

Preface

The development of bistatic synthetic aperture radar (SAR) can date back to the earliest days of radar. After the invention and demonstration of the monostatic radar principle in the late 1930s, bistatic SAR entered into the silent phase despite of multiple recovery during last decades. Only in recent ten years, bistatic SAR received increasing interest and a number of spaceborne bistatic and multistatic radar missions have been suggested, some of which are now under development or in planning, the most successful representative is the bistatic TerraSAR-X tandem.

The space distribution between the transmitter and receiver improves the capability, reliability, and flexibility of the SAR system, which in turn makes it a promising and useful supplement to a classical monostatic SAR system. Many advantages in bistatic SAR beyond our imagination have been investigated, including frequent monitoring, resolution enhancement, reduced vulnerability for military applications, reduced costs using existing illuminators of opportunity with several receive-only systems, and also the possibility of forward-looking or backward-looking SAR imaging, global high precise digital elevation model (DEM) measurement and urban infrastructure monitoring. To exploit these advantages, many engineers and scientists have devoted themselves to the development of bistatic SAR system designing, signal processing, and elaborate post processing.

This book reviews the development of bistatic SAR and strives to make a comprehensive framework of it and devoted to presenting the typical processing algorithms for the bistatic SAR signal. This presentation proceeds from a systematic and unitary point of view, starting from fundamental principles, and deriving variant processing algorithms in the bistatic SAR operational modes.

This book is organized into eight chapters. Chapter 1 focuses on the fundamentals of the bistatic AR system, including the development history, the bistatic SAR imaging geometry, and the signal model with the two-dimensional resolution. At last, bistatic radar equation and bistatic RCS are illustrated. This chapter is preliminary to the following deeper analysis and provides the readers with an overview of features, capabilities, and limitations of the SAR system. Chapter 2 presents three kinds of two-dimensional bistatic point target reference spectrum,

including Loffeld Bistatic Fomular, the method of series reversion, the extended Loffeld Bistatic Fomular, and the bistatic spectrum based on the two-dimensional principle of stationary phase. Chapter 3 focuses on the azimuth-variant bistatic SAR signal processing, while Chap. 4 presents the frequency domain imaging algorithm for the azimuth-invariant configuration. Chapter 5 describes a unique hybrid bistatic SAR configuration, the one-stationary bistatic SAR mode. The fast back-projection algorithm, the modified azimuth-nonlinear chirp scaling algorithm, and the polar format algorithm are derived and demonstrated in detail. Synchronization is a challenging task for the bistatic SAR system to implement. In Chap. 6, the beam synchronization, time synchronization, and phase synchronization schemes are presented and analyzed. In Chap. 8, a bistatic interferometry SAR mission example is given. The system design and interferometric performance analysis of a twin L-band satellite configuration are represented in detail. At last of Chap. 7, the multistatic multibaseline interometric experiment (MC-InSAR) is presented, including the imaging geometry, system configuration, and baseline design, the interferogram.

This book can be useful to scientists and engineers working in the bistatic SAR signal processing field, and more generally to all the remote-sensing community. I hope that the readers could appreciate this book and give their constructive criticisms to this book.

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