

Efficient Doppler Mitigation for High-Speed Rail Communications

Bing Hui*, Junhyeong Kim*, Hee-Sang Chung*, Il-Gyu Kim*, Hoon Lee*

** Communication Internet Research Laboratory, Electronic and Telecommunications Research Institute, Daejeon Korea*

huibing@etri.re.kr, jhkim41jf@etri.re.kr, hschung@etri.re.kr, igkim@etri.re.kr, hlee@etri.re.kr

Abstract— Since the high-speed rail (HSR) communications are suffering from the huge Doppler shift, an efficient Doppler mitigation method is proposed in this paper. The proposed method mainly concerns about the mitigation of Doppler shift in OFDM based systems, especially for the case of employing mmWave with very high mobility. The proposed method can be used for both downlink and uplink of the system and it is quite robust to the time-varying mobility. Furthermore, the pilot-aided channel estimation for Doppler compensation is not necessary in most of the cases, which indicates the pilot density in time-domain can be reduced. Simulation results show that by using the proposed method, the residual Doppler shift can be compressed to 0 Hz with the probability of 90%.

Keyword— Doppler mitigation, HSR communications, LTE, mmWave, OFDM



Bing Hui (M'09) received the B.S. degree in communication engineering from Northeastern University, Shenyang, China, in 2005. He received the M.Eng. degree and Ph.D. degree at the Graduate School of Information Technology and Telecommunications, Inha University, Incheon, Korea, in 2009 and 2013 respectively. He was with the Electronic Engineering Department, Inha University, Incheon, Korea as a Postdoctoral research fellow from 2013 to 2014. Since 2014, he has been working as a Researcher in the Electronics and Telecommunications Research Institute (ETRI), Daejeon, Korea. His research interests include the 3GPP LTE(-A)/5G systems, mmWave mobile wireless backhauling, MIMO techniques, optimal codebook design, and mobile Ad-Hoc networks.



Junhyeong Kim received his B.S. degree in Electronic Engineering from Tsinghua University, Beijing, China, in 2008, and M.S. degree in Electrical Engineering from Korea Advanced Institute of Science and Technology (KAIST), Korea, in 2011. He is currently with Electronics and Telecommunications Research Institute (ETRI), Korea. His research interests include handover, cooperative communications, and MIMO technology for wireless communications.



Hee-Sang Chung was born in Korea in 1969. He received the bachelor's degree in physics from KAIST, Daejeon, Korea, in 1993, and the M.S. and Ph. D. degrees from Chungnam National University, Daejeon, Korea, in 1995 and 1999, respectively. Since then, he has been with Electronics and Telecommunications Research Institute, Daejeon, Korea, where he is currently the Principal Researcher. His career in ETRI began with the optical communications, and moved on to the mobile and wireless communication systems in 2005. He had involved in research projects related to LTE and LTE-Advanced from 2006 to 2010. His recent research interests are in 5G with special emphasis on high data-rate services for passengers on public transportations such as the buses, subway and bullet trains.



Ilgyu Kim received the B.S., M.S. degrees in electrical engineering from University Of Seoul and Ph.D. degrees in KAIST, Korea, in 1993, 1995, and 2009, respectively. He is currently a team leader in Electronics and Telecommunications Research Institute. His current research interests include millimeter-wave mobile communication system.



Hoon Lee (BS'95–MS'97) received his BS and MS degrees in electrical engineering from Jeonbuk National University, Jeonju, Rep. of Korea, in 1995 and 1997, respectively. Since 1999, he has been with ETRI, where he is currently a principal research engineer. His current research interests are mobile communication, millimeter wave transmission technology and 5G cellular system.