

Preface

Space-time array communications – vector channel estimation and reception is stemmed from the integration of two emerging technologies for the future wireless mobile systems: space-time array processing and spread spectrum multiple access communications. The vector channel constitutes the spatial-temporal multipath propagation environment resulting from multiple reflection, refraction, diffraction and scattering phenomena experienced by the propagating signal. By applying space-time processing in spread spectrum multiple access system, the multiuser vector channel can be exploited, in accordance to its environmental context, to provide a mitigation of the various associated channel impairments. As a consequence, new dimensional layer of interference cancellation methodology can be devised, and additional form of inherent diversity can be derived, based on specifically developed vector channel estimation technique integrated at the front-end of the reception process. This book will look at the following three original integrated vector channel estimation and reception algorithms, with each dealing with different practical environmental scenario.

First is the Polarisation-Space-Time estimation and reception. Traditional array processing techniques often ignore the polarisation aspect of the signal, disregarding the fact that, in typical mobile environment, the received signal rarely takes on its transmitted polarisation. The diversity in the signal polarisation is not insignificant due to the depolarisation mechanism intrinsic in the propagation channel, and considering the recent development of portable handheld terminals which are often randomly orientated. Hence, instead of taking the polarisation factor as part of signal fading, the polarisation information inherent in the signal can be exploited to improve the accuracy and resolution of the estimation process and enhance the detection capability of the receiver.

Second is the Diffuse-Space-Time estimation and reception. Most array processing models frequently assume a rather simplistic view of

the multipath propagation environment, which is made up of multiple point sources in the channel. However in typical wireless urban or suburban setup, the signal transmitted into the channel may suffer localised scattering which will inevitably create diffusion in its signal components. This consequently leads to a performance degradation when conventional array processing technique, founded on point sources assumption, is employed. A generalised diffusion framework is therefore devised to cope with both point and/or diffuse sources resulted in the signal environment. Its underlying architecture also permits ease in an extension to a co-code environmental scenario.

Third is the Doppler-Space-Time estimation and reception. Doppler spread, due to the relative motion in the environment, is detrimental in typical Multiple Input Multiple Output (MIMO) system. This can however be incorporated as a source of diversity by exploiting these multipath Doppler components in the receiver design. Unlike many MIMO works which are based on multiple independent antenna elements, the proposed MIMO array receiver is built on antenna array technology which is commonly used in applications such as the well-known smart-antenna system. It does not require the imposition of the knowledge of the channel or the need of any power control as in its conventional counterparts.

To gain a deeper understanding in the above algorithmic frameworks, other representative examples are also included at the end of the text to allow new insights into the application of these algorithms. Following that, some of the key points in the current research are highlighted, which offer some indicative views into the various potential areas for further investigative studies.

Note that this book is meant to provide a holistic picture in the treatment of the subject, bringing and linking together a number of the author's main relevant publications. It is hopeful that the readers will find the text useful, in not only gaining a comprehensive understanding but also in extending the work to other fields of research.

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