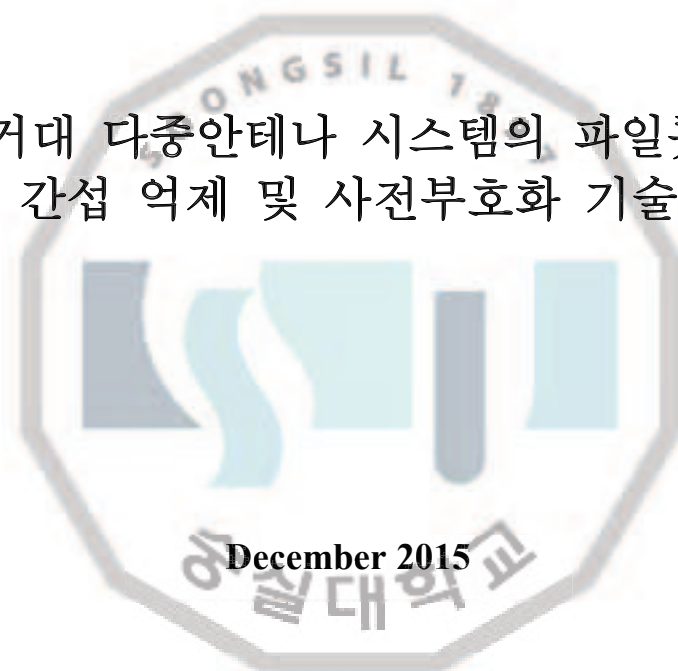


Thesis for the Degree of Master

**Pilot Contamination Reduction and
Precoding for Massive MIMO Systems**

거대 다중안테나 시스템의 파일럿
간섭 억제 및 사전부호화 기술



December 2015

Department of Electronic Engineering

Graduate School of Soongsil University

NGUYEN VAN HIEU

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**Pilot Contamination Reduction and
Precoding for Massive MIMO Systems**

A thesis supervisor : Professor Oh-Soon Shin

**Thesis submitted in partial fulfillment of the
requirements for the Degree of Master**

December 2015

Department of Electronic Engineering

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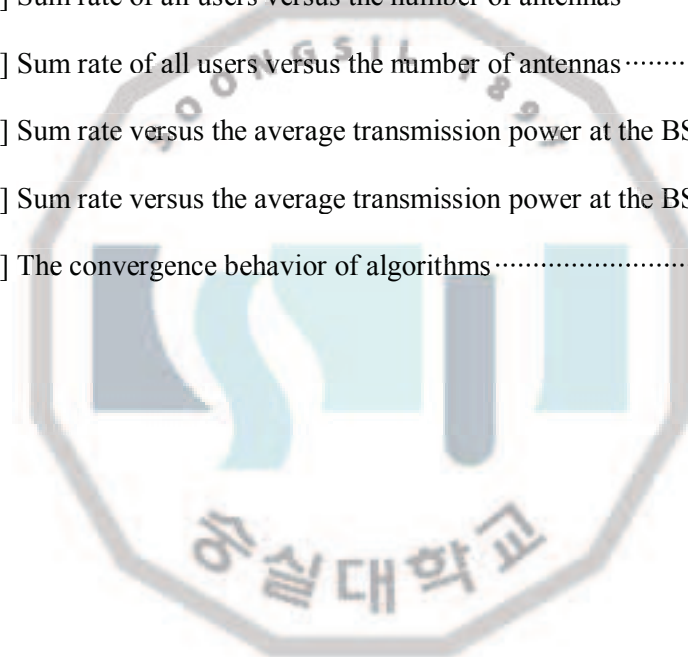
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ABSTRACT

Pilot Contamination Reduction and Precoding for Massive MIMO Systems

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We propose an improved uplink training strategy based on the minimum mean square error criterion to enhance the accuracy of the channel estimation. Then, the improved channel state information estimated by the proposed strategy will be applied to the downlink precoding in the reciprocal channel. As the performance measure of the precoding design, we consider the downlink sum rate. In particular, we derive an unconstrained objective function and apply a quasi-Newton method for maximization of the sum rate compared to the traditional Newton's method so that our optimization gives better performances with the fast convergence. Consequently, those are the significant reasons to use non-linear precoding instead of linear ones in the system of the finite number of antennas. Finally, the numerical results indicate that the combination of our training strategy and low-complexity optimization outperform the preceding approaches.

국문초록

거대 다중안테나 시스템의 파일럿 간섭 억제 및 사전부호화 기술

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Pilot Contamination은 다수의 안테나를 사용하는 Massive MIMO 시스템에서 인접 셀과 셀 내의 단말로부터의 Training 신호를 구별하지 못하는 문제를 발생시킨다. 본 논문에서는 이러한 문제의 개선방안으로 MMSE (Minimum Mean Square Error) 알고리즘을 이용한 채널 추정 기법을 제안하였다. 그리고 제안한 알고리즘을 통해 획득한 Uplink 채널 정보를 이용하여 하향링크(Downlink) 채널의 Precoding에 이용하는 것을 제안하였다. 모의실험에서는 전체 시스템의 성능 확인을 위한 방안으로 Unconstrained 문제를 정립하고 Quasi-Newton 알고리즘을 통한 해를 구하였으며 기존의 Newton 알고리즘과의 비교를 통해 성능을 분석하였다. 이를 통해 제안한 Precoding 기법이 기존의 연구에서 제안된 기법들의 성능보다 우수함을 확인하였다.