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Jiaxing Liu

Spacecraft TT&C and Information Transmission Theory and Technologies

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Foreword

“TT&C” is the abbreviation of tracking, telemetry and command. “Spacecraft information transmission” refers to the mutual transmission of information acquired from or generated by spacecraft and ground station. With the development of technologies, TT&C and information transmission have been organically linked, in that they are complementary in functions, unified in signal design and integrated in equipment. In addition, telemetry and telecommand are essentially a kind of information transmission. From the view of development, information warfare and integrated electronic information system require that TT&C and information transmission be designed on a unified basis and integrated into a single device. Therefore, this book highlights the characteristics of the combination of TT&C and information transmission with the latter being particularly emphasized. Based on the practices of the author in developing various TT&C equipment over many years and trying to combine theory with the practices, the book focuses on the basic technologies commonly applied for C&T system of various vehicles, with the intention to help the readers to obtain deeper understanding about TT&C systems and provide them with a theoretical basis for resolving practical engineering problems.

The book falls into two major parts of TT&C and Information Transmission, and is composed of five chapters. Chapter 1 introduces the past, present and future of TT&C and information transmission technologies. Chapter 2 introduces tracking and orbit measuring theories and technologies, with focus on CW radar’s velocity-measuring, ranging, angle measuring technologies and locating technology. Chapter 3 (Information Transmission Technology) introduces analog transmission technology and digital transmission technology. In addition to the basic theories in combination with features of C&T, the telemetry, telecommand and remote sensing technologies are also provided. Chapter 4 (Spread Spectrum TT&C) introduces the application of spread spectrum technologies in C&T field. Chapter 5 introduces the development of TT&C frequency band in combination with special problems occurring in radio transmission channel, such as impacts of rain attenuation, atmospheric attenuation and radio wave propagation upon accuracy of orbit

determination during transmission, impact of multi-path transmission, and polarization diversity synthesis.

With its main purpose being the introduction on basic theoretical knowledge and technology, the main feature of this book is the idea of combining TT&C with information transmission, and combining theory with the practical experiences in equipment development.

With the wider application of C&T system, particularly with its increasing significance in military application field, C&T system becomes the only information line between the spacecraft and ground, so there are more and more people engaged in the development, production, application and teaching of such engineering system. However, there are only a few books involving the technology. For this reason, the author, by incorporating the experiences from the practices of engaging in different engineering equipment research for many years, studies and summarizes his published papers and training materials to complete the writing of this book, hoping to provide support to the science-technological workers and university teachers and students who are involved in the development, design, production and application of the C&T system.

This book is compiled under great support from China Southwest Institute of Electronics Technology – the employer of the author – and National Defense Industry Press. Many contents in this book reflect the achievements made by China Southwest Institute of Electronics Technology from developing C&T systems for many years and so it is the fruit of all the participants' efforts. In addition, in the course of compiling this book, academician Yang Shizhong reviewed the manuscript, researchers Lei Li and Zhang Hansan put forward many valuable comments, Yang Hongjun provided a lot of materials, and Liu Yu and Liu Yanmeng completed numerous text processing works. The author hereby expresses his sincere gratitude to all of them for their great support.

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Jiaxing Liu

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