

Recent Advances in Space Modulation Techniques

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Abstract: The demand for high data rate and the inflation in the number of wireless users witnessed unprecedented growth in the past few years and the trend does not seem to flatten in the coming years. Spectrum scarcity and limited energy resources dictate the need for innovative systems, algorithms and schemes to be included in the future 5G communication standard and beyond. Space modulation techniques (SMTs), or generally called index modulation (IM) techniques, promises significant advantages and attracted significant research interest due to their remarkable enhancements in terms of spectral and energy efficiencies. In these systems, the indexes of the building blocks or existing resources are utilized as an extra sources of information that are used to convey additional data bits. SMTs include variant techniques such as spatial modulation (SM), space shift keying (SSK), quadrature spatial modulation (QSM) and their generalization parts. These techniques were investigated widely in the past few years and many variant schemes were proposed. For instance, non-coherent SMTs are designed such that they alleviate the need for channel knowledge at the receiver side. Also, non-coherent IM techniques were proposed very recently and transmitter designs with optimum number of hardware components were proposed. The use of these techniques to enhance the performance of variant wireless communication systems in different areas are also presented recently in literature. For example, SMTs concept is used to develop a multiple access scenario that is shown to significantly enhances the overall system performance. As well, IM techniques were applied to wireless sensor networks and new communication protocols were suggested. Other attempts applied SMTs to sparse code multiple access (SCMA) and several non-orthogonal multiple access schemes were developed based on the working principle of SMTs.

The talk will cover the basic working mechanism of these techniques and shed light on recent advances and communication protocols utilizing the basic working mechanism of SMTs and IM techniques. At the end, future directions for promising research studies in these areas will be highlighted and summarized.

Biography: Dr. Raed Mesleh is currently the vice dean of the school of Electrical Engineering and Information Technology at German Jordanian University in Amman, Jordan. He served previously as the head of communication engineering department and the director of Research Excellence and Intellectual Property units at University of Tabuk in Saudi Arabia. He obtained his Ph.D. from Jacobs University, Bremen, Germany in 2007 and worked there as a postdoctoral fellow until 2010. He was a visiting scholar at Boston University, The University of Edinburgh and Herriot—Watt University. He Authored a book entitled “*Space Modulation Techniques*” published by Wiley in June 2018. He is an inventor of 9 patents and published more than 150 journal and conference papers with an overall citations of more than 6500. He was an exemplary reviewer for IEEE Communication Letters, IEEE Photonics Letters, IEEE Transactions on Communications and Optics Engineering. He served as TPC members for several IEEE conferences and he is an Associate Editor for IEEE Access. He was a guest editor for a special issue on Index Modulation Techniques in IEEE Access and he is a guest editor for a special issue in IEEE Journal of Selected Topics in Signal Processing. His main research interests are in wireless communication and optical wireless communication with particular focus on MIMO techniques. He is the inventor of spatial modulation, quadrature spatial modulation, and transmitter designs for different SMTs.