Preface

During the past few decades, there has been significant research into sensor array signal processing, culminating in the development of superresolution array processing, which asymptotically exhibits infinite resolution capabilities.

Array processing has an enormous set of applications and has recently experienced an explosive interest due to the realization that arrays have a major role to play in the development of future communication systems, wireless computing and biomedicine (bio-array processing).

However, the 'heart' of any application is the structure of the employed array of sensors and this is completely characterized [1] by the *array manifold*. The *array manifold* is a fundamental concept and is defined as the locus of all the response vectors of the array over the feasible set of source/signal parameters. In view of the nature of the array manifold and its significance in the area of array processing and array communications, the role of differential geometry as the most particularly appropriate analysis tool, cannot be over-emphasized.

Differential geometry is a branch of mathematics concerned with the application of differential calculus for the investigation of the properties of geometric objects (curves, surfaces, etc.) referred to, collectively, as 'manifolds'. This is a vast subject area with numerous abstract definitions, theorems, notations and rigorous formal proofs [2][3] and is mainly confined to the investigation of the geometrical properties of manifolds in three-dimensional Euclidean space $\mathcal{R}^3$ and in *real* spaces of higher dimension.

However, the array manifolds are embedded not in real, but in N-dimensional complex space (where N is the number of sensors). Therefore, by extending the theoretical framework of $\mathcal{R}^3$ to complex spaces, the underlying and under-pinning objective of this book is to present a summary of those results of differential geometry which are exploitable and of practical interest in the study of linear, planar and three dimensional array geometries.

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Keywords for the book:

linear arrays, non-linear arrays, planar arrays, array manifolds, differential geometry, array design, array ambiguities, array bounds, resolution and detection.

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