

## Preface

This monograph provides an introduction to the development and use of antenna arraying in the Deep Space Network (DSN). It is intended to serve as a starting point for anyone wishing to gain an understanding of the techniques that have been analyzed and implemented. A complete discussion of the general subject of arraying has not been provided. Only those parts relevant to what has been used in the DSN have been included.

While baseband arraying, symbol combining, and carrier arraying were discussed and developed fairly early in the history of the DSN, it wasn't until the failure of the main antenna onboard the Jupiter-bound Galileo spacecraft that arraying antennas became more critical. In response to this crisis, two methods were analyzed: full-spectrum arraying and complex-symbol combining. While both methods were further developed, it was full-spectrum arraying that was finally implemented to support the Galileo data playback. This effort was so successful that a follow-on implementation of full-spectrum arraying was begun that provided for much higher data rates than for the Galileo Mission and allowed for arraying of up to six antennas within the Goldstone Complex. In addition to providing a backup to the 70-m antenna, this array (the Full Spectrum Processing Array, or FSPA) allows future missions to use a varying number of antennas as a function of time, and thereby to optimize the use of resources. This capability is also being implemented at the other DSN complexes.

We present here a description of this development, including some historical background, an analysis of several methods of arraying, a comparison of these methods and combinations thereof, a discussion of several correlation techniques used for obtaining the combining weights, the results of several arraying experiments, and some suggestions for future work. The content has been drawn from the work of many colleagues at JPL who have participated in

the effort to develop arraying techniques and capabilities. We are indebted to the large number of scientists, engineers, testers, and operators who have played a crucial role in the implementation of antenna arraying in the DSN. Finally, we acknowledge the primary role of NASA, its Deep Space Network, and especially the Galileo Project in the development of this exciting capability.

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