGISAR with Barker PCM waveform	101
6.4.1. BGISAR Barker PCM signal formation algorithm	102
6.4.2. BGISAR image reconstruction algorithm and experimental results	104
6.5. Example 5: BGISAR with GPS C/A PCM waveform	109
6.5.1. BGISAR GPS C/A PCM signal formation algorithm.	110
6.5.2. BGISAR image reconstruction algorithm and experimental results	112
6.6. Example 6: BGISAR with GPS P PCM waveform	115
6.6.1. BGISAR GPS P PCM signal formation algorithm	116
6.6.2. BGISAR image extraction algorithm and experimental results	118
CHAPTER 7. BSAR MATLAB IMPLEMENTATION	123
7.1. Construction of a helicopter image	123
7.2. BGISAR imaging	124
7.3. BFISAR imaging by short pulses	134
7.4. Continuous linear frequency modulated waveform generation	137
7.5. Pulse LFM waveform generation	138
7.6. BFISAR imaging by pulse LFM waveform	139
7.7. GPS coarse acquisition phase code modulated waveform generation	145
7.8. BGSAR imaging by GPS C/A PCM waveform	146
7.9. GPS precision phase code modulated waveform generation	152
7.10. BGISAR imaging by GPS P PCM waveform	153
7.11. Multistatic SAR imaging by pulse LFM waveform	162
7.12. Isorange ellipse generation	166
7.13. Range resolution determination	168
BIBLIOGRAPHY	171
INDEX	181