Cosine Similarity based Bit to Symbol-and-antenna Mapping in Spatial Modulation System

Na Zhang[1], Zhiquan Bai[1*], Qi Zhang[1], Anyang Liu[2], Shangqian Sun[3], and Kyungsup Kwak[4]

[1]School of Information Science and Engineering, Shandong University, Jinan, China
[2]School of Communication Engineering, Xidian University, Xi'an, China
[3]School of Physics, Shandong University, Jinan, China
[4]Graduate School of Information Technology and Telecommunications, INHA University, Incheon, Korea

Email: zqbai@sdu.edu.cn[*]

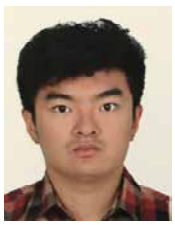
***Abstract*—In spatial modulation (SM) system, the information bits can be transmitted through two ways, the selection of both the transmit antenna and the constellation symbol. However, conventional bit-to-symbol mapping scheme in SM system only selects the transmit antenna or the constellation symbol independently. With the consideration of the similarity among the transmit antennas and the joint selection of the transmit antenna and the constellation symbol, cosine similarity based bit to symbol-and-antenna mapping scheme is proposed in this paper to reduce the hamming distance between adjacent symbols and achieve better system performance. Simulation results and performance analysis show that the proposed scheme can improve the system average bit error rate (BER) effectively compared with the conventional bit-to-symbol mapping scheme.**

Keyword—spatial modulation*; *cosine similarity*; *hamming distance*; *bit error rate

Na Zhang received the B.Eng. degree from the school of Electrical Engineering in Northwest University for Nationalities in 2015. She is pursuing Master degree at the school of Information Science and Engineering in Shandong University. Her main research interests focus on the areas of cooperative communication and spatial modulation.

Zhiquan Bai received the M.Eng. degree in communication and information systems from Shandong University, Jinan, China, in 2003, and the Ph.D degree in communication engineering with honor from INHA University in 2007, under the Grant of Korean Government IT Scholarship, Incheon, Korea. From 2007 to 2008, he was a post-doctor with UWB Wireless Communications Research Center, INHA University, Incheon, Korea. Since 2007, he has been an associate professor with the School of Information Science and Engineering, Shandong University, China. He has published more than 70 papers in international conferences and journals. His current research interests include cooperative communications and MIMO system, ultra wideband communications, cognitive radio system, and 5G wireless communications. Dr. Bai is the associate editor of the Introduction Journal of Communication Systems. He served as TPC member and session chair for many international conferences.

Qi Zhang received the B.Eng. degree from the School of Mechanical, Electrical & Information Engineering in Shandong University (Weihai) in 2015. He is pursuing Master degree at the school of Information Science and Engineering in Shandong University. His main research interests are in the areas of visible light communication and spatial modulation.



Anyang Liu is a junior student of Communication Engineering institution of Xidian University. He will receive the Bachelor degree in the summer of 2019. He also has the student qualification of Heriot-Watt University. His research field concentrates on communication engineering.

Shangqian Sun received his master degree from the school of physics in Shandong University in 2004 and PhD degree from Institute of Crystal Materials in Shandong University in 2014. Now he is a teacher at the school of physics in Shandong University. His current research interests are crystal spectroscopy including Raman, IR, absorption and fluorescence etc.

Kyung Sup Kwak received his BS degree from the Inha University, Inchon, Korea, in 1977 and his MS degree from the University of Southern California in 1981 and his PhD degree from the University of California at San Diego in 1988, under the Inha University Fellowship and the Korea Electric Association Abroad Scholarship Grants, respectively. Since then, he has been with the School of Information and Communication Engineering, INHA University, Incheon, South Korea, as a Professor, and served as the Dean of the Graduate School of Information Technology and Telecommunications and the Director of the UWB Wireless Communications Research Center, an IT research center, South Korea, since 2003. In 2006, he was the President of the Korean Institute of Communication Sciences (KICS), and in 2009, the President of the Korea Institute of Intelligent Transport Systems. He published more than 200 journal papers and served as TPC and Track Chairs/Organizing Chairs for several IEEE related conferences. His research interests include multiple access communication systems, mobile and UWB radio systems, future IoT, and wireless body area networks: nano networks and molecular communications. In 1993, he received the Engineering College Achievement Award from INHA University, and a service award from the Institute of Electronics Engineers of Korea, in 1996 and 1999 he received distinguished service awards from the KICS. He received official commendations for UWB radio technology research and development from the Minister of Information and Communication, Prime Minister, and President of Korea in 2005, 2006, and 2009, respectively. In 2007, he received Haedong Paper Award and in 2009, Haedong Scientific Award of research achievement. In 2008, he was elected as an INHA Fellow Professor and currently as an INHA Hanlim Fellow Professor.